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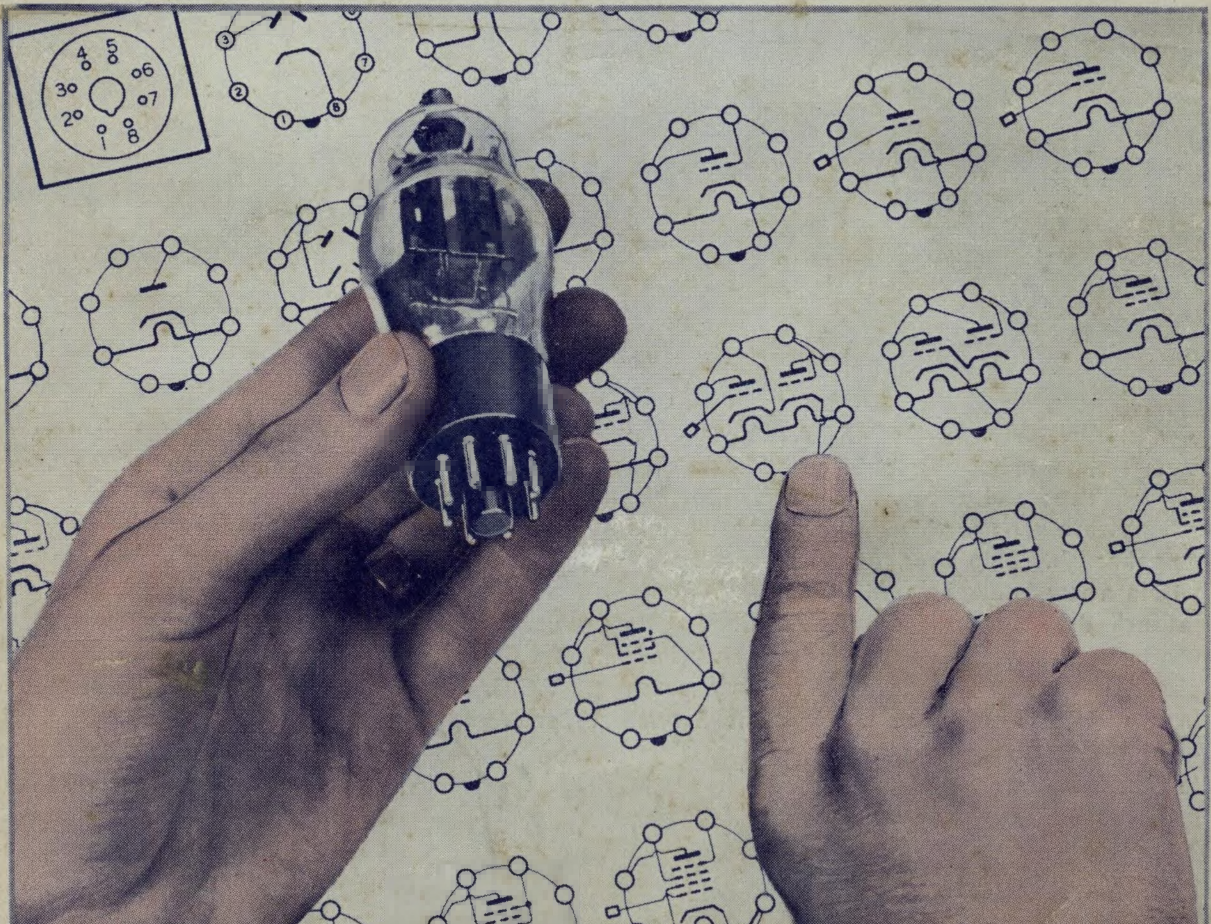

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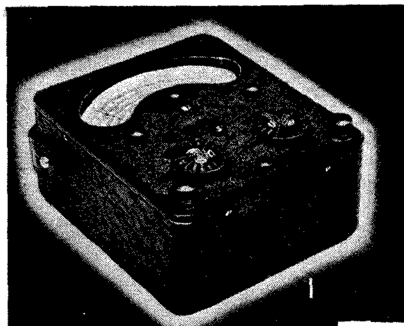
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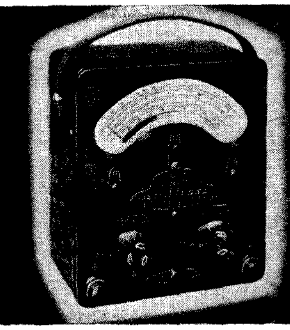
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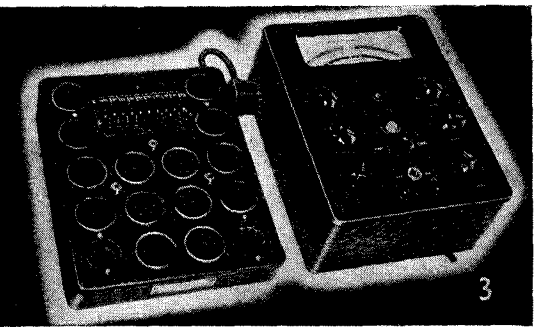
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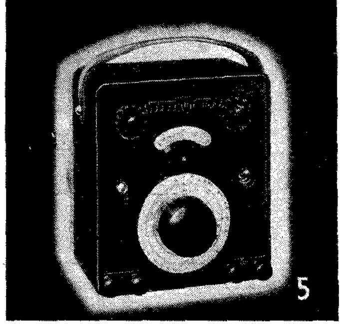
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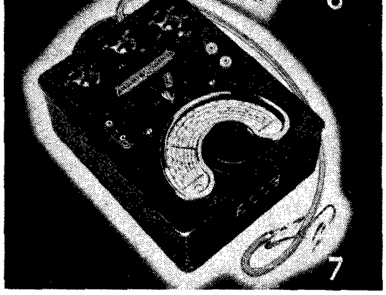
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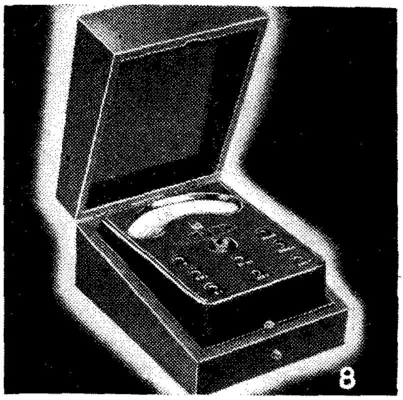
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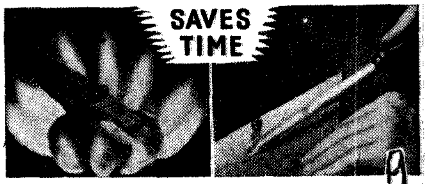

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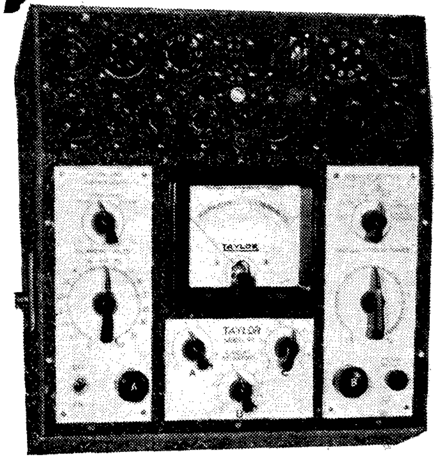

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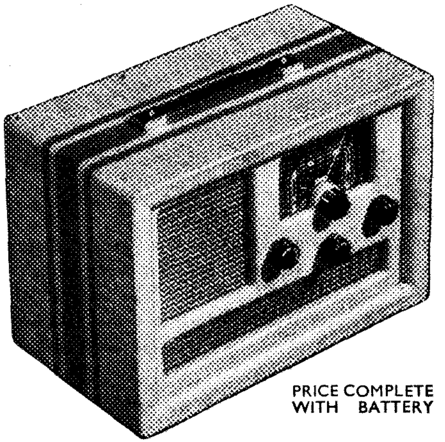

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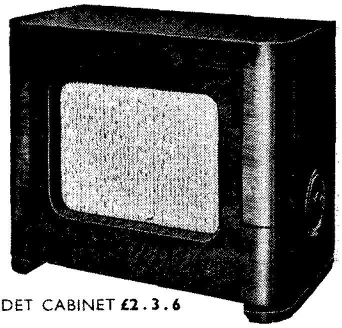

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MAY 1940

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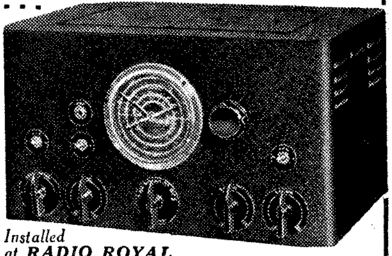

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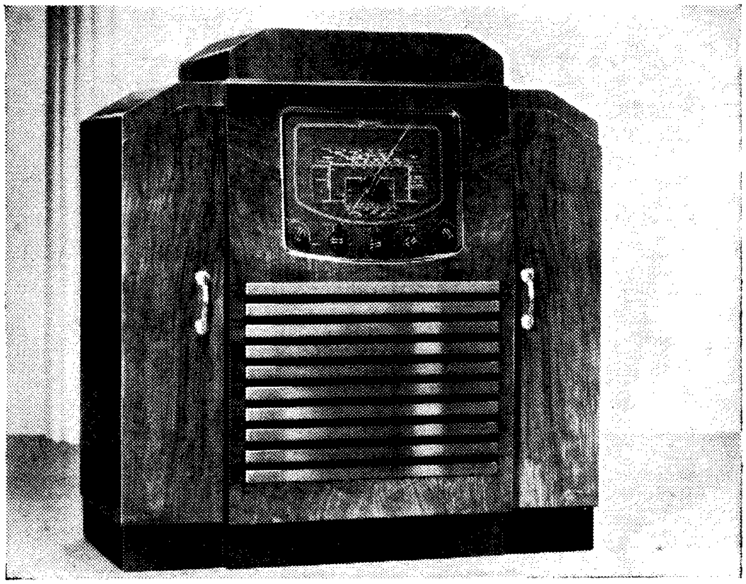

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Editorial Comment

VALVE DATA

Essential Information in a New Form

FOR reasons explained in last month's *Wireless World*, the customary annual publication of our Valve Data Supplement in the early winter was prevented by circumstances brought about by the war. Fortunately, however, means have now been found to put before readers in this issue the information that is so necessary to most of them; briefly, the principal valve manufacturers have agreed to publish in our advertising pages the technical data on their products that has hitherto appeared in the editorial columns. The information has been set out on lines suggested by us as being the most convenient for our readers.

It is difficult to imagine a better way of gaining the goodwill of their customers than that which the firms concerned have adopted. It is indeed gratifying that in our little world of wireless there is enough flexibility of mind to meet exceptional circumstances by exceptional action, and it is a good augury for the ability of the wireless industry to adapt itself to whatever may eventuate.

Graphical Valve Base Charts

The ever-growing diversity of valve base connections in use in this country—there are now well over 200 distinct variations—has compelled us to modify our former method of presenting this essential information. It is hoped that the plan adopted will prove convenient and quick in use; a single direct reference from the appropriate column in the manufacturers' lists to the valve base section will show at a glance the correct connections to any type of valve. Time should be saved, and the risk of error reduced, by representing the valve electrodes and their connections by conventional graphical symbols, instead of in tabular form as hitherto.

Apart from mechanical matters, of which "footless" valve construction is possibly the most important, there have been few basic developments since our last Valve Number. Possibly the most far-reaching and welcome innovation is the introduction of a series of low-consumption valves with filaments designed for operation on a single dry-cell. *The Wireless World* has for several years stressed the attractions of dry-battery LT, but only for sets intended strictly for intermittent use. For continuous operation, the secondary accumulator can still hold its own, and it is well that designers of the more ambitious portable sets—and also of deaf aids—should bear this point in mind, as there is always a tendency to adopt a new thing merely on account of its novelty. A contributor to our correspondence columns pointed out last month that the drift towards the dry-cell as a source of LT supply would be checked if simple and inexpensive appliances for the home charging of accumulators were readily available. Facilities for the easy connection of such chargers to the accumulator would tend to popularise the scheme among the general public.

Readers are probably tired of hearing that there are too many valve types. That this is true is self-evident from the contents of this issue, and we do not propose to weary them by returning to the subject. There are, however, clear indications that questions of wartime standardisation are being seriously studied, and we hope that the valve will not be overlooked.

"All-dry" Valves

OBTAINING GOOD PERFORMANCE WITH LOW-WATTAGE FILAMENTS

Valves designed to operate from a dry-cell LT supply represent a major advance since our last Valve Number was published. This article shows how good performance is obtained from filaments rated at the low wattage of 0.07, and also discusses practical problems connected with the use of 1.4-volt valves.

ACCENTUATED probably by the special conditions in which we live at present, and the feeling that one likes to have a wireless receiver that is independent of the supply companies' mains, a revived interest is noticeable in the self-contained battery-operated set.

Hitherto, except for a few isolated examples, this type of set has been designed to accommodate a 2-volt accumulator for filament heating, with a primary battery of anything from 90 to 150 volts for the HT supply, although some sets have been produced which make use of accumulator to supply both LT and HT by means of a self-rectifying vibrator unit.

For use in such sets there is available a wide range of valves with 2-volt filaments which cover all the requirements of receiver design, including those of efficient short-wave reception and those of power outputs up to 1,000 milliwatts or more. Unfortunately, however, the 2-volt accumulator used for heating these filaments calls for periodic recharging, with consequent inconvenience and expense. Further, the correct rate of charge is not always applied, with a resultant shortening of the life of the accumulator; this is a very real difficulty not always appreciated by the owners of 2-volt battery receivers, particularly those of the portable variety.

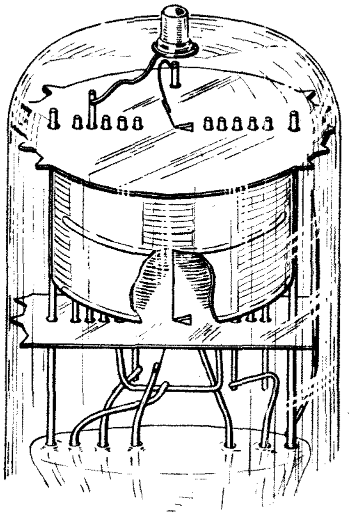
1.4-volt valves are conveniently small for use in lightweight portables ; this example, an Osram output tetrode, has an overall diameter of only $1\frac{3}{16}$.

The attraction of abolishing the accumulator is, therefore, a real one, the more appreciated by listeners who may not have convenient means of having their accumulators consistently and frequently charged. Hence the appearance of the so-called "1.4 volt" valve, for which filament heating current is derived from a single dry cell.

As will be seen later, the title of "1.4 volt" must be treated as a title only, as there may be very considerable difference between this rated figure and the voltage such a valve actually gets in practical working.

The idea of the dry-battery valve is by no means new—many readers will remember the sensation away back in 1924 when the first 3-volt 60 mA filament valves made their appearance on the British market. Well-known examples were the DE3 and the B5, not to mention many others of like characteristics.

To recall the days of the DE3 takes us back to the technique of the thoriated filament, now only applied to the higher power dull emitters, particularly transmitting valves, but which was at that time in itself a novelty to the valve manufacturer. Actually the first commercial thoriated dull-emitter valves had then only been produced in this country some two years previously, and the attempt to whittle down the dimensions of such filaments, which, dull-emitters though they were, involved a considerable difference of temperature between the cold and the operating conditions, led to many disasters due to filament expansion and grid contacts which made these valves the bane of the valve manufacturer.



Cut-away view of a 1.4-volt heptode frequency changer (Osram), showing spring anchorage of the upper end of the filament, which receives support at the points where it passes through the triangular holes in the mica.

In addition, the range of operating temperature lying between the limits of short life and inadequate electron emission was small, and consequently such valves were in a very short time replaced by the sturdier 2-volt battery valves whose filament operating temperature during life could be more closely controlled, and which have held the field in battery sets ever since.

Why, then, is it that the modern dry-battery "1.4-volt" valve can be claimed to be a success where the earlier attempts of 16 years ago failed? The answer is, of course, in the vastly improved emission efficiencies that are obtainable from modern oxide-coated cathodes.

"All-dry" Valves—

Having thus arrived at the introduction of the dry battery operated valve in practical form, the subject immediately takes on a very much wider aspect than the successful production of a valve to operate at a primary battery voltage of nominal 1.4, combined with an economical current consumption—in its scope must now be included the whole picture of valve, circuit and battery supply. In fact, without viewing these three aspects of the problem, valve, circuit and battery as a whole, it is useless to treat the subject of the dry-battery valve with any hope of arriving at the true picture covering life and performance expectation. It is this "marrying up" of the three fundamentals, which go to make up a satisfactory "all-dry" battery receiver, that is not always appreciated as it should be.

The purpose of this article is to present a brief review of the subject which necessarily includes the all-important aspect of the dry battery discharge characteristic as applied to the valve performance.

At this stage it is worth noting one or two points of technical interest which are becoming more apparent as the study and use of "all-dry" battery valves widens.

First, there is the design of the low-consumption valve itself, and naturally this must be fundamentally based on a cathode technique designed specifically to meet the particular operating conditions met with in practice. As has been mentioned earlier, the underlying reason for any possible commercial success of such a valve lies in the enhanced emission efficiency which can be obtained from the modern filament.

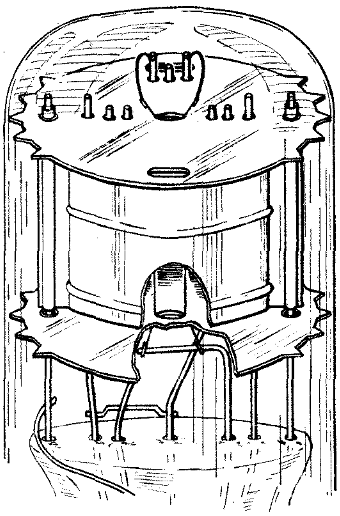
It is not generally appreciated that in many of the new "1.4-volt" valves now appearing on the market a thermionic efficiency greater even than that prevalent in the general run of 2-volt battery valves has been achieved. This allows for the use of a smaller diameter filament wire which in its way brings about a reduction in current consumption.

It is this economy in current consumption which gives to the range its commercial success by reducing the discharge rate of the filament battery to that consistent with a reasonably long battery life. High though the cathode efficiency may be, however, a reduction to a figure of 0.07 watt necessarily means that every bit of the emitting area must be utilised if the mutual conductances required by the set designer are to be maintained.

Another example of an "all-dry" valve—an Osram top-capped diode-triode.

Now in the higher wattage 2-volt valves it is often possible to sacrific some small part of the total available cathode emission by anchoring or supporting the filament, which has the twofold result first of introducing damping points to minimise microphony, and secondly to afford general rigidity in structure. But each of these supports has the effect of cooling a small portion of the filament and thus reducing its available electron emission.

With the dry-battery valve no such cooling points are permissible without appreciable limitation of the available emitting surface, and thus the design takes the form of a "straight-through" filament enclosed by a cylindrical grid and electrode structure. For this reason the 1.4-volt, or as it might be more correctly called the "50 mA filament type of valve," is necessarily more prone to microphony than many of the 2-volt valves to which we have been accustomed, and appropriate precautions are necessary in the design and layout of the receiver.



A 1.4-volt pentode output valve (Osram) with anode partly cut away to show how the paralleled "straight-through" filaments are supported at each end.

In some types, such as power valves, where a higher electron emission is required to satisfy the characteristic, two 50 mA filaments may be used in parallel to give a total current consumption of 0.1 amp.

A further advantage of the new oxide-coated cathode is that the introduction of a special alloy for the core metal has permitted the use of sufficient spring tension to keep the filament straight, and thus in some types close grid-filament clearances can be adopted such as would have been quite impossible with the early types of thoriated filament 60-mA valves, or even with earlier types of oxide-coated filaments of this rating. A normal grid-filament clearance adopted in these new 1.4 V., 0.05 amp. valves is 0.30 mm.

This again results in an improvement in mutual conductance and explains why these new valves can be manufactured with less reduction in mutual conductance than would be expected from the fall in current consumption.

As has been indicated above, the two other features involved in a successful "all-dry" battery receiver are the type of circuit to which the valves are to be applied and the nature of the battery supply.

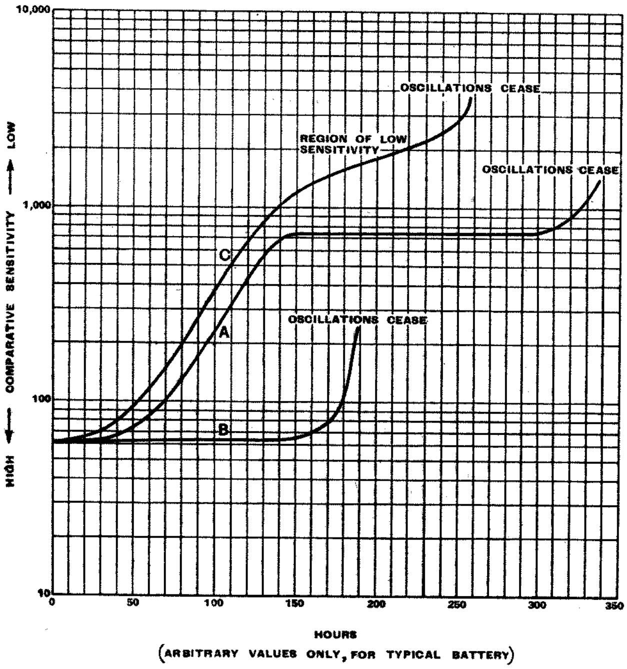
By common consent, the superheterodyne appears to have been adopted as practically universal where this range of dry battery valves is concerned, and, as is well known, the key valve in any superhet design is the frequency changer.

Experience has shown that the public will tolerate a

“All-dry” Valves—

good deal of deterioration in valve performance, due either to falling cathode emission or falling feed voltages, providing some sort of performance is put up. When a frequency changer is involved, however, falling emission or inadequate feed voltages lead to the disastrous result of complete cessation of signals. This is where a major problem in the application of low consumption dry-battery valve appears. The question of adequate power output with falling supply voltages both for HT and LT also becomes of far greater importance with the dry-battery operated receiver.

A study of the effect on these two stages in the set—the frequency changer and the output valve—by the nature of the falling discharge voltage rate of the dry battery supply is of the greatest importance. The matter is further complicated if an attempt to introduce short-wave reception is made, as here the maintenance of adequate emission from the oscillator in the frequency changer stage is even more vital.



Curves showing relationship between receiver sensitivity and effective battery life. A, LT fixed at 1.5V, HT falling; B, HT fixed, LT falling; C, HT and LT both falling, as in a practical case. The nature of curve C is dependent on battery quality and on frequency of oscillation; in curve B the point of cessation of oscillation depends on the individual vave and frequency.

Further, even with the most perfect of manufacturing methods, some divergency between individual valves is inevitable, and for commercial reasons any complete design must take care of normal manufacturing tolerances in characteristics and total cathode emission for a given operating temperature.

This question of tolerance is a matter of commercial expediency, but it has a very definite effect on the permissible range of battery voltage (between a brand-new and a run-down battery) in deciding the failing point in hours of running, determined by the cessation of oscillation in the frequency changer.

It is safe to say that manufacturers of both batteries and valves who are jointly concerned with this problem are sparing no effort to ensure that the normal discharge rate of the batteries employed shows the most useful type of characteristic.

In a receiver of this kind, where both the LT and HT voltages are falling during the battery life, the problem of the manufacturer is not the same as for a 2-volt accumulator and HT battery receiver.

For example, it has been found that the cessation of oscillation in the oscillator component of the frequency changer is due to the drop in LT rather than in the HT voltage, and this necessitates an adequate capacity for the LT section of the dry battery. Secondly, it has also been found that even though the LT voltage drops to a considerable extent, oscillation may still be maintained providing the HT drops correspondingly, as is fortunately the case in practice.

Thus, if means can be taken to ensure that the correct discharge rates are followed in both the LT and HT sections of the dry battery, the falling voltage of both sources of supply, which in the limit determines the cessation of oscillation, is to some extent a compensating feature. In other words, the limiting LT voltage is lower if HT voltage has also dropped.

The accompanying curves show the typical relationship between comparative sensitivity and effective life in hours of the battery. From these it will be apparent that if in a hypothetical case the LT supply could be maintained at a fixed voltage and the HT discharged at a given rate, the comparative sensitivity would initially fall and thereafter be maintained substantially constant until a further drop in HT voltage caused cessation of oscillation.

If, again, in a hypothetic case the HT could be maintained at its initial value, while the LT supply was allowed to drop its voltage at a defined rate in accordance with the discharge current, sensitivity would be maintained at its initial value for a longer period, but this would be followed by a very rapid deterioration and almost immediate failure to oscillate as the LT voltage falls to a critical value. This value will again depend upon the cathode emission of the individual frequency changer valve and will in all probability occur at an earlier period of the HT battery life when the valve is being used for short-wave reception than for medium and long-wave bands, owing to the greater losses which are present in the short-wave operating region.

The result we can deduce from these characteristics is that an attempt to use an HT supply of high voltage in conjunction with a run-down LT supply is likely to lead to trouble, due to failure of the frequency changer to oscillate satisfactorily on account of limiting emission or saturation. This is the effect which would be produced if the HT section of the battery were renewed before the LT section, and it illustrates the desirability for renewal of both sections at the same time.

These brief comments may serve to indicate some of the problems involved in a successful “all-dry” receiver—these and other problems connected with the sensitivity and effective power output obtainable being likely to determine the future of the 1.4-volt valve.

Valves at Low Voltages

OPERATING CONDITIONS FOR A HEADPHONE PORTABLE

The present need for small, lightweight portable receivers can best be met by the use of headphones and low-voltage operation of the valves. In this article the effects of using abnormally low HT voltage are described in some detail.

By W. T. COCKING

RECEIVERS designed especially for use with headphones are something of a rarity nowadays, but under wartime conditions such sets offer certain advantages over the more customary types. Not only does the use of phones lead to economy in power consumption, it makes possible a reduction in bulk and weight that can hardly be attained by other means. Phones are thus an almost essential feature of ultra-lightweight broadcast receivers for service conditions.

Typical modern phones will operate satisfactorily upon an audio-frequency power input of only one-thousandth of that needed by a loud speaker. There is consequently no difficulty in obtaining an adequate undistorted output from a phone set with an economy of power consumption from the batteries impossible in the case of a loud-speaker receiver.

With the conventional battery set the output stage always presents the designer with a problem to which an ideal solution is impossible. The attainment of high quality and adequate volume demand an output stage which is capable of delivering several watts to the loud speaker, but this results in an HT consumption by this stage alone of up to four times as many watts. No battery which is sufficiently cheap, light and compact for general use is capable of giving the necessary power for a long enough period to be satisfactory.

It is generally agreed that for reasonable economy in operation the HT battery should not exceed 120 volts, and the current drawn from it should not be greater than 10 mA. This is a power of 1.2 watts, and is for the whole receiver. The output stage itself cannot draw more than about 5 mA. if the other valves are to operate satisfactorily, so that its power consumption is limited to about 0.6 watt.

This is less than the undistorted output required. The design cannot even approach the desired standard of performance, and has to sacrifice both quality and volume to a considerable degree. In view of this it is surprising that the performance given by many battery receivers is so good.

Power Needed for Phones

If phones are used instead of a loud speaker, however, the designer does not suffer from any such limitations, for the output needed is only about 1 mW. The impedance of a pair of phones varies greatly with frequency; it may be 4,000 ohms at low frequencies and rise to some 30,000 ohms at high frequencies. Taking the lower figure, however, a power of 1 mW. represents a current of 0.5 mA. RMS at 2 volts RMS.

The average small triode has an AC resistance of the order of 25,000-30,000 ohms, and if a compromise matching be adopted so that the load on the valve is made to equal its AC resistance at low frequencies, the phones should be fed through a transformer of about 2.5-1 step-down ratio. The alternating voltage across, and current through, the load impedance are then 5 volts and 0.2 mA. respectively.

The peak anode current is 0.28 mA., and so a standing anode current of 0.4-0.5 mA. should be adequate for the output valve. On the basis of output only, an anode potential of 10-15 volts would be enough, but it is unwise to work at a very low voltage because it may not be possible to obtain even 0.5 mA. anode current without making the grid potential positive with respect to cathode. This is very undesirable, and a good general rule is to make the standing anode potential not less than the value needed to give the desired anode current at zero grid bias.

With battery valves, grid current does not flow until the grid is more than about 0.25 volt positive with respect to the negative end of the filament. It is consequently permissible to work with zero grid bias as long as the input does not exceed 0.25 volt peak.

The curves of a typical triode are shown in Fig. 1, and it will be seen that at zero bias the anode current is 0.5 mA. for an anode potential of 27.5 volts. This, therefore, represents the minimum anode potential which should be used with this valve. At this voltage this particular valve has an AC resistance of 40,000 ohms and an amplification factor of 33. If used with a load of 25,000 ohms, which is rather low, it will need an input of 0.55 V peak for 1 mW. output. This is too great to permit the use of zero grid bias, and a grid voltage of rather more than 0.25 volt should be used.

Suppose this bias is −0.29 volt, then from Fig. 1 the anode voltage should not be less than 37 volts. The AC resistance is substantially unaltered because the anode current has not been changed. Therefore,

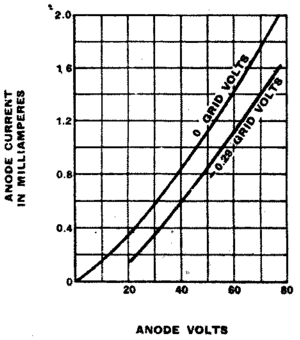


Fig. 1.—Two anode-volts anode-current curves of a triode are shown here.

Valves at Low Voltages—

the input will be the same as before —0.55 volt peak.

This is quite a practical operating condition, but does not allow anything for the inevitable fall in voltage as the HT battery runs down. To allow for this it is wise to start with not less than 50 volts and a somewhat higher current at this voltage. If the grid bias is fixed the normal value should be retained so that it is not excessive when the HT voltage falls, but if automatic bias is used it can well be increased somewhat, for it will become smaller with the decline in HT voltage.

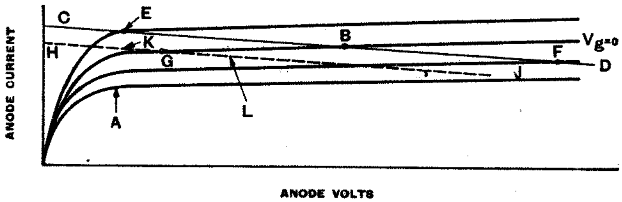


Fig. 2.—This diagram illustrates the effect of reducing the anode voltage of an RF pentode.

Of course, conditions are different if a lower resistance valve is used. A lower value of load impedance would be needed so that the current would have to be higher and the voltage could be lower. In general, however, this offers no advantage, especially as low-resistance valves often take double the filament current.

Average Working Voltage

As a standard size of HT battery is 60 volts, it is convenient to make 50 volts the normal HT supply to a phone receiver. This represents a mean voltage between that of a new battery (60 volts) and that of a run-down battery (40 volts).

It will be clear that there is no difficulty in obtaining an adequate output for phone operation with a 50-volt supply and an exceedingly small current consumption. The question now arises as to how screened pentodes will operate at such a voltage, as values of this type are highly desirable in RF and IF stages.

The discussion will be confined to pentodes and kinkless tetrodes so that secondary emission effects can be ignored. These valves fall naturally into two classes, the main difference between which lies in the design of the screen grid. The valves in Class 1 are designed to operate with screen grid and anode at the same mean potential, which is normally 100-150 volts, while those in Class 2 are designed for operation with a screen potential of 60-80 volts and an anode potential of 100-150 volts. In general, valves in Class 2 are used with the screen at about one-half the mean anode voltage.

In what follows there will be frequent reference to "normal operation conditions," and these are taken as zero grid bias and 120 volts anode potential for RF pentodes used as amplifiers; screen potential is assumed to be 120 volts for Class 1 valves and 60 volts for Class 2 valves.

Small set, large aerial. An ingenious method of increasing the pick-up of the frame aerial is embodied in this miniature American portable. The wires of the frame are woven into the webbing carrying strap. Incidentally, the latest American minature valves for sets such as this are designed to work on 45 volts HT.

Now suppose we take a Class 1 valve and operate it at 50 volts on both screen and anode, what sort of performance can we expect? In the first place, the total current will fall considerably, and in a typical case it will drop from 4.0 mA. to 1.1 mA. The mutual conductance will also fall, but not to the same extent; it may change from 1.4 mA/V. to 0.83 mA/V. The anode AC resistance will increase and the undistorted voltage output be reduced.

With a Class 2 valve, conditions are quite different and are most easily understood by reference to Fig. 2. Operation must be kept to the right of A if satisfactory results are to be secured, and the normal operating condition is with an anode potential B. The load line can be drawn through this point and is CD. With an applied signal voltage the anode potential swings along CD and must be restricted to the limits EF if overloading is to be avoided.

Let us now reduce the mean anode potential to equality with the screen voltage. The operating point is G and the load line becomes HJ. The output is now greatly restricted, for it is clear that it cannot exceed KL without distortion being introduced, and this is much less than EF.

As the valve curves are nearly horizontal, the fall in anode current consequent upon the reduction of anode voltage is very small and is accompanied by a very slight increase of screen current. The total current is almost unchanged.

The mutual conductance of the valve is also hardly affected, while the AC resistance may be slightly reduced.

To a first approximation we can say that by using a Class 2 valve with normal screen voltage and reduced anode voltage the performance is hardly affected as far as amplification and current consumption are concerned. The voltage output obtainable, however, is considerably restricted. With a Class 1 valve, however, amplification suffers as well as output, but there is a reduction in the current consumed.

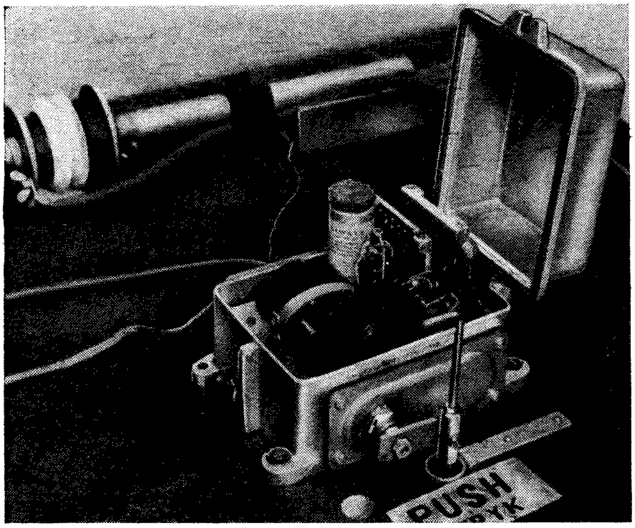
It is clear that as the mutual conductance of battery valves is never very high the use of Class 2 valves is usually to be preferred for re-

Valves at Low Voltages—

duced-voltage operation. The low output obtainable from the valves will not, in general, be important, because much less output than usual will be needed in a phone set. Precautions must be taken against the application of an excessive input to the set, however, but these will often be automatic, since a set of this type will generally be used with only a small aerial. However, difficulties may be encountered in connection with AVC.

Raft Radio

AUTOMATIC SOS TRANSMITTER



The apparatus is contained in a waterproof metal box. The indented transmitting disc can be seen in the foreground.

SPECIAL interest attaches nowadays to emergency transmitting apparatus designed to enable an SOS message to be sent without the assistance of a skilled operator. One of the latest examples of this kind of thing was produced by the Danish firm of Wilhelm Johnsen shortly before the invasion of Denmark.

It is intended to be attached permanently to a raft, and to function no matter which side up the raft falls into the water. For this purpose the transmitter is contained in a waterproof casing, and has two rod aerials, one on either side of the raft. There is also a starting knob on each side of the raft, and when this is pushed in it switches on the automatic transmitter and makes connection with the appropriate aerial rod.

Power is supplied by three large capacity dry cells, giving a 6-volt input to a vibrator unit for HT supply, and to a motor which rotates an indented disc to provide the SOS signal. The AC output from the transformer is fed in an unrectified state to the transmitting valve, this providing modulation in a very simple manner. The power output is 10 watts, which is calculated to give a range of about 40 miles over water.

The transmitter, which is, of course, tuned to the 600-metre wavelength, sends out distress calls at regular intervals. It is also intended for use in lifeboats in a slightly modified form.

In both cases the leading feature is that no skill of any kind is required to operate the apparatus.

Henry Farrad's Problem Corner

No. 46.—

Negative Feedback?

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

All Hallows School,
Berkhamstead.

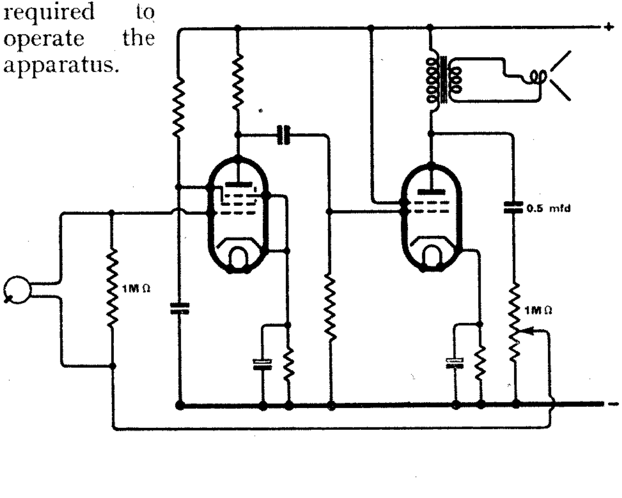
Dear Henry,

I have recently acquired a rather wizard crystal pick-up, and fortunately have a 2-valve amplifier ready made for it. Actually, with both valves the output from the pick-up is much too much, so most of it has to be thrown away to avoid the useful volume control range being all at one end (*vide* Voigt in the March *Wireless World*, Fig. 7 (d)). But connected straight to the output valve it is just not enough. It seemed to me a bright idea that instead of wasting the surplus amplification it could be applied as negative feedback, with beneficial results on the quality. So I connected the 1-meg. volume control, as shown, through a largish condenser (actually half-mfd. and guaranteed O.K.), so as to tap off part of the output in series with the input. The idea was that by applying more negative feedback the amplification is reduced, and so the thing works as a volume control as well.

The plan is good, but the execution is rotten. What happens is that the affair motor-boats violently directly the potentiometer is turned. I believe there are some hidden snags somewhere or other in negative feedback, so perhaps I have struck one. Can you elucidate, please, Henry?

Yours ever,
Tony.

Why this result? And what should be done to put it right? Henry Farrad's solution is on p. 265.



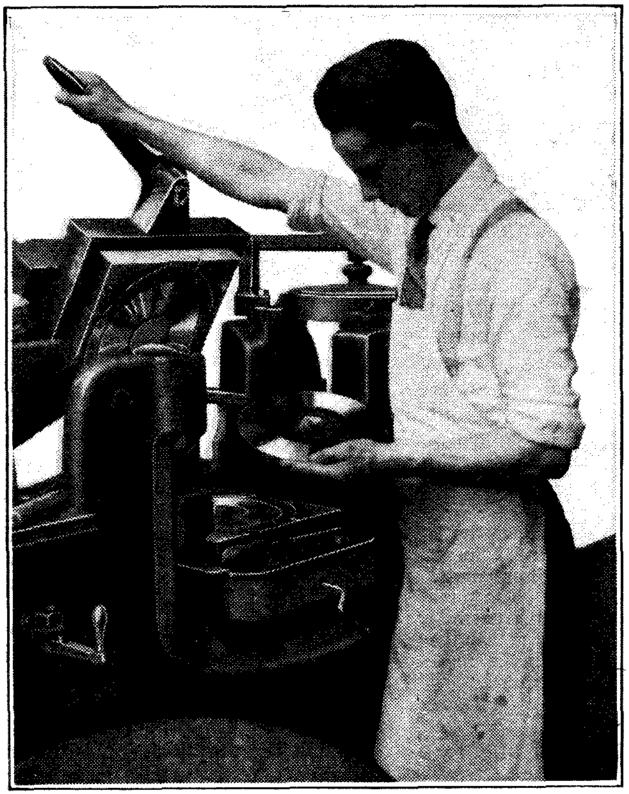
The circuit arrangement used by Henry Farrad's correspondent.

Getting the Best from Records

Part IV.—THE RECORD HAS THE LAST WORD

By P. G. A. H. VOIGT, B.Sc., A.M.I.E.E.

Even under ideal conditions the work performed by the gramophone record is extremely arduous. In this, the concluding article of the series, the author interprets the imaginary thoughts of a record and gives inside information of practical value to the user.



(Courtesy: *The Gramophone Co., Ltd.*

AH! that's better, thanks for turning off the heat and releasing the press. Now I feel I can speak freely; but before I deliver the set piece which has been so firmly impressed upon me, I should like to say a few words on my own behalf in the hope that I may avoid some of the maltreatment and blame which unthinking people may heap upon me.

It seems to me that the thing which upsets people most is the sound of scratch. Somehow the idea seems to have got about that I consist of 99 per cent. of grinding materials, and that the only joy I get in life is when I can get busy grinding away the point of a needle. This is not true at all. I may contain a little slate, barytes or other "filler," but slate is really quite soft and can easily be scratched with a knife.

What is far more important is that I consist of a portion of expensive shellac. Now shellac is a material that flows when it is hot, and which will flow into the most minute crevices if the pressure is great enough. When I am being made to take up my final shape, I am heated up so that I get as soft as putty, and then I am squeezed flat between two hot matrices with a pressure of about 100 tons. Under these conditions the shellac flows wherever it can to escape from this pressure, and thus flows all round any hard particles until it is in intimate contact with the surface of the matrix. Providing the matrix is cooled properly, so that I set before the pressure is released, then the shellac in me will remain in position, and my surface will be practically as smooth as that of the matrix which made me.

Sometimes, of course, someone is negligent, or economy has to be studied, and then materials may get in which try to expand after leaving the press. Even the best shellac cannot resist such pressure indefinitely, especially when the weather is hot, and in those cases the surface will show little irregularities under the microscope. The outer blank part before the music starts is usually the best part to examine for this purpose, since in the actual matrices used, this part is usually polished before it is put in the press. Therefore, if the material is right, we also show a bright polish which gives a good reflection from the part concerned. In those parts of the matrix where the music is, they cannot do much polishing (as this would scour out the wave), and so irregularities which you may see in us there may have been in the matrix itself. In fact *quite a large proportion of the surface noise for which we get blamed is actually in the matrix.* The fact that you can hear it only shows that we are doing our job properly and giving you a faithful replica of what has been impressed into us.

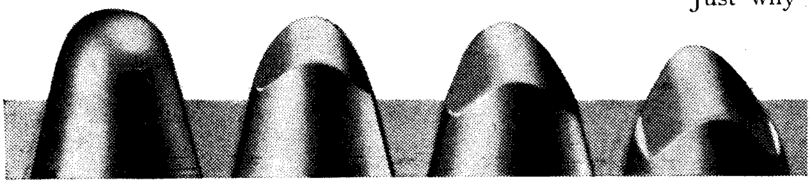
If you doubt what I say, get hold of a "mother" matrix and play it with a fibre needle, compensating for the usual top loss. You will then hear much of the noise for which the record is usually blamed.

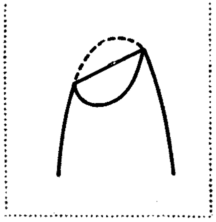
Some people say that if we had been made of so-called cellulose acetate or other special material, the surface noise would have been greatly reduced, and they take this as proof that the "stock" from which we are usually made is responsible. I must point out, however, that these other materials are flexible. (In fact their unbreakability is stressed as an advantage) and consequently the material will also flex to the needle point. Thus, the irregularities impressed in the surface tend to be pushed down by the needle and do not therefore agitate it as they would if they were as hard as they

Getting the Best from Records—

ought to be. Naturally, such a material is not good for passing on energy at very high frequencies where the wavelength is very short, and consequently these records may sound a little dull over high quality equipment, especially if the pick-up point, etc., has appreciable inertia.

I do not want to pretend that no noise is due to our composition, but we are blamed for much more than we actually cause.





Successive stages in the wearing down of a needle point. The elongation of the contact surface will be apparent from the side elevation shown in the sketch on the right.

The scratch trouble will, of course, get worse as we get older if people use heavy sound-boxes or pick-ups on us with hard needles. They exert an enormous pressure at one or two points, and quickly wear through or crush through our smooth shellac skins. This explains why we like the so-called fibre (actually treated bamboo) or thorn needles. They are much softer, therefore the point cannot press so hard, and unless they pick up some abrasive they are harmless. I believe though that the spreading of the point which results from its softness makes the reproduction go "off" toward the end of the record much more than with harder needles.

The spreading is presumably a function of the downward pressure of the point. Therefore, if a pick-up could be designed in which a much smaller downward pressure is satisfactory, then fibre needles might stand up better. I hope the research people are working on this subject.

Needle Wear

The spreading is not only due to deformation of the point by the downward pressure, it is augmented by any wear that may be taking place. When you consider that at the end of a record the point has run over about 200 yards of my groove, it is hardly surprising if the point is worn and shows extensive flats on each side.

Think also how the waves crowd up near the centre, and you will realise how undesirable a large flat is if good quality is required. Let me stress the matter by working out a practical example. Toward the end (where the climax of the music often occurs) the track diameter may be about 4in. As I rotate at 78 rpm, the surface speed under the needle is about 16.3 inches per sec. A 5,000-cycle harmonic therefore has a wavelength of only 3¼ "thou." Naturally, if the needle point is to reproduce this harmonic faithfully, the point itself may be only a tiny fraction of that length. Thus, even if the active length of the point is as much as 1 "thou.," some distortion is bound to occur.

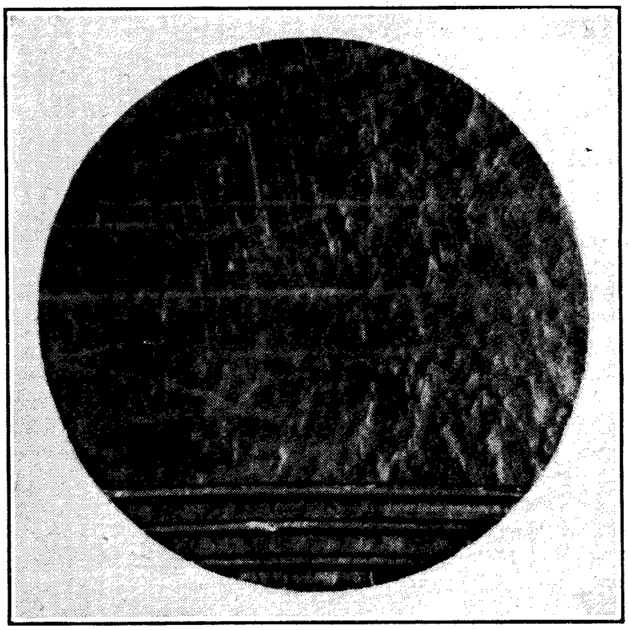
At the outside of a record, the track diameter is about 11½in. so the wavelength is about three times greater. A slight elongation of the point there is consequently not so serious. In the early days of gramophones, this was realised, and I am told that one firm used to start at the inside, so that where the wavelengths were short, the needle point was fresh, and as the point wore, so also did the wavelengths open out. However, it did not catch on with the public, and had to be abandoned. The talkie people had more sense, and the 16in. talkie records started at the inside.

Just why the centre start did not catch on when it is obviously so much better is a matter for surmise, but my private opinion is that it is due to the way the public buys records. It just tries over the opening bars in the shop and takes the rest for granted. This, naturally, gave those records which put their opening bars on the outside an unfair advantage. The extra complication involved in getting uniform outer borders when recording may also have counted against these records.

Now let me revert to my own troubles, namely, the unfair treatment with which I am expected to put up by the people who use hard needles on me.

Has it ever occurred to you to work out the colossal pressure with which the needle is trying to crush my surface?

Our little calculation just now showed that when the point had elongated itself to 1 "thou.," the needle could be considered slightly worn and unable to reproduce accurately a 5,000-cycle harmonic from the inner



Microphotograph of the outer edge of a record containing a filler which has expanded after leaving the press, giving rise to a "mountainous" surface and considerable noise.

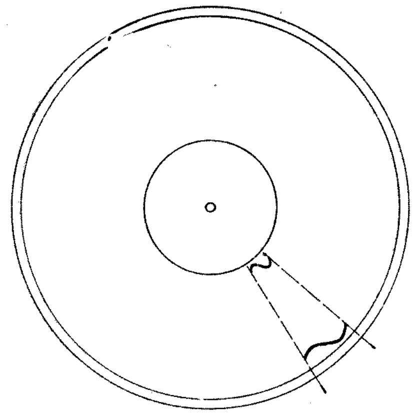
grooves of a record. Let us therefore assume a point elongation of $\frac{1}{2}$ "thou.," a cut 8 "thou." wide, and that the point fits the groove perfectly. The projected area of the point is $8 \times \frac{1}{2}$ "thou." squared or four millionths of a square inch, and this has to support a pick-up weight of about 4 oz. This works out at 28 tons per square inch, so that a square of this size ■ would have to support a typical family saloon car weighing 1 ton.

Actually, of course, owing to the wedging action the pressure is even higher, while when the point does not fit the groove perfectly (and it rarely does) it may contact it only over one or two limited areas, and the pressure may then be multiplied several times. Can you wonder if my grooves show signs of distress under such a strain?

Unfortunately, this is not all, because I am expected not only to support the pick-up, but also to agitate the needle according to the vibrations in my groove. This means that extra forces have to be exerted sideways on the needle. In some pick-ups (where they have tried to kill the top resonance by severe armature damping) the needle is held almost rigidly. The extra forces then become very considerable when the waves of big amplitude come along. At the resonance points of the tone arm, things are even worse, because the increased output is due to the fact that the vibration of the pick-up head is such that the armature movement relative to the pole tips is increased. The forces are therefore also greater and this reacts back on me as I have to supply the energy in the first place.

There are two frequency regions, and sometimes three of which I am always particularly afraid. One, I have just mentioned, the other is the top resonance, where I find the needle tries to overrun and again I have to exert extra large forces to control it. The third region occurs only with some tone arms, and is due to the torsional resonance. When this happens, there is one frequency where I have to do extra work, and just below it another where the needle follows my groove with practically no effort on my part. I am told that at that particular frequency there is a trough in the response. Now although I like that bit especially, it does not seem very sensible to use a pick-up which treats me very kindly at one frequency, and at a neighbouring one overworks me badly. I would much rather things were evened out, as then the danger of breaking down my groove surface would be greatly reduced.

You see, therefore, how much the resonances trouble me. Unfortunately, when you correct electrically for the extra output which the pick-up has extracted out of me at these frequencies, it does not save me from doing the extra work. So please do not delude yourselves that because you can no longer hear the excess, I am being saved from its ill effects.



On a record turning with constant angular velocity the wavelength of a given note is much greater at the start than at the finish of the groove.

I can imagine that some of you might doubt what I have been saying about wear at certain frequencies. If so, get hold of two of my brothers (twins) both with the long name of "heterodyne gliding tone," and play one over and over again with a hard needle in a pick-up having a violent peak in the treble. You will soon be able to see for yourself that the frequencies near this resonance peak are wearing out and in fact the apparent response curve of the pick-up will gradually get better and better. This is, however, not actually true, as a check curve taken on the unplayed record will show. All that has really been happening, is that the first record was rapidly being spoiled.

Although the pick-up is wearing out the record and thus reducing the response at resonance, please don't imagine that this is a good thing. With ordinary music there are usually many frequencies all at once. If the pick-up tries to wear out one frequency in particular, it will inevitably damage all others occurring at that spot. The only way of saving us is by reducing the amount of work we have to do.

I consider that the standard steel needle just by itself already has too much inertia. When these needles are used in massive armatures or other things which I have to move about, matters only get worse. So please, those of you who design pick-ups, cut down the inertia of the moving parts. I know this means scrapping the standard needle of which millions are made every year, but there are at least two makes of miniature needles available[1] with a weight less than a quarter that of ordinary needle, and arrangements using jewel points on very light shanks could also be used. If the weight of the rest of the moving parts can be similarly cut down, see how it will help me. Such reduction might cause loss in output, but does this matter? Quite often it can be made good simply by turning the volume control knob. If the reduced weight has the effect of making the treble resonance go up the scale, so much the better.

Another thing which is helpful is to have the movement very free in the pick-up head. I do not then have to push so hard at low frequencies. Even if at the tone arm resonance I have to push three or four times as hard as normal, the work can still be light, if the normal push is low enough. If I can be saved from having to push sideways very hard, then a small downward pressure is enough to hold the needle to its work. Most of the weight of the pick-up can then be counterbalanced or taken up by a spring so that both the reproducing point and the record will last longer. If you can go far enough in this direction, there seems to be no reason why a fibre point should not last perfectly for several records, and thus be fit for use on first-class reproducing gear.

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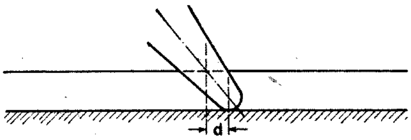
[1] (1) The Murdoch "Euphonic" each of which plays several records; (2) The H.M.V. "Silent Stylus," a chromium-plated long-playing needle.

Getting the Best from Records—

With reduced work and downward pressure the tendency for hard points to wear me out is, of course, greatly reduced, so that these can be used without the feeling that serious damage is being done at each playing. When a jewel point is used under these conditions, its life too should be greatly prolonged, a matter of importance if the point is expensive or difficult to renew.

There are thus many advantages in reducing the work I have to do so that a lighter downward pressure is possible. The only disadvantage seems to be that it may not be possible to trip those automatic stops or record changers which require considerable mechanical force to operate them.

With regard to jewel points, I must mention one disadvantage. Namely, they cannot adapt themselves to a badly shaped groove. Thus, for example, in the rare case of a record with a flat-bottomed groove, the jewel point will "skate" about on this flat surface, and reproduce sound only when the point happens to touch the side of the groove. This produces an incredibly bubbly, distorted sound for which the recording engineer is really responsible. He should not be using a cutting tool with the bottom of the point chipped off.



Loss of top response must result from the trailing angle of the needle since the difference (d) between the contacts at the bottom and top of the groove is equivalent to flattening of the needle point.

Another serious trouble can occur if the cutting point has a chip in the side. There is then a ridge in the groove, and a reproducing jewel pressing on this ridge will produce very severe surface noise. With a softer point, a channel is formed and the excess pressure no longer occurs. However, such ridges should not exist, so recording engineers, please take more care and check up your cutting sapphires so that records with faulty grooves will never be made. Remember, the jewel reproducing point will show up this kind of fault and bear perpetual witness to your carelessness.

Another matter which I cannot quite understand is this: At the time of recording, the cutter is generally trailing so slightly as to be practically vertical. Yet when I am being reproduced, people cheerfully let the needles trail by amounts approaching 45 deg. and with some special needles even more. If the shape of the "point" in contact with the groove was perfectly spherical, the plane of the line of contact would be vertical and all would be well. In practice this does not happen, and along the conical part of the "point" the plane of contact agrees with the axis of the needle. Thus we find that the contact at the bottom of the groove is in front of that at the top so that different parts of the point must be playing *different parts* of a high frequency note. Surely this must have much the same effect as a flat on the point? The remedy seems to be to make the reproducing angle agree with the recording angle (i.e., between 0 deg. and 5 deg. trailing). I know this is done with one pick-up having a jewel point, but with steel needles there seems to be some practical reason against this, as I know of no steel needle pick-up in which the needle is nearly vertical.

Now for a concluding remark on how to treat me when I am not in use. *Please keep me flat.* Especially in the summer, or when I am near warm things. If you want to stand me up on edge, please make sure that I can't lean over sideways. (If the box is not already full, put some packing into it.) If you use albums, have a good look at them, and make sure that covers and binding margins, etc., are not likely to cause warping. There are some albums which seem to have been made expressly to warp us!

I am afraid that I must now conclude this talk and return to my normal state in which the only voice I have is that of the music that has been impressed on me. I hope that I have interested you, and that in future my many brothers and I can all look forward to such good treatment that we shall always be able to give you faithfully that which has been stored in us.

News from the Clubs

Bristol Experimental Radio Club

Headquarters: 21, King's Corridor, Old Market Street, Bristol 2, Gloucestershire.
Meetings: Alternate Tuesdays at 7.30 p.m.
Hon. Sec.: Mr. D. J. James, 40, Robertson Road, Eastville, Bristol, 5, Gloucestershire.

Recent activities have included a demonstration of a PA amplifier, a Hallicrafter "Super Sky Rider" receiver and of a special amplifier with a somewhat unusual circuit. There has also been a talk on frequency meters.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon, Surrey.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon, Surrey.

On February 1st, Mr. H. G. Menage, of R. A. Rothermel, Ltd., spoke on "Latest Developments in Piezo Crystals." At the meeting on March 7th, Mr. Nixon, of the G.E.C., gave a lecture entitled "Lantern Valve Development." The final meeting of the session was held on April 4th. The Society is following its usual procedure of closing down during the summer. The new session will be opened in October.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne, Sussex.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne, Sussex.

At a recent meeting Mr. J. A. Penfold gave a lecture entitled "Problems of the Superheterodyne," in which he went very exhaustively into the design of this type of receiver.

Robert Blair Radio Society

Headquarters: L.C.C. Evening Institute, Blundell Street, London, N.7.
Hon. Sec.: Mr. H. Shelton, 9, Gordon House, N.1.

The new session commenced on April 4th. It was announced that new equipment had been ordered to complete the test bench equipment which includes a cathode ray oscillograph.

Edgware Short Wave Society

Headquarters: 4, Gainsborough Gardens, Edgware, Middx.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. F. Bell, 118, Colin Crescent, Hendon, London, N.W.9.

The third annual general meeting was held recently. Both membership and finances have improved during the past year. The subscription is to be reduced to 2s. 6d. for 1940, and members serving in H.M. Forces will become honorary members.

Ashton-under-Lyne and District Amateur Radio Society

Headquarters: 17a, Oldham Road, Smallshaw, Ashton-under-Lyne, Lancs.
Meetings: Wednesdays at 8 p.m. and Sundays at 2.30 p.m.
Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne, Lancs.

Great interest was taken in the recent demonstration of a new AF amplifier constructed by Mr. J. Cropper. It consists of a 6C5 push-pull transformer coupled to the two halves of a 6F8 twin triode. The output valves work with positive bias on the grids. There is a certain amount of negative feed-back and with 250 volts HT, 9 watts output is obtained with a very low percentage harmonic distortion.

Mr. W. P. Green and Mr. J. Phillips have constructed a signal generator for the club. The society's future programme includes, among other things, the construction of a steel wire recorder.

Test Report

Murphy A90

AC SUPERHETERODYNE (FOUR VALVES+RECTIFIER). DESIGNED FOR WARTIME PRODUCTION. PRICE £11

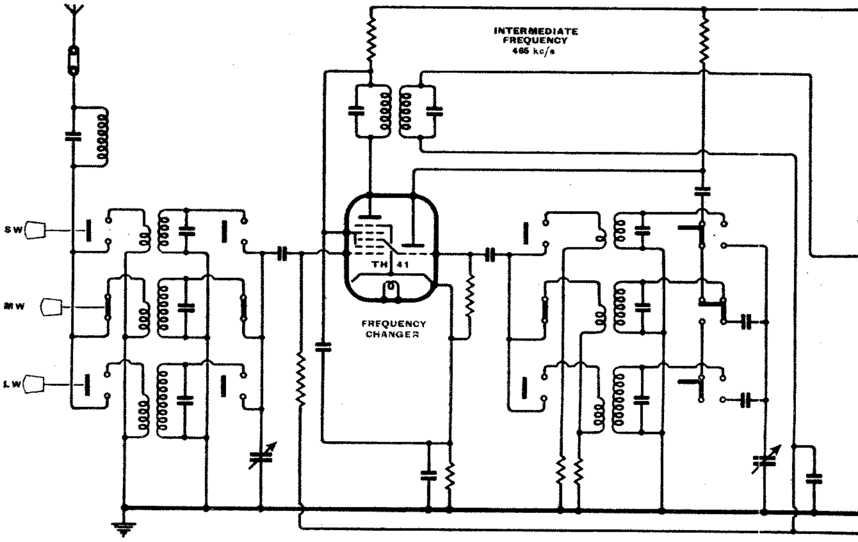
THE recently introduced "90" series has been developed specifically to meet wartime conditions. The keynote of the design is simplicity, and all non-essentials have been omitted in order that the highest possible performance, particularly on short waves, may be retained with economy in materials and labour.

Nothing has been done, however, which would compromise the standards of reliability which Murphy Radio have set for themselves, neither is the appearance and finish in any way inferior to that of pre-war sets. There are many neat features in the mechanical design and wartime conditions of working have evidently been conducive to the growth of new ideas. This is a set which would have attracted favourable notice in the days of peace as a basically sound design without frills at a reasonable price.

Circuit.—In general outline the circuit follows that of last year's "70" series. A triode-hexode frequency changer is followed by one stage of IF amplification, a double-diode-triode and a pentode output valve.

Iron-cored tuning coils are used throughout the receiver on all three wavebands in the oscillator as well as the aerial circuits. An IF filter is included in the aerial lead and there is provision for the introduction of single or double filter units for use when the set is installed near to a powerful transmitter or transmitters. The object is to prevent overloading of the frequency changer and the generation of whistles on the local station, without impairing the sensitivity at other parts of the waverange. The filters are fitted free of charge in districts where they are necessary.

Circuit diagram of the Murphy A90. In addition to the permanent IF filter in the aerial circuit, local station filters can be introduced if required to prevent overloading of the frequency changer.



The remainder of the circuit is straightforward. It will be observed that AVC is undelayed. There is no switch for the gramophone pick-up and the "live" lead should therefore be disconnected from the socket when receiving radio. A higher degree of AF amplification has been obtained compared with the A70, partly by a more efficient valve in the detector stage and partly by the use of a cathode by-pass condenser on the bias resistance of the output stage.

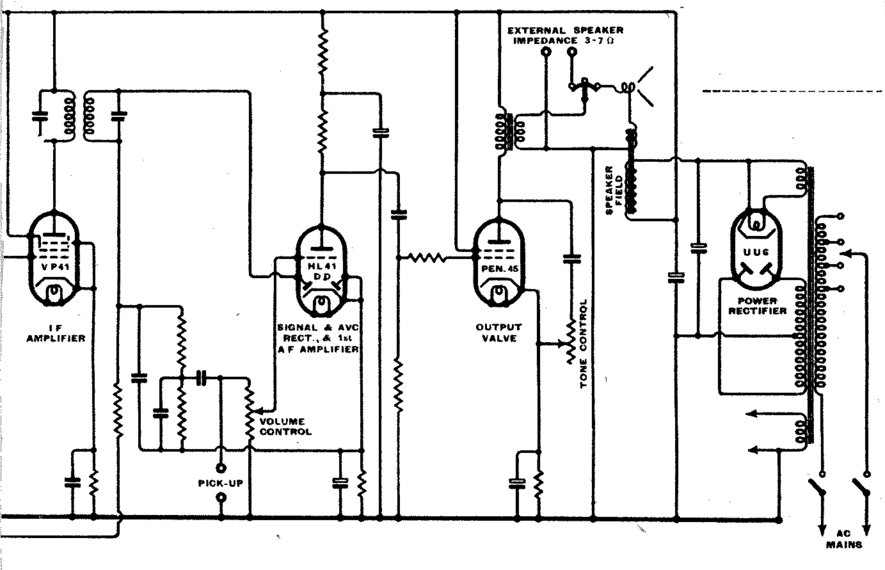
The Pen45 output valve is rated for an anode dissipation of 10 watts and therefore no Post Office permit is required to purchase the set. For this anode dissipation the very high undistorted output of 4.5 watts is claimed.

A further minor improvement in design is to be found in the use of a higher inductance for the field coil of the loud speaker and a consequent reduction of mains hum.

Performance. — A systematic examination of the receiver for typical faults in performance produces very little ammunition for the would-be critic. The medium and long wave ranges provide all the sensitivity required by the general listener with sufficient selectivity to take advantage of the range available. There are no self-generated whistles on these ranges and very few on the short-wave range.

With only a single tuned circuit preceding the frequency changer the performance in the matter of image rejection on short waves is naturally not so good as that of the A76, but the sensitivity and signal-to-noise ratio are so good that an occasional whistle is readily forgiven. There can be no doubt of the efficiency of the short-wave circuits and the power and clarity of reception on this waverange is much above the average for receivers in this price class.

The excellent radio performance is capped by quality of reproduction which is remarkable for the skill with which the requirements of speech and music have been balanced. Although the diameter of the loud speaker cone is only 6½ inches, the semblance of bass in musical items is by no means lacking; yet there is no colouration of the male speaking voice by any suggestion of resonance. A clean treble response speaks for the absence of harmonic distortion and transient response is remarkably good.



Constructional Features.—More than usual interest is to be found in the mechanical design of this receiver. The necessity of planning ahead for wartime production is responsible in some degree for a fresh approach to the problems of the choice and utilisation of materials, but the ingenuity of the designers has by no means been entirely absorbed by these considerations.

One of the most notable developments is the employment of push-button control for waverange switching. The short direct leads which can be obtained with this type of switch have contributed in no small measure to the efficiency and stability of the short-wave range, and from the user's point of view there can be no doubt that the push-buttons are much more attractive than the conventional rotary waverange control.

The push-button switches, together with all the RF components, are built on a thick metal front panel which also carries the tuning dial. This RF unit is assembled separately from the main chassis which carries the remainder of the circuit from the frequency changer onwards.

WAVERANGES

Short ...	*16.7 -*	*50 metres*
Medium	*190 -*	*550 metres*
Long ...	*970 -*	*2000 metres*

The two-gang tuning condenser is mounted underneath the chassis where it is protected from dust. It is coupled to the tuning knob through a two-speed slow-motion drive, and for short-wave station logging an auxiliary 100-degree dial has been provided. This is chain-driven from the main spindle with an 8:1 reduction ratio.

Station names are printed in transparent white on an opaque black background and each waverange is selectively illuminated from behind. The auxiliary dial is illuminated only on short waves. Looking ahead, those British and Continental stations which have temporarily closed down are included on the dial, but in smaller lettering than the stations which are at present in operation.

The engraving of control knobs to identify their functions is, we believe, a new departure in Murphy receivers, and one which will be generally welcomed. The tuning and volume controls are mounted in the bakelite front panel and the combined tone and on-off switch in a recess at the left hand side of the set.

To facilitate removal of the chassis from the cabinet, comparatively long leads have been fitted to the latter control and the loud speaker connections are made through a detachable four-pin plug.

A special word of praise is due to the external loud speaker switch incorporated with the socket connections. This has a sliding action and works in a slot which automatically exposes lettering indicating whether internal, external or both speakers are in circuit.

Another new departure is to be found in the use of moulded coil formers designed specially for use with "Speednut" fixing to the chassis.

To conserve as far as possible the use of aluminium, electrolytic condensers with impregnated cardboard cases have been specified. Also, with an eye to fluctuations in the supply of plywood, the cabinet has been designed so that it can be equally well made in solid wood. The set tested had a cabinet of the latter type and it would seem that absence of veneers is not going to mean any deterioration in the ex-

Murphy A90—
terior finish, which is quite up to pre-war standard.

There can be no doubt that the A90 is a thoroughly sound engineering job, and one with which the makers may look to the future with confidence in sustaining flow of production and reliability of performance.

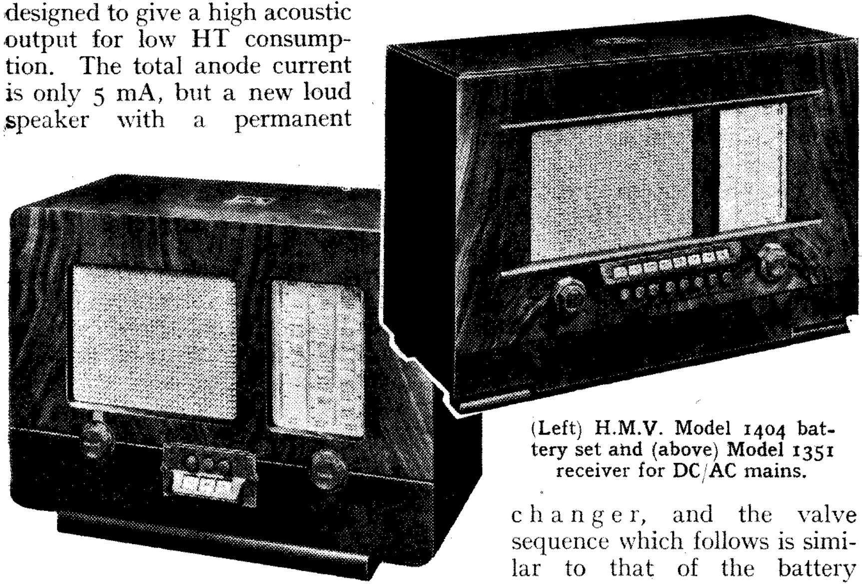
Two New H.M.V. Models

A BATTERY SET AND A DC/AC RECEIVER

THE new Model 1404 battery receiver is a successor to the Model 1400 and has been designed to give a high acoustic output for low HT consumption. The total anode current is only 5 mA, but a new loud speaker with a permanent magnet giving a flux density of 10,000 lines/cm^2 has been specially developed to make the most of the output from the KT2 in the final stage. This is preceded by a double-diode-triode detector, AVC rectifier, and first AF stage, a single pentode IF amplifier, and a triode-hexode frequency changer. Switching for these three wavebands is by means of push buttons, and the only other controls are tuning and combined volume and on-off switch. The price is 11 guineas.

In the Model 1351, which replaces the Model 1350, push-button tuning is arranged for five stations, and three additional buttons are used for waverange switching. As in the battery model, there is a short-wave range from 16 to 50 metres in addition to the usual medium- and long-wave ranges.

A high-efficiency aerial coupling transformer with an image rejector circuit precedes the frequency changer, and the valve sequence which follows is similar to that of the battery receiver. A KT35 is used in the output stage and the rectifier is a U31. The set is protected by 2-amp fuses. The price is 12 guineas.


(Left) H.M.V. Model 1404 battery set and (above) Model 1351 receiver for DC/AC mains.

The Wireless Industry

TWO new receivers have been introduced by the Marconiphone Co., Ltd. The Model 892 battery receiver at 11 guineas is a four-valve superhet with a battery economiser circuit. Maximum output is obtained with an HT consumption of 10mA, but this may be reduced to 5 mA for normal conditions.

The other receiver, Model 892, is for AC/DC mains and costs 12 guineas. It has push-button tuning for five stations and employs a four-valve superhet circuit with three waveranges. The short-wave range goes down to 16 metres.

◆ ◆ ◆ ◆

An important addition has been made to the PA equipment produced by the G.E.C. This is the type BCS.2290 Current Fed Microphone. Designed to feed a standard 15 ohm PA loud speaker, this microphone derives its power from a 12-volt accumulator and operates without the use of an amplifier. The price is £8 5s., and a special matching transformer is available at £1 10s.

◆ ◆ ◆ ◆

The Uganda Motor Works, Kampala, Uganda, East Africa, have opened a Radio Department, and would be glad to receive catalogues and trade terms from manufacturers of components, accessories and complete receivers.

◆ ◆ ◆ ◆

New firms engaged in the manufacture of components employing aluminium and light alloys are reminded that the Technical Advisory Service of the Northern Aluminium Co., Ltd., Banbury, Oxfordshire, is at their disposal for free advice on all problems relating to the working and treatment of aluminium and its alloys.

New Tungsram Frequency Changer

TYPE 6E8-GM

A NEW octal-based triode-hexode has recently been introduced for use in conjunction with the American-type octal range valves. Its leading characteristics are as follows:—

Heater volts	= 6.3 volts
Heater current	= 0.3 amp
Conversion conductance	= 0.65 mA/V
Optimum heterodyne voltage	= 10 volts r.m.s.
Hexode anode voltage	= 250 volts
Hexode screen voltage	= 100 (or fed through 50,000 ohms from 250 v)
Signal grid voltage	= − 2 to − 20 volts
Triode conductance	= 2.8 mA/V
Triode anode voltage	= (fed through 30,000 ohms from 250 v)
Optimum triode grid leak	= 50,000 ohms
Total screen current	= 3 mA
Hexode anode current	= 2.3 mA
Triode anode current	= 3.3 mA
Capacitance to Earth.	
Input grid	= 4.8 μμF
Output	= 9.0 μμF
Oscillator grids	= 8.8 μμF
Triode anode	= 4.7 μμF
Mutual Capacitances.	
Input grid to anode	= 0.0015 μμF
Input grid to heater	= 0.001 μμF
Input grid to oscillator grids	0.2 μμF
Oscillator grids to triode anode	1.5 μμF

The 6E8-GM has a floating screen voltage characteristic resulting in a conversion conductance curve which is practically pure logarithmic function of the input voltage, and hence the valve has considerably reduced cross-modulation and lower noise level. Due to the separation of the two systems in the valve, the frequency drift on short waves due to AVC or variation of supply voltage is reduced to a negligible quantity.

Transit time effects have been reduced so that at 25 Megacycles the kinetic grid current at normal grid bias is only 2-3 μA. The input impedance at this frequency is of the order of 15,000 ohms.

As the valve has the same general shape and size as the normal American-type mixer and RF valves, it will be useful in all classes of work, including midget superhets.

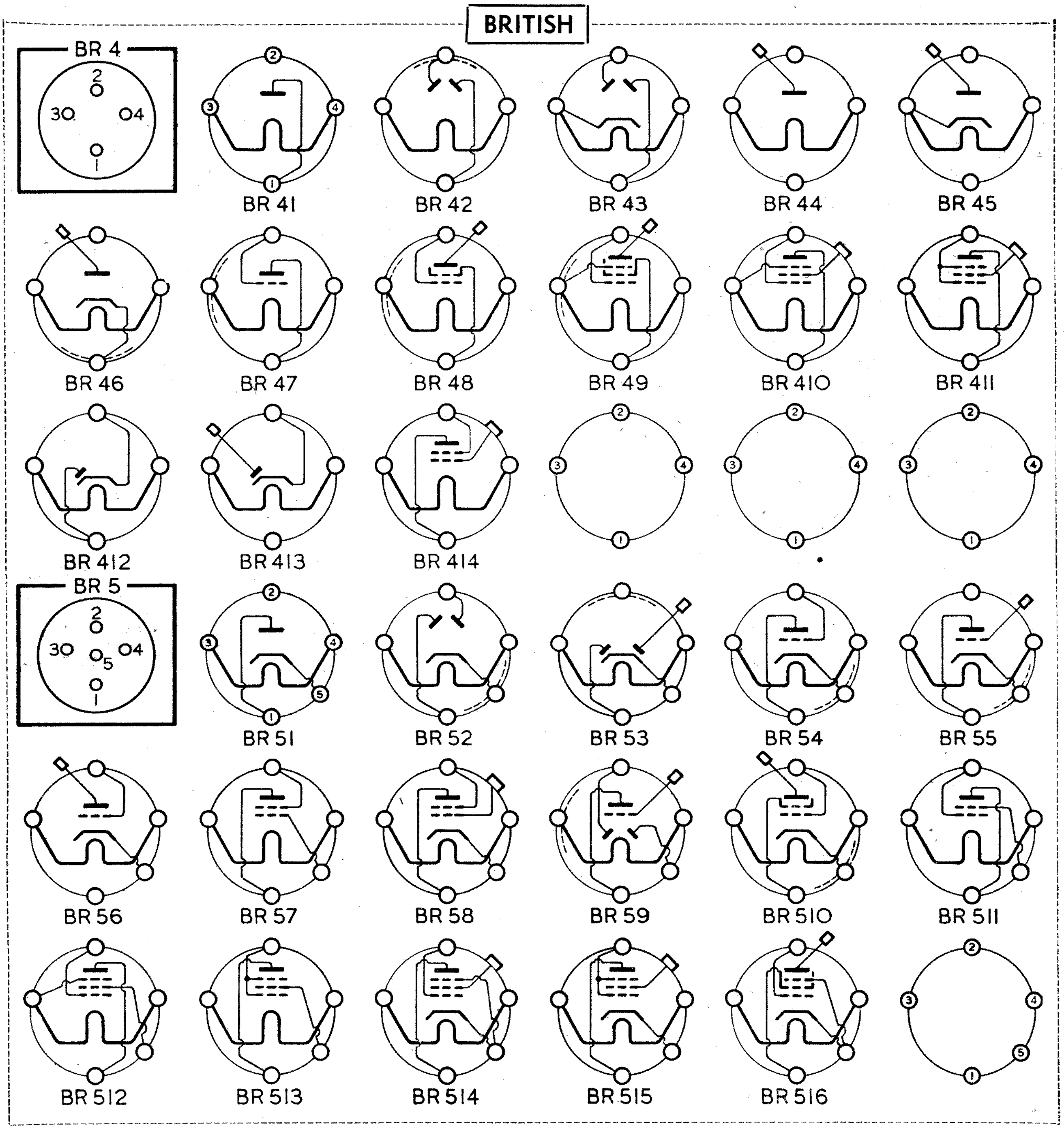
The price of the Tungsram 6E8-GM is 11s. 6d.

"The Wireless World" Valve Data, 1940

KEY TO VALVE BASE CONNECTIONS

THE pin connections of all the valves listed in this issue are drawn as they would appear when the base or its holder are viewed from the underside of the chassis. The code numbers used for cross reference which appear in the valve data columns headed "*Wireless World* Base No." are preceded by letters indicating the type, and the first digit indicates the number of sockets in the valve holder. The succeeding figures merely give the order of appearance in the particular section to which the valve belongs. In a few cases, e.g., where a valve is available in both metallised and clear bulbs, or with special internal screening, a single base diagram covers both types and the connections which may or may not be present are shown dotted. Elsewhere only those electrodes which have independent external connections are shown; thus, in the case of some tetrodes, the beam-forming electrodes may be omitted.

Each section is preceded by a sketch (not necessarily to scale) showing the arrangement of the pins in each type.



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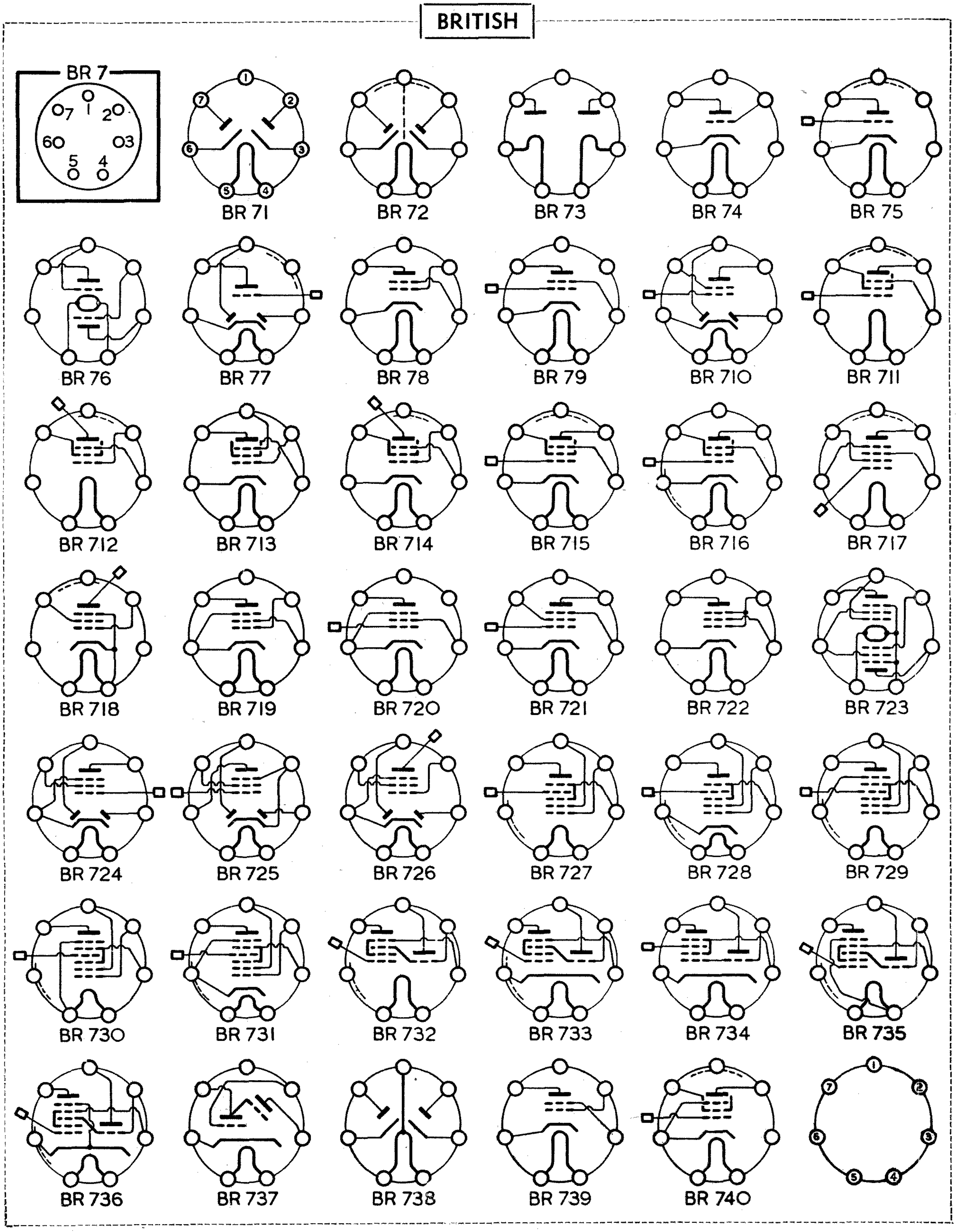
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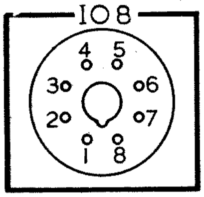
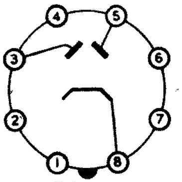
INTERNATIONAL OCTAL





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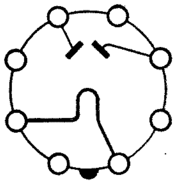
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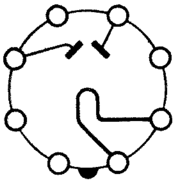
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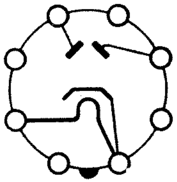
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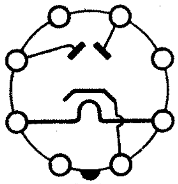
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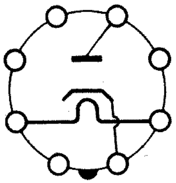
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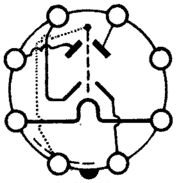
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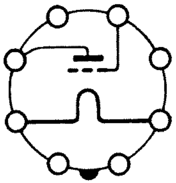
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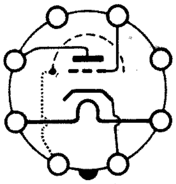
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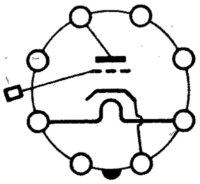
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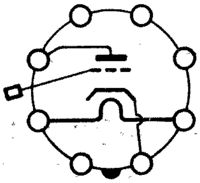
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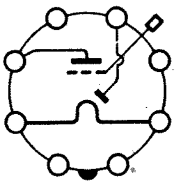
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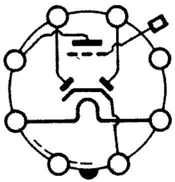
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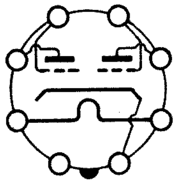
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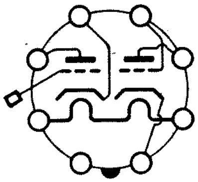
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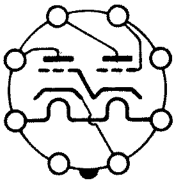
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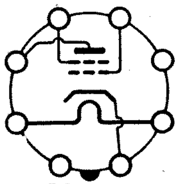
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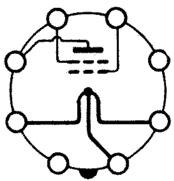
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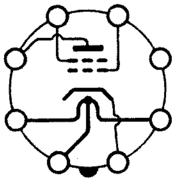
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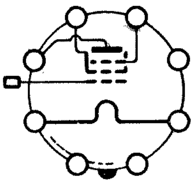
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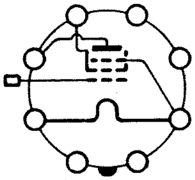
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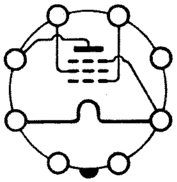
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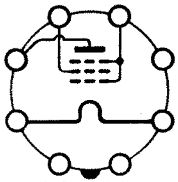
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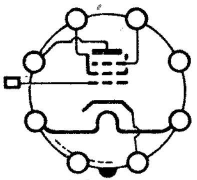
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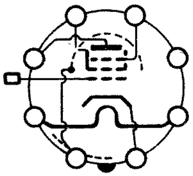
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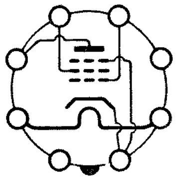
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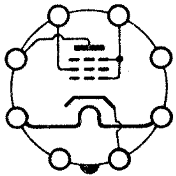
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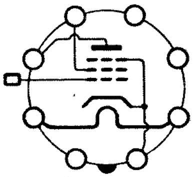
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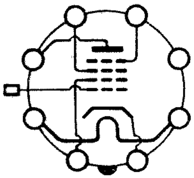
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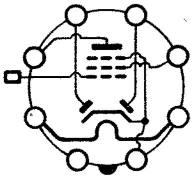
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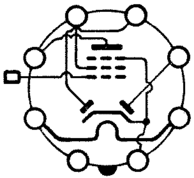
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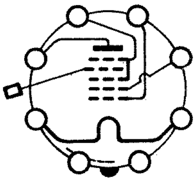
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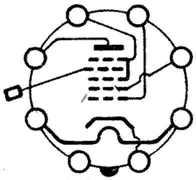
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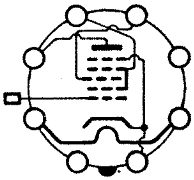
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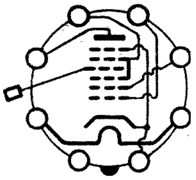
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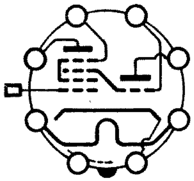
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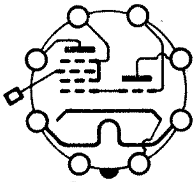
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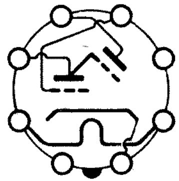
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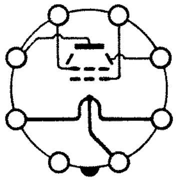
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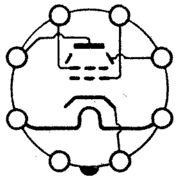
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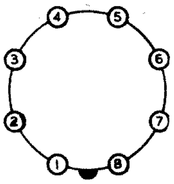
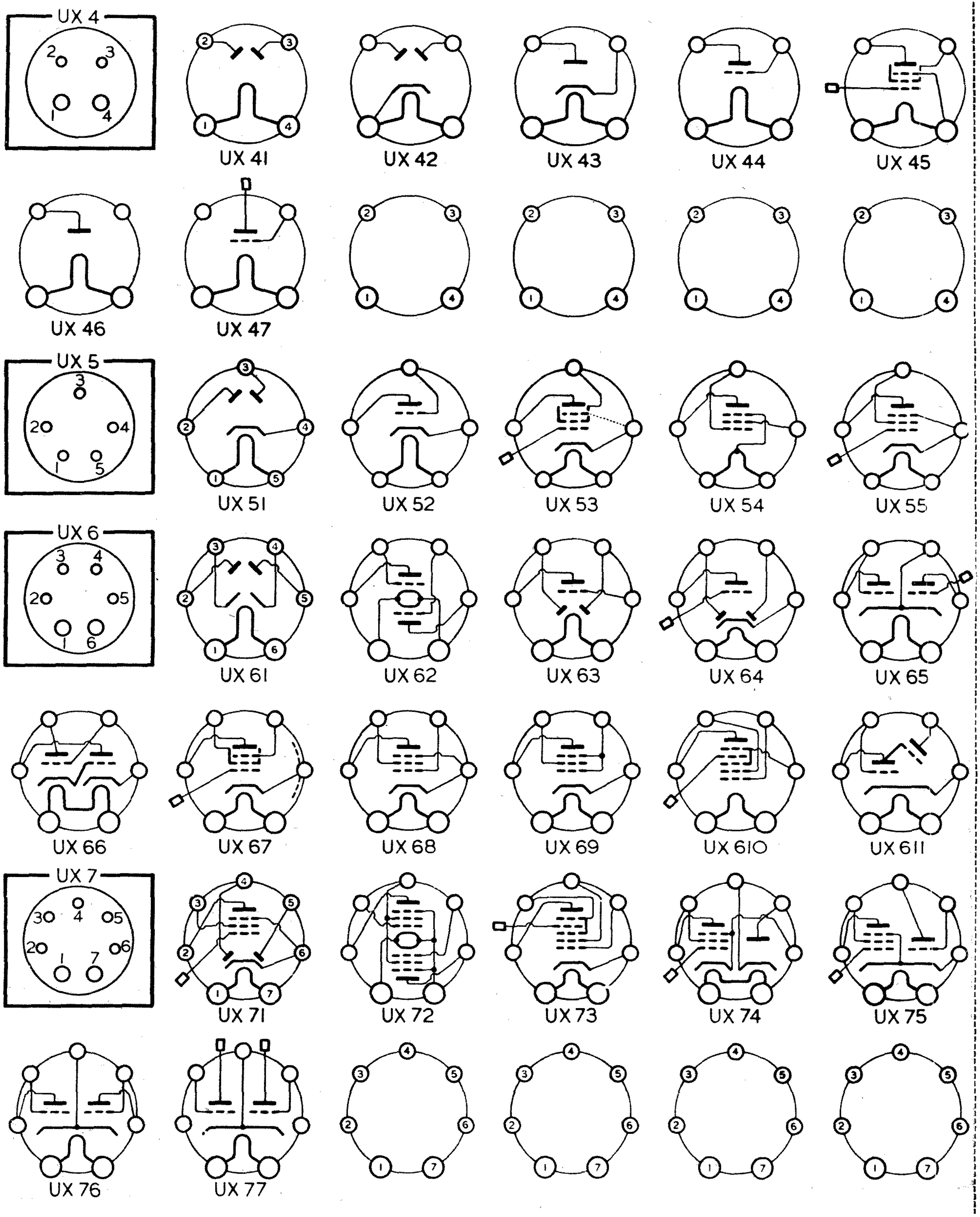


AMERICAN UX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UX 53
UX 54
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UX 61
UX 62
UX 63
UX 64
UX 65
UX 66
UX 67
UX 68
UX 69
UX 610
UX 611
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UX 76
UX 77

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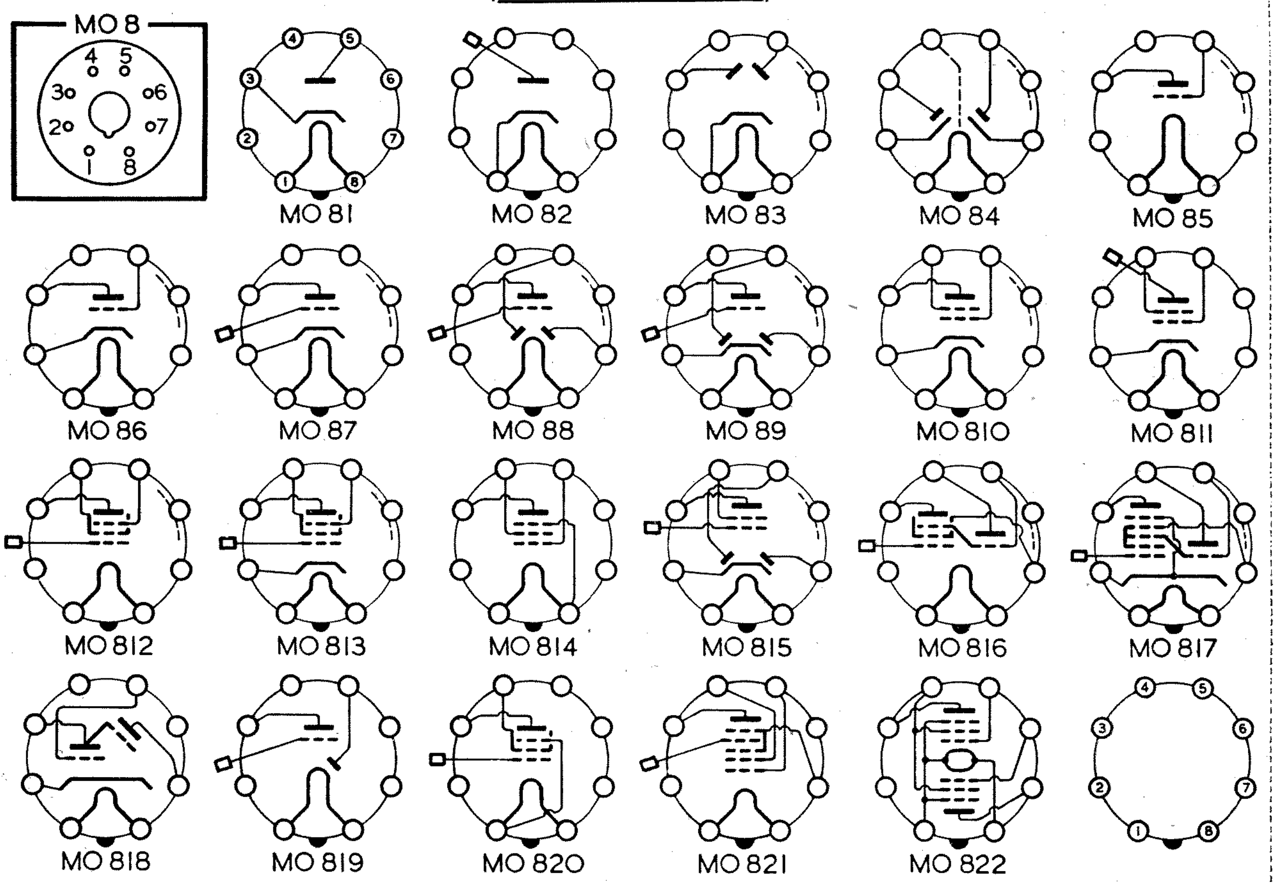

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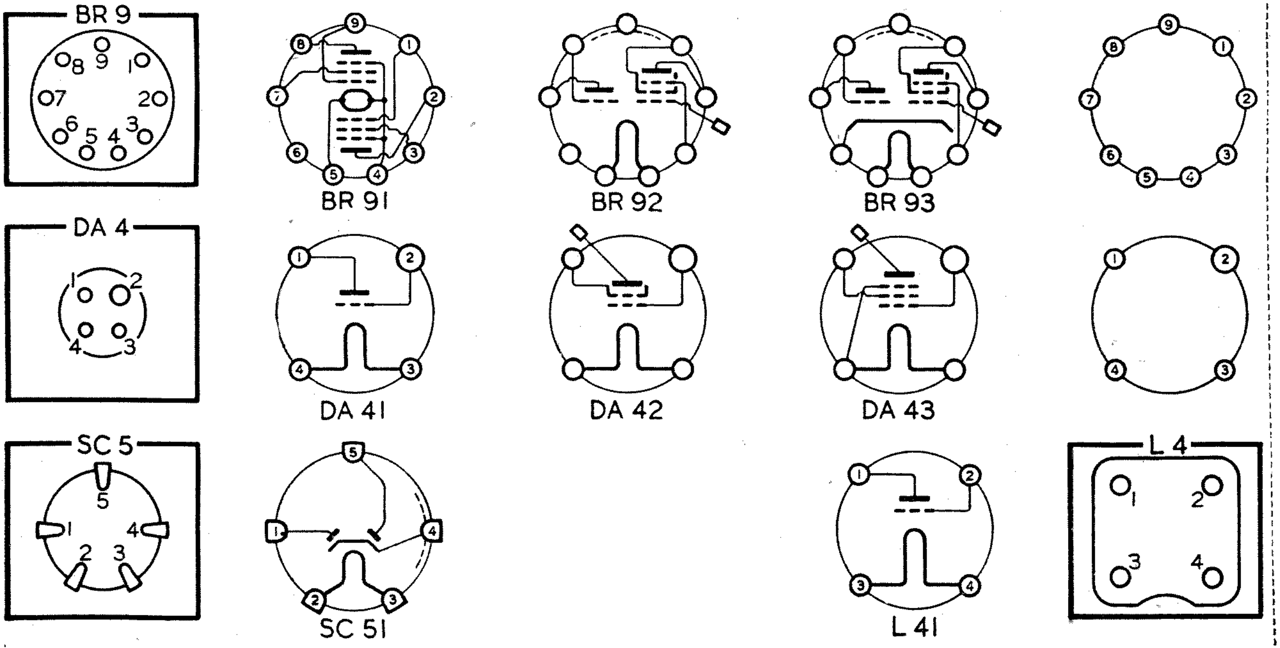
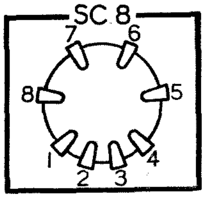


SIDE CONTACT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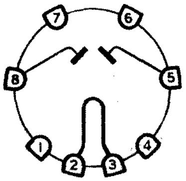

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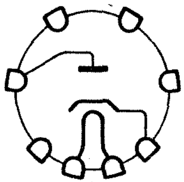
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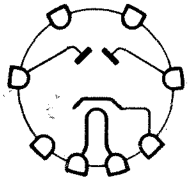
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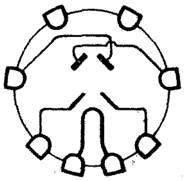
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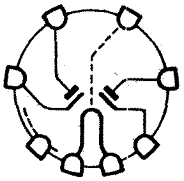
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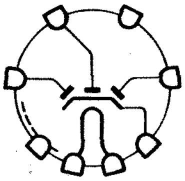
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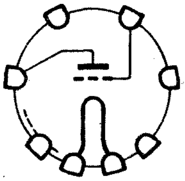
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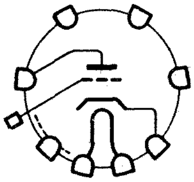
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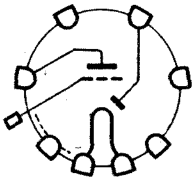
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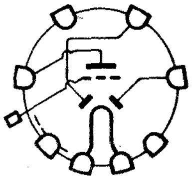
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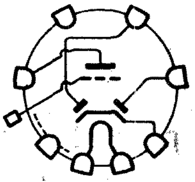
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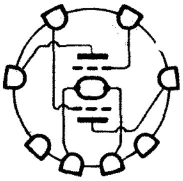
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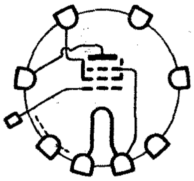
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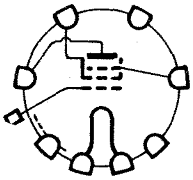
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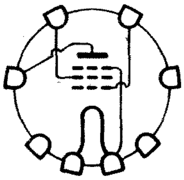
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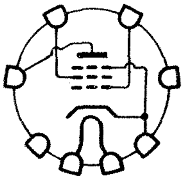
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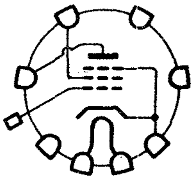
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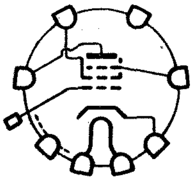
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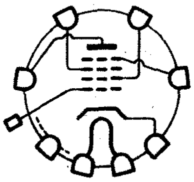
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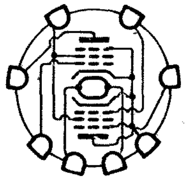
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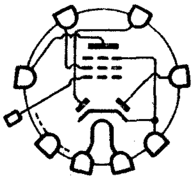
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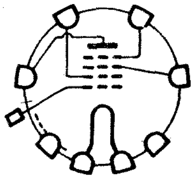
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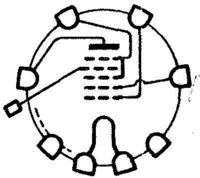
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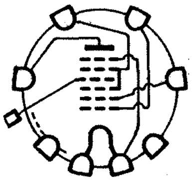
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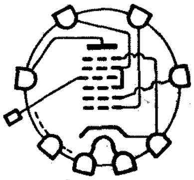
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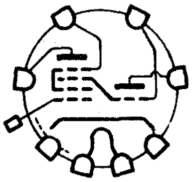
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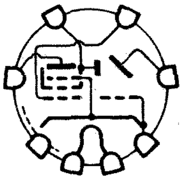
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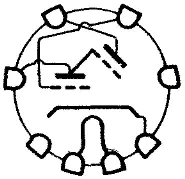
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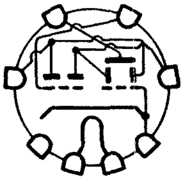
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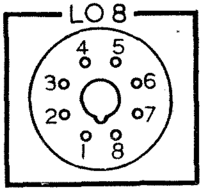
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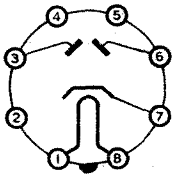

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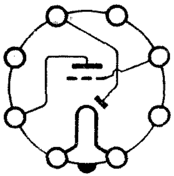
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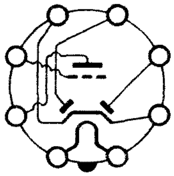
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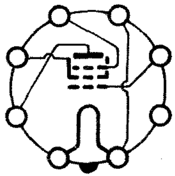
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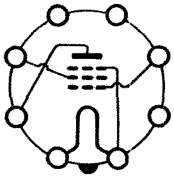
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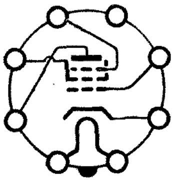
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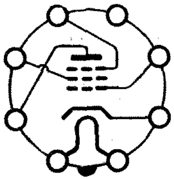
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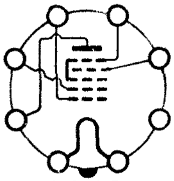
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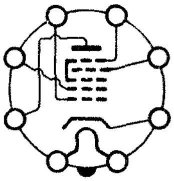
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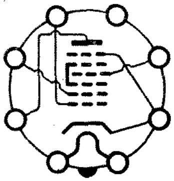
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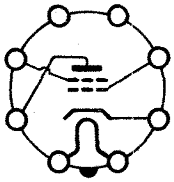
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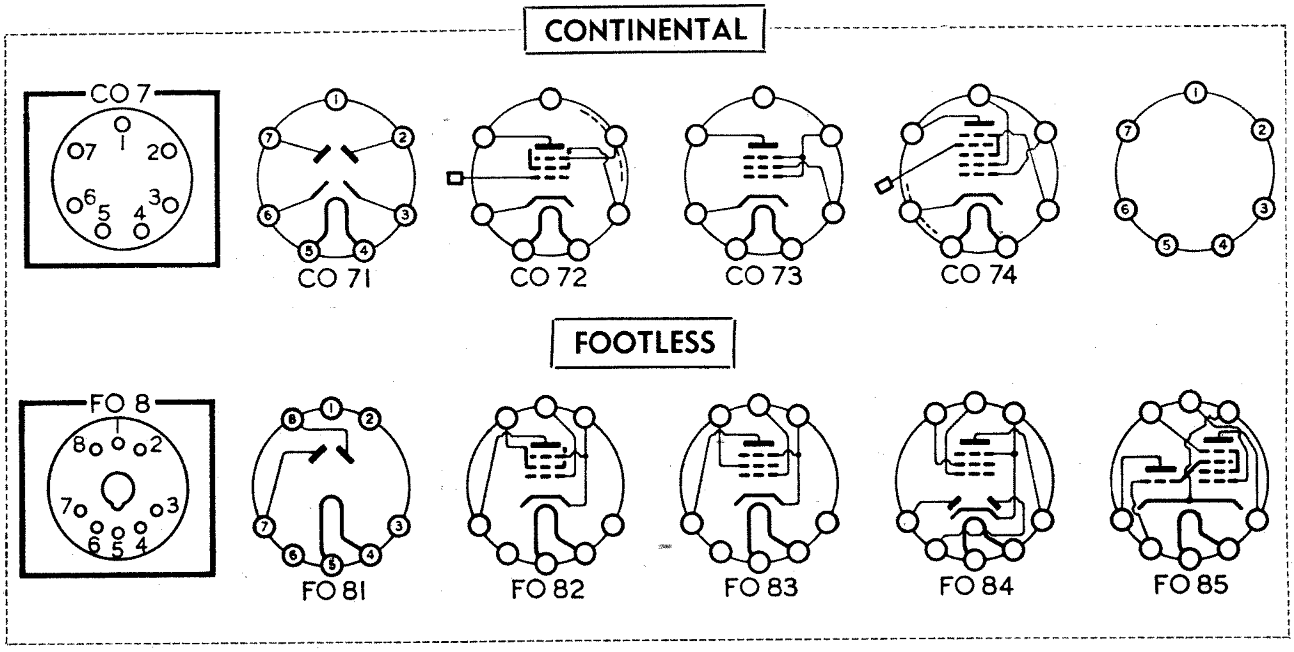

For Morse Practice

Signals Recorded on Gramophone Discs

WE have received a series of three gramophone records prepared by an ex-R.A.F. signal instructor for the benefit of those desiring to learn morse by home study.

The records contain examples of plain language, numerals and code groups, and are recorded at various speeds from 2 to 15 words per minute. It is possible, by adjusting the r.p.m. of the turntable to obtain a limited variation in the speed of sending in the case of each record, and a leaflet is supplied giving the corresponding morse and turntable speeds as well as the full text of each record for checking purposes. The provision of this information is particularly commendable, and although a change of speed means a variation in the pitch of the note, this is immaterial.

The records are models of clear-cut sending, which is particularly desirable for learners, even though such good sending may seldom be heard in actual practice. There would seem to be room for more advanced records at higher speeds and with a background of jamming such as a wireless operator might normally experience.

These records cost 3s. 6d. each, or 9s. for the set of three, and can be obtained post free from C. E. Masters, Forest Way, Pound Hill, Crawley, Sussex.

All records are of the standard ten-inch type suitable for use with ordinary needles.

Three New K.B. Sets

KOLSTER BRANDES, LTD., Cray Works, Sidcup, Kent, have just released three new receivers, all under £10.

The Model KB808 is a four-valve table model superhet for AC mains with a heptode frequency changer, and a pentode output valve giving three watts output. The anode dissipation does not exceed 10 watts and no permit is required to purchase. There are three wave-ranges and the short-wave range goes down to 16.5 metres. The price is 9 guineas.

A similar wave-range is covered in the KB800 which is the battery equivalent. The frequency changer in this set is a triode hexode and automatic bias is provided for the output pentode valve. The price is 8 guineas, less batteries.

Finally, there is the KB817, which is an "all-dry" battery portable using 1.4 volt valves. A four-valve superhet circuit is employed and the wavelengths covered are 200-545 and 1050-2000 metres. The weight is 18lb. and the price, complete with batteries, is £7 19s. 6d.

Hearing Aids

The concluding article of Dr. Littler's series of contributions on hearing aids has been unavoidably held over.

BRIMAR BVA VALVES

AMERICAN U.X. TYPES

Type Number	Application	Heater		Anode Voltage Normal	Screen Voltage Normal	Grid Voltage Normal	Anode Current mA	Screen Current mA	Amplification Factor	Impedance Ohms	Mutual Conductance mA/V	Optimum Load Ohms	Auto Bias Resistor	Power Output in Watts	*Wireless World* Base Number	Price
		Volts	Amps													
1A4E	Battery H.F. Pentode	2.0	0.06	180	67.5	-3/-15	2.3	0.8	750	1.0 Meg.	0.75	—	—	—	UX45	9/-
1A6	Battery Heptode F.C.	2.0	0.06	180	67.5	-3/-22.5	1.3	2.4	—	0.5 Meg.	300†	—	—	—	UX610	10/6
1C6	Battery Heptode F.C.	2.0	0.12	180	67.5	-3/-14	1.5	2.0	—	0.75 Meg.	325†	—	—	—	UX610	10/6
5Z3	A.C. Rectifier ..	5.0	3.0	Max. A.C. Voltage per Anode 500 R.M.S.						Max. Rectified Current 250 mA.					UX41	15/-
6A3	Power Triode ..	6.3	1.0	250	—	-45	60.0	—	4.2	800	5.25	2,500	—	3.2	UX44	9/6
6A7	Frequency Changer ..	6.3	0.3	250	100	-3/-40	3.5	2.2	—	360,000	550†	—	300	—	UX73	11/6
6A7E	Frequency Changer ..	6.3	0.3	250	100	-3/-40	3.3	2.0	—	300,000	500†	—	300	—	UX73	11/6
6B5	Double Output Triode	6.3	0.8	300	—	—	43.0	8.0	54	24,000	2.25	7,000	0	5.0	UX66	15/-
6B7	Double Diode Pentode	6.3	0.3	250	125	- 3	9.0	2.3	730	650,000	1.10	—	250	—	UX71	12/6
6B7E	Double Diode Pentode	6.3	0.3	250	125	- 3	7.5	2.1	700	650,000	1.1	—	250	—	UX71	12/6
6C6	H.F. Pentode ..	6.3	0.3	250	100	- 3	2.0	0.5	1,900	1.5 Meg.	1.25	—	600	—	UX67	10/6
6D6	Vari-Mu H.F. Pentode	6.3	0.3	250	100	-3/-40	8.2	2.0	1,280	800,000	1.6	—	300	—	UX67	10/6
6F7B	Triode Pentode ..	6.3	0.3	250	100	-3/-35	6.5	1.5	900	850,000	1.1	—	500	—	UX75	11/6
6U5/6G5	Magic Eye (Tuning In.)	6.3	0.3	250	—	0/-22	—	—	—	—	—	—	—	—	UX611	8/6
12A7	Pentode Rectifier ..	12.6	0.3	135	135	-13.5	9.0	2.5	100	102,000	0.975	13,500	1,250	0.55	UX74	12/6
12Z3	A.C. or A.C./D.C. Rect.	12.6	0.3	Max. A.C. Voltage per Anode 250 R.M.S.						Max. Rectified Current 60 mA.					UX43	9/-
15E	Battery H.F. Pentode	2.0	0.22	135	67.5	- 1.5	1.85	0.3	600	800,000	0.75	—	—	—	UX53	9/-
18	Power Pentode ..	14.0	0.3	250	250	-16.5	34.0	6.5	190	80,000	2.35	7,000	410	3.5	UX69	10/6
18E	Power Pentode ..	14.0	0.3	250	250	-16.5	32.0	6.2	180	80,000	2.25	7,000	410	3.5	UX69	10/6
19	Battery Class "B" Amp.	2.0	0.26	135	—	0	—	—	—	—	—	10,000§	—	2.1	UX62	9/6
24A	Screened Tetrode ..	2.5	1.75	250	90	- 3.0	4.0	1.7	630	600,000	1.05	—	500	—	UX53	10/6
24E	Screened Tetrode ..	2.5	1.75	250	90	- 3.0	4.0	1.7	600	600,000	1.0	—	500	—	UX53	10/6
25RE	A.C./D.C. Rectifier ..	25.0	0.3	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 80 mA.					UX61	9/-
25Y5	A.C./D.C. Rectifier ..	25.0	0.3	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 80 mA.					UX61	9/-
25Z5	A.C./D.C. Rectifier ..	25.0	0.3	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 85 mA.					UX61	9/-
27	G.P. Triode	2.5	1.75	250	—	-21	5.2	—	9	9,250	0.97	—	—	—	UX52	7/6
30	Battery Triode ..	2.0	0.06	180	—	-13.5	3.1	—	9.3	10,300	0.9	—	—	—	UX44	6/-
32E	Battery H.F. Tetrode	2.0	0.06	180	67.5	- 3	1.7	0.4	780	1.2 Meg.	0.65	—	—	—	UX45	9/-
34E	Battery H.F. Pentode	2.0	0.06	180	67.5	-3/-22.5	2.8	1.0	620	1.0 Meg.	0.62	—	—	—	UX45	9/-
35RE	A.C./D.C. Rectifier ..	35.0	0.3	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 120 mA.					UX61	9/-
36	Screened Tetrode ..	6.3	0.3	250	90	- 3.0	3.2	1.0	595	550,000	1.08	—	850	—	UX53	10/6
36E	Screened Tetrode ..	6.3	0.3	250	90	- 3.0	3.2	1.0	550	550,000	1.0	—	850	—	UX53	10/6
37	G.P. Triode	6.3	0.3	250	—	-18	7.5	—	9.2	8,400	1.1	—	—	—	UX52	7/6
39/44	H.F. Pentode ..	6.3	0.3	250	90	-- 3.0	5.8	1.4	1,050	1,000,000	1.05	—	400	—	UX53	10/6
39/44E	H.F. Pentode ..	6.3	0.3	250	90	- 3.0	5.8	1.4	1,000	1,000,000	1.0	—	400	—	UX53	10/6
41E	A.C. & Car Radio Power Pentode ..	6.3	0.4	250	250	-18.0	32.0	5.5	150	68,000	2.2	7,600	480	3.4	UX69	10/6
42	Power Pentode ..	6.3	0.7	250	250	-16.5	34.0	6.5	190	80,000	2.35	7,000	410	3.5	UX69	10/6
42E	Power Pentode ..	6.3	0.7	250	250	-16.5	32.0	6.2	180	80,000	2.25	7,000	410	3.5	UX69	10/6
43	Power Pentode ..	25.0	0.3	180	135	-20	38.0	7.5	100	40,000	2.5	5,000	440	2.75	UX69	10/6
43E	Power Pentode ..	25.0	0.3	180	135	-20	38.0	7.5	90	40,000	2.25	5,000	440	2.75	UX69	10/6
45	Power Triode ..	2.5	1.5	250	—	-50	34.0	—	3.5	1,600	2.17	3,900	—	1.6	UX44	9/6
47	Power Pentode ..	2.5	1.75	250	250	-16.5	31.0	6.0	150	60,000	2.5	7,000	450	2.7	UX54	10/6
47E	Power Pentode ..	2.5	1.75	250	250	-16.5	31.0	6.0	140	60,000	2.3	7,000	450	2.7	UX54	10/6
71A	Power Triode ..	5.0	0.25	180	—	-40.5	20.0	—	3	1,750	1.7	4,800	—	0.79	UX44	9/6
75	Double Diode Triode ..	6.3	0.3	250	—	- 2.0	0.4	—	100	90,000	1.10	—	5,000	—	UX64	9/6
76	G.P. Triode	6.3	0.3	250	—	-13.5	5.0	—	13.8	9,500	1.45	—	2,500	—	UX52	7/6
77	H.F. Pentode ..	6.3	0.3	250	100	- 3.0	2.3	0.5	1,500	1.5 Meg.	1.25	—	1,000	—	UX67	10/6
77E	H.F. Pentode ..	6.3	0.3	250	100	- 3.0	2.3	0.5	1,500	—	1.0	—	1,000	—	UX67	10/6
78	Vari-Mu H.F. Pentode	6.3	0.3	250	125	-3/-40	10.5	2.6	1,000	600,000	1.65	—	200	—	UX67	10/6
78E	Vari-Mu H.F. Pentode	6.3	0.3	250	100	- 3	10.5	2.6	1,000	700,000	1.40	—	300	—	UX67	10/6
79	A.C. Class "B" Amp...	6.3	0.6	250	—	0	—	—	—	—	—	14,000§	—	8.0	UX65	15/-
80	A.C. Rectifier ..	5.0	2.0	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 125 Milliamps.					UX42	9/-
84	A.C. & Car Radio Rect.	6.3	0.5	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 50 Milliamps.					UX51	9/-
85	Double Diode Triode ..	6.3	0.3	250	—	-20	8.0	—	8.3	7,500	1.1	20,000	2,500	0.35	UX64	9/6
2101	Battery Power Pent.	2.0	0.12	135	135	- 4.5	8.0	2.6	340	200,000	1.7	16,000	—	0.45	UX54	9/-
2102	Battery Double Diode Triode	2.0	0.12	135	—	- 1.5	2.1	—	30	23,000	1.3	—	—	—	UX63	7/6
2103	Battery Double Pent.	2.0	0.26	135	135	- 7.5	4.0	1.2	350	—	1.6	24,000§	—	0.6	UX72	12/6
2151	Power Pentode ..	14.0	0.3	250	250	-31	47.0	11.6	120	50,000	2.4	—	—	6.0	UX69	12/-

¶ Available with 5 or 7 pin base. † Conversion Conductance in Micromhos. § Anode to Anode Load.
|| Available with 5 pin and side terminal or 7 pin base.

NOTE.—The Brimar Type Numbers in the U.X. and Octal Ranges correspond exactly with existing American Type Numbers, i.e. The Brimar 6A7 will replace any 6A7 of American manufacture.

Advertisement of Standard Telephones and Cables, Limited, Foots Cray, Sidcup, Kent.

BRIMAR BVA VALVES

ENGLISH TYPES

Type Number	Application	Heater		Anode Voltage Normal	Screen Voltage Normal	Grid Voltage Normal	Anode Current mA	Screen Current mA	Amplification Factor	Impedance Ohms	Mutual Conductance mA/V	Optimum Load Ohms	Auto Bias Resistor	Power Output in Watts	*Wireless World* Base Number	Price
		Volts	Amps													
20A1	Triode Hexode F.C. ..	4.0	1.2	250	80	–1.5/–30	2.2	3.0	—	750,000	650*	—	300	—	BR736	11/6
20D2	Triode Hexode F.C. ..	13.0	0.15	250	100	–3/–30	2.5	4.5	—	1,000,000	350*	—	300	—	BR734	11/6
15D1	Frequency Changer ..	13.0	0.2	250	100	–3/–40	3.5	2.2	—	360,000	550*	—	300	—	BR728	11/6
15D2	Frequency Changer ..	13.0	0.15	250	100	–3/–40	3.5	2.2	—	360,000	550*	—	300	—	BR728	11/6
9D2	Vari-Mu H.F. Pentode	13.0	0.2	250	125	–3/–40	10.0	2.6	1,000	600,000	1.65	—	200	—	BR721	10/6
11D3	Double Diode Triode..	13.0	0.2	250	—	– 2	0.4	—	100	90,000	1.10	—	5,000	—	BR77	9/6
11D5	Double Diode Triode..	13.0	0.15	250	—	– 3	3.8	—	40	26,700	1.5	—	750	—	BR77	9/6
10D1	Double Diode.. ..	13.0	0.2	—	—	—	—	—	—	—	—	—	—	—	BR52	5/6
4D1	Triode	13.0	0.2	200	—	– 3	5.0	—	40	10,000	4.0	—	800	—	BR75	7/6
7D6	Power Pentode ..	40.0	0.2	250	250	– 6	32.0	6.0	600	60,000	10.0	8,500	150	3.75	BR722	10/6
7D8	Power Pentode ..	13.0	0.65	250	250	– 6	32.0	6.0	600	60,000	10.0	8,500	150	3.75	BR722	10/6
7A3	Power Pentode ..	4.0	2.0	250	250	– 6	32.0	6.0	600	60,000	10.0	8,500	150	3.75	BR722	10/6
7D3	Power Pentode ..	40.0	0.2	180	135	– 20	38.0	7.5	100	40,000	2.5	5,000	440	2.75	BR722	10/6
				135	135	– 20	37.0	8.0	100	40,000	2.5	5,000	440	2.0		
7D5	Power Pentode ..	13.0	0.35	250	250	– 16.5	34.0	6.5	190	80,000	2.35	7,000	410	3.0	BR722	10/6
1D5	A.C./D.C. Rectifier ..	40.0	0.2	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 75 Milliamps.					BR51	9/–
R2	A.C. Rectifier ..	4.0	2.5	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 120 Milliamps.					BR43	9/–

INTERNATIONAL OCTAL TYPES

Type Number	Application	Heater		Anode Voltage Normal	Screen Voltage Normal	Grid Voltage Normal	Anode Current mA	Screen Current mA	Amplification Factor	Impedance Ohms	Mutual Conductance mA/V	Optimum Load Ohms	Auto Bias Resistor	Power Output in Watts	*Wireless World* Base Number	Price
		Volts	Amps													
0Z4	Full Wave Rectifier ..	—	—	Max. A.C. Volts per Anode 300 R.M.S.						D.C. Output 75 mA Max., 30 mA Min.					IO81	12/6
1A5EG	Battery Power Pent.	1.4	0.05	90	90	–4.5	4.0	0.8	255	300,000	0.85	25,000	—	0.115	IO823	9/–
1A7EG	Battery F.C.	1.4	0.05	90	45	0/–3	1.2	0.6	—	600,000	250*	—	—	—	IO832	10/6
1C5EG	Battery Power Pent.	1.4	0.10	90	90	–7.5	7.5	1.6	180	115,000	1.55	8,000	—	0.24	IO823	9/–
1H5G	Battery Diode Triode	1.4	0.05	90	—	0	0.14	—	65	240,000	0.275	—	—	—	IO812	7/6
1N5EG	Battery H.F. Pentode	1.4	0.05	90	90	0/–4	1.2	0.3	1,160	1.5 Meg.	0.75	—	—	—	IO820	9/–
1Q5G	Battery Power Pent.	1.4	0.1	90	90	– 4.5	9.5	1.6	—	—	2.1	8,000	—	0.27	IO840††	9/–
3Q5G	Battery Power Pent.	3.0	0.05	90	90	– 4.5	9.5	1.6	—	—	2.1	8,000	—	0.27	IO839	9/–
5U4G	A.C. Rectifier ..	5.0	3.0	Max. A.C. Voltage per Anode 500 R.M.S.						Max. Rectified Current 250 Milliamps					IO82	15/–
5V4G	A.C. Rectifier ..	5.0	2.0	Max. A.C. Voltage per Anode 400 R.M.S.						Max. Rectified Current 200 Milliamps.					IO84	9/–
5X4G	A.C. Rectifier ..	5.0	3.0	Max. A.C. Voltage per Anode 500 R.M.S.						Max. Rectified Current 250 Milliamps.					IO83	15/–
5Y3G	A.C. Rectifier ..	5.0	2.0	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 125 Milliamps.					IO82	9/–
5Y4G	A.C. Rectifier ..	5.0	2.0	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 125 Milliamps.					IO83	9/–
5Z4G	A.C. Rectifier ..	5.0	2.0	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 125 Milliamps.					IO84	9/–
6AG6G	Power Pentode ..	6.3	1.2	250	250	– 6	32.0	6.0	600	60,000	10.0	8,500	150	3.75	IO827	10/6
6A8G	Frequency Changer ..	6.3	0.3	250	100	–3/–40	3.5	2.2	—	360,000	550*	—	300	—	IO833	11/6
6A8EG	Frequency Changer ..	6.3	0.3	250	100	–3/–40	3.3	2.0	—	300,000	500*	—	300	—	IO833	11/6
6B4G	Power Triode ..	6.3	1.0	250	—	– 45	60.0	—	4.2	800	5.25	2,500	—	3.2	IO88	9/6
6B6G	Double Diode Triode..	6.3	0.3	250	—	– 2.0	0.4	—	100	90,000	1.10	—	5,000	—	IO813	9/6
6B8G	Double Diode Pentode	6.3	0.3	250	125	– 3	9.0	2.3	800	600,000	1.35	—	—	—	IO830	12/6
6B8EG	Double Diode Pentode	6.3	0.3	250	125	– 3	7.5	2.1	750	550,000	1.3	—	—	—	IO830	12/6
6B8SG	Dbl. Diode V-Mu Pen.	6.3	0.3	250	100	–3/–30	6.5	1.4	800	800,000	1.0	—	—	—	IO830	12/6
6C5G	Triode	6.3	0.3	250	—	– 8	8.0	—	20	10,000	2.0	—	1,000	—	IO89	7/6
6F5G	Triode	6.3	0.3	250	—	– 2	0.9	—	100	66,000	1.5	—	2,000	—	IO810	7/6
6F6G	Power Pentode ..	6.3	0.7	250	250	– 16.5	34.0	6.5	190	80,000	2.35	7,000	410	3.5	IO827	10/6
6F6EG	Power Pentode ..	6.3	0.7	250	250	– 16.5	32.0	6.2	180	80,000	2.25	7,000	410	3.5	IO827	10/6
6H6G	Double Diode.. ..	6.3	0.3	—	—	—	—	—	—	—	—	—	—	—	IO85	5/6
6J5G	Triode	6.3	0.3	250	—	– 8	9.0	—	20	7,700	2.6	—	—	—	IO89	7/6
6J7G	H.F. Pentode ..	6.3	0.3	250	125	– 3	2.0	0.5	1,900	1,500,000	1.25	—	600	—	IO825	10/6
6K5G	Triode	6.3	0.3	250	—	– 3	1.1	—	70	50,000	1.4	—	3,000	—	IO811	7/6
6K7G	Vari-Mu H.F. Pentode	6.3	0.3	250	125	– 3	10.5	2.6	1,000	600,000	1.65	—	200	—	IO824	10/6
6K7EG	Vari-Mu H.F. Pentode	6.3	0.3	250	100	– 3	10.5	2.6	1,000	700,000	1.40	—	300	—	IO824	10/6
6K8G	Triode Hexode F.C. ..	6.3	0.3	250	100	–3/–30	2.5	4.5	—	1,000,000	350*	—	300	—	IO837	11/6
6L6G	Power Pentode ..	6.3	0.9	250	250	– 14	72.0	5.0	135	22,500	6.0	2,500	170	6.5	IO840	15/–
6L7G	Frequency Changer ..	6.3	0.3	250	150	– 3	3.3	8.3	—	1,000,000	350*	—	260	—	IO834	10/6
6N6G	Double Output Triode	6.3	0.8	300	—	0	43.0	8.0	54	24,000	2.25	7,000	0	5.0	IO816	15/–
6N7G	Double Triode ..	6.3	0.8	300	—	0	—	—	35	—	—	10,000‡	0	10.0	IO814	15/–
6P8G	Triode Hexode F.C. ..	6.3	0.8	250	80	–1.5/–30	2.2	3.0	—	750,000	650*	—	300	—	IO836	11/6
6Q7G	Double Diode Triode..	6.3	0.3	250	—	– 2	1.1	—	70	58,000	1.2	—	4,000	—	IO813	9/6
6R7G	Double Diode Triode..	6.3	0.3	250	—	– 9.0	9.5	—	16	8,500	1.9	—	1,000	—	IO813	9/6
6U7G	Vari-Mu H.F. Pentode	6.3	0.3	250	100	–3/–40	8.2	2.0	1,280	800,000	1.6	—	300	—	IO824	10/6
6V6G	Power Pentode ..	6.3	0.45	250	250	– 12.5	45.0	4.5	218	52,000	4.1	5,000	240	4.25	IO840	10/6
6X5	Car Radio Rectifier ..	6.3	0.6	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 75 mA.					IO85	9/–
6ZY5G	A.C. Rectifier ..	6.3	0.3	Max. A.C. Voltage per Anode 350 R.M.S.						Max. Rectified Current 35 mA.					IO85	9/–
25A6G	Power Pentode ..	25.0	0.3	180	135	– 20	38.0	7.5	100	40,000	2.5	5,000	440	2.75	IO827	10/6
				135	135		37.0	8.0						2.00		
25L6G	Power Pentode ..	25.0	0.3	110	110	– 7.5	49.0	4.0	82	10,000	8.2	2,000	140	2.2	IO840	10/6
25Z6G	A.C./D.C. Rectifier ..	25.0	0.3	Max. A.C. Voltage 250 R.M.S.						Max. Rectified Current 85 Milliamps.					IO85	9/–

* Conversion Conductance in Micromhos. ‡ Anode to Anode Load. †† Without cathode.

BRIMAR (BVA) VALVES

LOCTAL TYPES

Type Number	Application	Heater		Anode Voltage Normal	Screen Voltage Normal	Grid Voltage Normal	Anode Current mA	Screen Current mA	Amplification Factor	Impedance Ohms	Mutual Conductance mA/V	Optimum Load Ohms	Auto Bias Resistor	Power Output in Watts	*Wireless World* Base Number	Price
		Volts	Amps													
1LA4E	Battery Power Pent.	1.4	0.05	90	90	– 4.5	4.0	0.8	255	300,000	0.85	25,000	—	0.115	LO85	9/-
1LA6E	Battery Freq. Changer	1.4	0.05	90	45	0/–3	1.2	0.6	—	600,000	250†	—	—	—	LO88	10/6
1LH4	Battery Diode Triode	1.4	0.05	90	—	0	0.14	—	65	240,000	0.275	—	—	—	LO82	7/6
1LN5E	Battery H.F. Pentode	1.4	0.05	90	90	0	1.6	0.35	880	1.1 Meg.	0.8	—	—	—	LO84	9/-
7A7E	Vari-Mu H.F. Pentode	6.3	0.3	250	100	-3/-35	8.6	2.0	1,600	0.8 Meg.	2.0	—	300	—	LO86	10/6
7A8E	Frequency Changer ..	6.3	0.15	250	100	-3/-35	3.0	2.8	—	0.7 Meg.	600†	—	300	—	LO810	11/6
7B5E	Power Pentode ..	6.3	0.4	250	250	–18	32.0	5.5	150	68,000	2.2	7,600	500	3.4	LO87	10/6
7B6	Double Diode Triode ..	6.3	0.3	250	—	– 2	1.0	—	100	91,000	1.1	—	2,000	—	LO83	9/6
7B7E	Vari-Mu H.F. Pentode	6.3	0.15	250	100	– 3	8.5	2.0	1,200	0.7 Meg.	1.7	—	300	—	LO86	10/6
7B8	Frequency Changer ..	6.3	0.3	250	100	– 3	3.5	2.7	—	0.36 Meg.	550†	—	300	—	LO89	11/6
7C5	Power Pentode ..	6.3	0.45	250	250	–12.5	45.0	4.5	218	52,000	4.1	5,000	240	4.25	LO811	10/6
7C6	Double Diode Triode ..	6.3	0.15	250	—	– 1	1.3	—	100	0.1 Meg.	1.0	—	—	—	LO83	9/6
7C7E	H.F. Pentode ..	6.3	0.3	250	100	– 3	2.0	0.5	1,850	1.5 Meg.	1.2	—	1,200	—	LO86	10/6
7Y4	A.C. Rectifier ..	6.3	0.5	Max. A.C. Voltage per Anode 350 R.M.S. Max. D.C. Output 60 mA.											LO81	9/-

ENGLISH REPLACEMENT TYPES

Pen B1	Battery Power Pent.	2.0	0.2	150	150	– 4.5	8.0	1.6	—	—	2.5	18,000	—	—	BR512	9/-
HLA2	A.C. G.P. Triode ..	4.0	1.0	200	—	– 2	8.0	—	50	9,000	5.5	—	400	—	BR54	12/6
PA1	A.C. High Slope Output Triode	4.0	1.0	200	—	– 9	50.0	—	12.6	1,050	12.0	4,000	260	—	BR54	12/6
15A2	A.C. Freq. Changer ..	4.0	0.65	250	100	-3/-40	3.5	2.2	—	360,000	550†	—	300	—	BR728	11/6
9A1¶	A.C. Vari-Mu H.F.Pent	4.0	1.0	200	80	-1.5/-30	5.0	1.0	2,500	600,000	4.25	—	200	—	BR516 BR714	10/6
8A1¶	A.C. H.F. Pentode ..	4.0	1.0	200	80	– 1.5	3.5	0.7	2,400	600,000	4.0	—	200	—	BR516 BR714	10/6
11A2	A.C.Dble. Diode Triode	4.0	1.0	200	—	– 2	3.0	—	50	18,000	2.8	—	—	—	BR77	9/6
7A2‖	A.C. Power Pentode ..	4.0	1.2	250	250	–17.5	32.0	6.5	—	—	3.2	8,000	330	3.5	BR514 BR722	10/6
Pen A1	A.C. Power Pentode ..	4.0	1.0	250	250	–16.5	32.0	6.5	—	—	3.0	8,000	450	2.7	BR512	10/6
R1	A.C. Rectifier ..	4.0	1.0	Max. A.C. Voltage per Anode 250 R.M.S. Max. D.C. Current 60 Milliamps.											BR43	9/-
R3	A.C. Rectifier ..	4.0	2.5	Max. A.C. Voltage per Anode 500 R.M.S. Max. Rectified Current 120 Milliamps.											BR43	9/-
4215A	Battery G.P. Triode ..	1.0	0.25	45	—	– 3	0.8	—	6	25,000	0.4	—	—	—	—	10/-
8D2	A.C./D.C. H.F. Pent.	13.0	0.2	250	100	– 3	2.6	0.5	1,500	1.1 Meg.	1.35	—	1,000	—	BR721	10/6

† Conversion Conductance in Micromhos. ¶ Available with 5 or 7 pin base. ‖ Available with 5 pin and side terminal or 7 pin base.

BRIMAR (BVA) VALVES

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EFFICIENT • CONSISTENT • RELIABLE

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Note: The Valves with heaters rated at 6.3 volts may in most cases be used for either A.C. or A.C./D.C. operation, particularly in the case of the "O.M." series. The 16 volt .25 amp. valves are primarily designed for D.C. mains working.

FREQUENCY CHANGERS

BATTERY TYPES.

Type	Description	Base	Bulb	Nominal Rating					Typical Operating Conditions					*Wireless World* Base Number	Price
				Fil. or Heater Volts	Fil. or Heater Amps	Max. Anode Volts	Max. Screen Volts	Max. Osc. Anode Volts	Anode Volts	Screen Volts	Grid Bias Volts	‡Total Space Current mA.	Conversion Conductance mA/V.		
1A7G	Pentagrid	Octal	Clear	1.4	.05	90	90	90	90	45	0	2.3	.25	IO832	10/6
1A7VG	Var-mu Pentagrid	Octal	Met.	1.4	.05	90	90	90	90	45	0	2.3	.2	IO832	10/6
210 D.G.†	Bigrid	5-pin	Clear	2	.1	150	—	—	100	—	0	2.75	.19*	BR57	20/-
1A6E	Pentagrid	6-pin UX	Clear	2	.06	150	67.5	150	135	67.5	3	6.0	.275	UX610	10/6
210 P.G.	Pentagrid	7-pin	Met.	2	.1	150	80	150	120	40	0	1.9	.45	BR727	10/6
210 S.P.G.	Screened Pentagrid	7-pin	Met.	2	.1	150	80	150	120	40	0	1.9	.45	BR727	10/6
210 P.G.A.	Pentagrid	7-pin	Met.	2	.1	150	80	150	120	40	0	1.9	.45	BR727	10/6
1C6E	Pentagrid	6-pin UX	Clear	2	.12	150	67.5	150	135	67.5	3	4.1	.3	UX610	10/6
220 T.H.	Triode Hep.	7-pin	Met.	2	.2	150	150	100	120	4.5	0	2.6	.2	BR735	10/6
MAINS TYPES															
41 M.D.G.†	Bigrid	5-pin	Clear/Met.	4	1.0	200	—	—	150	—	0	3.7	.25*	BR58	19/-
41 M.P.G.	Pentagrid	7-pin	Met.	4	1.0	250	100	100	200	100	1.5	10.0	1.3	BR728	11/6
41 S.T.H.	Triode Hex.	7-pin	Met.	4	1.0	250	100	100	200	60	1.5	9.0	.6	BR733	11/6
4 T.H.A.	Triode Hex.	7-pin	Clear/Met.	4	1.5	250	100	100	250	100	2	11.0	.85	BR733	11/6
OM8	Octode	Octal	Met.	6.3	.2	250	50	200	250	50	2	4.0	.55	IO833	11/6
OM10	Triode Hex.	Octal	Met.	6.3	.2	250	100	250	250	100	2	8.5	.7	IO836	11/6
6A7E	Pentagrid	7-pin UX	Clear	6.3	.3	250	100	200	250	100	3	11.7	.52	UX73	11/6
6A8EG	Pentagrid	Octal	Clear	6.3	.3	250	100	200	250	100	3	10.5	.5	IO833	11/6
6F7B	Triode Pen.	7-pin UX	Clear	6.3	.3	250	100	100	250	100	3	3.4	.3	UX75	11/6
13 P.G.A.	Pentagrid	7-pin	Clear	13	.2	250	100	200	250	100	3	11.7	.52	BR728	11/6
202 M.P.G.	Pentagrid	7-pin	Met.	20	.2	250	100	100	200	100	1.5	10.0	1.3	BR728	11/6
202 S.T.H.	Triode Hex.	7-pin	Met.	20	.2	250	100	100	200	60	1.5	9.0	.6	BR733	11/6
302 T.H.A.	Triode Hex.	7-pin	Met.	30	.2	250	100	100	250	100	2	11.0	.85	BR733	11/6

† May be used as Triode detector. ‡ At Max. Osc. Anode Volts. * Mutual Conductance.

SCREEN-GRID VALVES

BATTERY TYPES

Type	V.M. = Var-mu	Base	Bulb	Nominal Rating				Typical Operating Conditions							*Wireless World* Base Number	Price
				Fil. or Heater Volts	Fil. or Heater Amps	Max. Anode Volts	Max. Screen Volts	Anode Volts	Screen Volts	Grid Bias Volts	Anode Current mA.	Mutual Cond. mA/V.	Impedance Ohms	Amplification Factor		
32E	—	4-pin UX	Clear	2	.06	150	67.5	135	67.5	3	1.7	.64	950,000	610	UX45	9/-
215 S.G.	—	4-pin	Clear/Met.	2	.15	150	80	120	60	1	1.25	1.1	300,000	330	BR48	9/-
220 S.G.	—	4-pin	Clear/Met.	2	.2	150	80	120	60	1	1.4	1.6	200,000	320	BR48	9/-
220 V.S.G.	V.M.	4-pin	Clear/Met.	2	.2	150	80	120	60	2.5	2.25	1.6	110,000	—	BR48	9/-
220 V.S.	V.M.	4-pin	Clear/Met.	2	.2	150	80	120	60	2.5	1.0	1.6	400,000	—	BR48	9/-
MAINS TYPES																
24E	—	5-pin UX	Clear	2.5	1.75	250	90	180	90	3	4.0	1.0	400,000	400	UX53	10/6
M.S.G./H.A.	—	5-pin	Clear/Met.	4	1.0	200	100	150	80	1.5	2.1	2.0	500,000	1,000	BR510	12/6
41 M.S.G.	—	5-pin	Clear/Met.	4	1.0	200	80	130	60	1.5	0.8	2.5	400,000	1,000	BR510	17/6
M.S.G./L.A.	—	5-pin	Clear/Met.	4	1.0	200	100	150	80	1.5	5.2	3.75	200,000	750	BR510	12/6
M.V.S.G.	V.M.	5-pin	Clear/Met.	4	1.0	200	100	200	80	1.5	7.8	2.5	200,000	—	BR510	10/6
36E	—	5-pin UX	Clear	6.3	.3	250	90	180	90	3	3.1	1.05	500,000	525	UX53	10/6
D.V.S.G.	V.M.	5-pin	Met.	16	.25	200	100	200	80	1.5	7.5	2.5	—	—	BR510	17/6

COSSOR VALVES

BATTERY TYPES

H.F. PENTODES

Type	V.M. = Var-mu	Base	Bulb	Nominal Rating				Typical Operating Conditions						*Wireless World* Base Number	Price
				Fil. or Heater		Max. Anode Volts	Max. Screen Volts	Anode Volts	Screen Volts	Grid Bias Volts	Anode Current mA.	Mutual Cond. mA/V.	Impedance Ohms		
				Volts	Amps										
1N5G	—	Octal	Clear	1.4	.05	90	90	90	90	0	1.2	.75	1,500,000	IO**8**21	9/–
1N5VG	V.M.	Octal	Met.	1.4	.05	90	90	90	90	0	1.6	.65	1,000,000	IO**8**21	9/–
1A4E	V.M.	4-pin UX	Clear	2	.06	150	67.5	150	67.5	3	2.3	.75	1,000,000	UX**4**5	9/–
34E	V.M.	4-pin UX	Clear	2	.06	150	67.5	135	67.5	3	2.8	.6	600,000	UX**4**5	9/–
210 V.P.T.	V.M.	4-pin 7-pin	Met. Clear/Met.	2	.1	150	80	150	60	1.5	2.9	1.1	600,000	BR**4**9 BR**7**12	9/–
210 V.P.A.	V.M.	7-pin	Met.	2	.1	150	150	120	90	3	2.2	1.1	600,000	BR**7**12	9/–
210 S.P.T.	—	4-pin 7-pin	Met. Clear/Met.	2	.1	150	80	150	60	1.5	1.2	1.3	600,000	BR**4**9 BR**7**12	9/–
220 I.P.T.*†	—	7-pin	Met.	2	.2	150	80	150	60	1.5	2.5	1.0	—	BR**7**18	9/–
15*	—	5-pin UX	Clear	2	.22	135	67.5	135	67.5	1.5	1.85	.75	800,000	UX**5**5	9/–
MAINS TYPES															
M.S./PEN	—	5-pin 7-pin	Clear/Met. Clear/Met.	4	1.0	200	100	200	100	1.5	5.0	2.8	800,000	BR**5**16 BR**7**14	10/6
M.V.S./PEN	V.M.	5- or 7-pin	Met.	4	1.0	200	100	200	100	1.5	4.3	2.2	600,000	BR**5**16/**7**14	10/6
M.S./PEN-B	—	7-pin	Clear/Met.	4	1.0	200	100	200	100	1.5	5.0	2.8	800,000	BR**7**15	10/6
M.V.S./PEN-B	V.M.	7-pin	Met.	4	1.0	200	100	200	100	1.5	4.3	2.2	600,000	BR**7**15	10/6
OM5	—	Octal	Met.	6.3	.2	250	100	250	100	2	3.0	1.8	2,500,000	IO**8**24	10/6
OM6	V.M.	Octal	Met.	6.3	.2	250	100	250	100	2.5	6.0	2.2	1,200,000	IO**8**24	10/6
6J7G	—	Octal	Clear	6.3	.3	250	100	250	100	3	2.0	1.225	1,500,000	IO**8**24	10/6
78E	V.M.	6-pin UX	Clear	6.3	.3	250	125	180	75	3	4.0	1.1	1,000,000	UX**6**7	10/6
39/44E	V.M.	5-pin UX	Clear	6.3	.3	250	90	180	90	3	5.8	1.0	750,000	UX**5**5	10/6
6K7G	V.M.	Octal	Clear	6.3	.3	250	125	180	75	3	4.0	1.1	1,000,000	IO**8**24	10/6
77E	—	6-pin UX	Clear	6.3	.3	250	100	250	100	3	2.3	1.25	1,500,000	UX**6**7	10/6
13 V.P.A.	V.M.	7-pin	Clear/Met.	13	.2	200	100	200	100	3	7.0	1.8	800,000	BR**7**15	10/6
13 S.P.A.	—	7-pin	Clear/Met.	13	.2	200	100	200	100	3	2.3	1.25	1,000,000	BR**7**15	10/6
D.S./PEN	—	5-pin	Clear/Met.	16	.25	200	100	200	100	1.5	4.7	2.3	—	BR**5**16	17/6
D.V.S./PEN	V.M.	5-pin	Met.	16	.25	200	100	200	100	1.5	5.5	2.0	—	BR**5**16	17/6
202 V.P.	V.M.	7-pin	Met.	20	.2	250	100	250	100	1.5	4.3	2.2	600,000	BR**7**14	10/6
202 V.P.B.	V.M.	7-pin	Met.	20	.2	250	100	250	100	1.5	4.3	2.2	600,000	BR**7**15	10/6
202 S.P.B.	—	7-pin	Met.	20	.2	250	100	250	100	1.5	4.8	2.8	800,000	BR**7**15	10/6

* Indirectly heated. † Detector Pentode.

BATTERY TYPES.

DIODES, DIODE TRIODES AND DIODE PENTODES

Type§	Base	Bulb	Nominal Rating				Typical Operating Conditions						*Wireless World* Base Number	Price
			Fil. or Heater		Max. Anode Volts	Max. Screen Volts	Anode Volts	Grid Bias Volts	Anode Current mA.	Mutual Cond. mA/V.	Impedance Ohms	Amplification Factor		
			Volts	Amps										
1H5G DT	Octal	Clear	1.4	.05	90	—	90	0	0.15	0.275	240,000	65	IO**8**12	7/6
210 D.D.T. DDT	5-pin	Met.	2	.1	150	—	100	0	2.3	1.1	25,000	27.5	BR**5**9	7/6
2102 DDT	6-pin UX	Clear	2	.12	150	—	100	0	2.5	1.3	23,000	30	UX**6**3	7/6
220 D.D.* DD	5-pin	Clear	2	.2	—	—	—	—	—	—	—	—	BR**5**2	5/6
MAINS TYPES														
D.D.4 DD	5-pin	Clear	4	.75	—	—	—	—	—	—	—	—	BR**5**2	5/6
D.D.T. DDT	7-pin	Met.	4	1.0	200	—	200	3	3.4	2.4	17,000	41	BR**7**7	9/6
D.D./PEN DDP	7-pin	Met.	4	1.0	250	200	200	2.5	‡5.0	2.7	—	—	BR**7**26	20/–
6B8EG DDP	Octal	Clear	6.3	.3	250	125	250	3	‡10.0	1.325	600,000	800	IO**8**30	12/6
OM3† DD	Octal	Met.	6.3	.2	—	—	—	—	—	—	—	—	IO**8**7	5/6
OM4 DDT	Octal	Met.	6.3	.2	250	—	200	4.5	4.0	2.0	15,000	30	IO**8**13	9/6
6B7E DDP	7-pin UX	Clear	6.3	.3	250	125	250	3	‡9.0	1.125	650,000	730	UX**7**1	12/6
6H6G† DD	Octal	Clear	6.3	.3	—	—	—	—	—	—	—	—	IO**8**7	5/6
6R7G DDT	Octal	Clear	6.3	.3	250	—	250	9	9.5	1.9	8,500	16	IO**8**13	9/6
6Q7G DDT	Octal	Clear	6.3	.3	250	—	250	3	1.1	1.2	58,000	70	IO**8**13	9/6
75 DDT	6-pin UX	Clear	6.3	.3	250	—	250	2	0.8	1.1	91,000	100	UX**6**4	9/6
85 DDT	6-pin UX	Clear	6.3	.3	250	—	250	20	8.0	1.1	7,500	8.3	UX**6**4	9/6
13D.H.A. DDT	7-pin	Clear	13	.2	250	—	250	1.5	1.0	1.5	83,300	125	BR**7**7	9/6
D.D.T.16 DDT	7-pin	Met.	16	.25	200	—	200	3	5.0	2.5	16,000	40	BR**7**7	15/6
202 D.D.T. DDT	7-pin	Met.	20	.2	200	—	200	3	3.5	2.4	17,000	41	BR**7**7	9/6

§ DT = Diode Triode; DDT = Double Diode Triode; DD = Double Diode; DDP = Double Diode Pentode. * Indirectly heated.
† Separate Cathodes. ‡ At Screen volts 100.

COSSOR VALVES

BATTERY TYPES

TRIODES

Type	Base	Bulb	Nominal Rating						Typical Operating Conditions			Wireless World Base Number	Price
			Fil. or Heater		Max. Anode Volts	Im-pedance Ohms	Mutual Cond. mA/V.	Ampli-fication Factor	Anode Volts	Grid Bias Volts	Anode Current mA.		
			Volts	Amps.									
30	4-pin UX	Clear	2	.06	150	7,500	1.25	9.4	135	9	3.0	UX44	6/-
210 R.C.	4-pin	Clear	2	.1	150	50,000	.8	40	125	1.5	0.45	BR47	4/9
210 H.L.	4-pin	Clear/Met.	2	.1	150	22,000	1.1	24	125	1.5	2.0	BR47	4/9
210 H.F.	4-pin	Clear/Met.	2	.1	150	15,800	1.5	24	125	1.5	2.25	BR47	4/9
210 DET.	4-pin	Clear/Met.	2	.1	150	13,000	1.15	15	125	1.5	4.5	BR47	4/9
210 L.F.	4-pin	Clear/Met.	2	.1	150	10,000	1.4	14	125	3	4.5	BR47	4/9
MAINS TYPES													
27†	5-pin UX	Clear	2.5	1.75	250	9,250	.975	9	180	13.5	5.0	UX52	7/6
41 M.R.C.	5-pin	Clear	4	1.0	200	19,500	2.6	50	150	1	2.5	BR54	14/-
41 M.H.	5-pin	Clear/Met.	4	1.0	200	18,000	4.0	72	150	1.5	1.5	BR54	7/6
41 M.H.F.	5-pin	Clear	4	1.0	200	14,500	2.8	41	150	2	2.5	BR54	14/-
41 M.H.L.	5-pin	Clear/Met.	4	1.0	200	11,500	4.5	52	200	3	4.0	BR54	7/6
41 M.L.F.	5-pin	Clear	4	1.0	180	7,900	1.9	15	160	4.5	7.5	BR54	14/-
76†	5-pin UX	Clear	6.3	.3	250	9,500	1.45	13.8	250	13.5	5.0	UX52	7/6
37†	5-pin UX	Clear	6.3	.3	250	8,400	1.1	9.2	250	18	7.5	UX52	7/6
6K5G	Octal	Clear	6.3	.3	250	42,000	1.65	70	100	1.5	0.35	IO811	7/6
D.H.L.	5-pin	Met.	16	.25	200	13,000	4.5	58	150	1.5	3.8	BR54	13/6

† General Purpose types.

AT YOUR SERVICE

If you should experience any difficulty or doubt in selecting the correct Cossor valves for your set—write to A. C. Cossor, Ltd., Technical Service Dept., Highbury Grove, London, N.5. They will gladly advise you as to the correct types which should be used

BATTERY TYPES

OUTPUT PENTODES AND TETRODES

Type§		Base	Nominal Rating					Typical Operating Conditions					Wireless World Base Number	Price
			Fil. or Heater		Max. Anode Volts	Max. Screen Volts	Mutual Cond. mA/V.	Anode Volts	Screen Volts	Grid Bias Volts	Anode Current mA.	Optimum Load Ohms		
			Volts	Amps.										
1C5G	P	Octal	1.4	.1	90	90	1.55	90	90	7.5	7.5	8,000	IO822	9/-
2101	P	5-pin UX	2	.12	150	150	1.8	150	150	6	8.5	15,000	UX54	9/-
220 P.T.	P	4/5-pin	2	.2	150	150	2.5	120	120	7.5	13.5	8,000	BR410/512	13/6
220 H.P.T.	P	4/5-pin	2	.2	150	150	2.5	120	120	3	6.5	20,000	BR410/512	9/-
220 O.T.	T	5-pin	2	.2	150	150	2.5	120	120	4.5	4.3	20,000	BR511	9/-
230 P.T.	P	4/5-pin	2	.3	150	150	2.0	150	150	15	14.0	10,000	BR410/512	16/6
MAINS TYPES														
47E*	P	5-pin UX	2.5	1.75	250	250	2.5	250	250	16.5	31.0	7,000	UX54	10/6
P.T.41*	P	5-pin	4	1.0	250	200	3.0	250	200	12.5	30.0	8,000	BR512	10/6
P.T.41 B*	P	5-pin	4	1.0	400	300	2.25	400	250	33	26.0	8,000	BR512	22/6
M.P./PEN.	P	5/7-pin	4	1.0	250	250	3.5	250	250	16	30.0	10,000	BR514/719	13/6
42 M.P./PEN.	P	7-pin	4	2.0	250	250	7.0	250	250	5.5	32.0	8,000	BR719	10/6
P.T.10	P	7-pin	4	2.0	250	250	9.0	250	250	7.5	40.0	5,000	BR719	10/6
42 O.T.	T	7-pin	4	2.0	250	250	7.0	250	250	5.5	34.0	6,500	BR78	10/6
42 O.T.D.D.†	T	7-pin	4	2.0	250	250	7.0	250	250	5.5	34.0	6,500	BR710	12/6
OM9	P	Octal	6.3	.2	250	250	2.8	250	250	18	32.0	8,000	IO828	10/6
38E	P	5-pin UX	6.3	.3	250	250	1.2	250	250	25	22.0	10,000	UX55	10/6
6K6G	P	Octal	6.3	.4	250	250	2.2	250	250	18	32.0	7,600	IO826	10/6
41E	P	6-pin UX	6.3	.4	250	250	2.2	180	180	13.5	18.5	9,000	UX68	10/6
42E	P	6-pin UX	6.3	.7	250	250	2.35	250	250	16.5	34.0	7,000	UX68	10/6
6F6EG	P	Octal	6.3	.7	250	250	2.5	250	250	16.5	34.0	7,000	IO826	10/6
2151	P	6-pin UX	14	.3	250	250	2.3	250	250	30	48.0	4,000	UX68	12/-
18E	P	6-pin UX	14	.3	250	250	2.5	250	250	16	35.0	7,000	UX68	10/6
D.P./PEN.	P	7-pin	16	.25	250	250	3.5	200	200	10	31.0	10,000	BR719	18/6
43E	P	6-pin UX	25	.3	180	135	2.5	180	135	20	38.0	5,000	UX68	10/6
40 P.P.A.	P	7-pin	40	.2	150	150	4.0	150	150	25	36.0	4,000	BR719	10/6
402 PEN.	P	7-pin	40	.2	250	250	7.0	200	200	6.7	40.0	5,500	BR720	10/6
402 PEN/A.	P	7-pin	40	.2	150	150	8.0	150	150	9	56.0	2,500	BR720	10/6
402 O.T.	T	7-pin	40	.2	250	250	7.0	200	200	6.6	40.0	5,500	BR79	10/6

§ P = Pentode; T = Tetrode. * Directly heated. † Double-diode Tetrode.

COSSOR VALVES

OUTPUT TRIODES

BATTERY TYPES

Type	Base	Nominal Rating						Typical Operating Conditions				Wireless World Base Number	Price
		Fil. or Heater		Max. Anode Volts	Mutual Cond. mA/V.	Impedance Ohms	Amplification Factor	Anode Volts	Grid Bias Volts	Anode Current mA.	Optimum Load Ohms		
		Volts	Amps.										
215 P.	4-pin	2	.15	150	2.25	4,000	9	150	7.5	10.0	9,000	BR47	6/-
220 P.	4-pin	2	.2	150	2.25	4,000	9	150	7.5	11.0	9,000	BR47	6/-
220 P.A.	4-pin	2	.2	150	4.0	4,000	16	150	4.5	10.0	9,000	BR47	6/-
230 X.P.	4-pin	2	.3	150	3.0	1,500	4.5	150	18	22.0	3,500	BR47	10/-

MAINS TYPES

Type	Base	Fil. or Heater Volts	Fil. or Heater Amps.	Max. Anode Volts	Mutual Cond. mA/V.	Impedance Ohms	Amplification Factor	Anode Volts	Grid Bias Volts	Anode Current mA.	Optimum Load Ohms	Wireless World Base Number	Price
2 P.*	4-pin	2	2.0	250	7.0	1,150	8	250	22	40.0	3,000	BR47	9/6
2 X.P.*	4-pin	2	2.0	300	7.0	900	6.3	300	36	50.0	4,000	BR47	9/6
45*	4-pin UX	2.5	1.5	275	2.05	1,700	3.5	250	50	34.0	3,900	UX44	9/6
41 M.P.	5-pin	4	1.0	200	7.5	2,500	18.7	200	7.5	24.0	3,000	BR54	7/6
41 M.X.P.	5-pin	4	1.0	200	7.5	1,500	11.2	200	12.5	40.0	2,000	BR54	9/6
4 X.P.*	4-pin	4	1.0	250	7.0	900	6.3	250	28.5	48.0	3,000	BR47	9/6
6J5G	Octal	6.3	.3	250	2.6	7,700	20	250	8	9.0	7,000	IO89	7/6
6B4G*	Octal	6.3	1.0	250	5.25	800	4.2	250	45	60.0	2,500	IO88	9/6
6A3*	4-pin UX	6.3	1.0	250	5.25	800	4.2	250	45	60.0	2,500	UX44	9/6
D.P.	5-pin	16	.25	200	6.0	2,800	17	200	7.5	25.0	3,500	BR54	14/-
402 P.	7-pin	40	.2	200	7.5	1,330	10	150	9.5	30.0	2,500	BR75	9/6

* Directly heated.

QUIESCENT OUTPUT TRIODES AND PENTODES

Type	Description	Base	Nominal Rating			Typical Operating Conditions					Wireless World Base Number	Price
			Fil. or Heater		Mutual Cond. mA/V.	Anode Volts	Screen Volts	Grid Bias Volts	†Anode Current mA.	Optimum Load Ohms		
			Volts	Amps.								
220 B	Battery Class B Double Triode	7-pin	2	.2	—	120	—	0	2.5	12,000	BR76	9/6
19	Battery Class B Double Triode	6-pin UX	2	.26	—	135	—	0	5.0	10,000	UX62	9/6
240 B	Battery Class B Double Triode	7-pin	2	.4	—	120	—	0	4.0	8,000	BR76	9/6
2103	Battery Q.P.P. Double Pentode	7-pin UX	2	.26	1.6	150	150	10.5	4.0	35,000	UX72	12/6
240 Q.P.	Battery Q.P.P. Double Pentode	7-pin	2	.4	2.5	120	120	9	3.5	24,000	BR723	12/6
79	Mains Class B Double Triode	6-pin UX	6.3	.6	—	250	—	0	10.6	14,000	UX65	15/-
6N7G	Mains Class B Double Triode	Octal	6.3	.8	—	300	—	0	35.0	10,000	IO814	15/-

† Total Quiescent current.

RECTIFIERS

Type	Description	Base	Heater or Filament		Max. Volts per Anode	Max. Rectified Current mA.	Wireless World Base Number	Price
			Volts	Amps.				
225 D.U.	Voltage Doubler ..	7-pin	†2	†.5	750	20	BR73	20/-
506 B.U.	Full Wave ..	4-pin	4	1.0	250	60	BR42	9/-
442 B.U.	Full Wave ..	4-pin	4	2.5	350	120	BR42	9/-
460 B.U.	Full Wave ..	4-pin	4	2.5	500	120	BR42	9/-
43 I.U.*	Full Wave ..	4-pin	4	2.5	350	120	BR43	9/-
44 I.U.*	Full Wave ..	4-pin	4	2.5	500	120	BR43	9/-
80*	Full Wave ..	4-pin UX	5	2.0	350	120	UX42	9/-
5Y4G	Full Wave ..	Octal	5	2.0	350	120	IO83	9/-
5X4G	Full Wave ..	Octal	5	3.0	500	250	IO83	15/-
5Z3	Full Wave ..	4-pin UX	5	3.0	500	250	UX41	15/-
6ZY5G*	Full Wave ..	Octal	6.3	.3	350	35	IO85	9/-
84*	Full Wave ..	5-pin UX	6.3	.5	350	60	UX51	9/-
25RE*	Multiple	6-pin UX	25	.3	250	80	UX61	9/-
25Z5*	Multiple	6-pin UX	25	.3	250	80	UX61	9/-
35RE*	Multiple	6-pin UX	35	.3	250	120	UX61	9/-
40 S.U.A.*	Half Wave ..	5-pin	40	.2	250	75	BR51	9/-

EB /TSD

* Indirectly heated. † Each filament.

Telephone:
Canonbury 1234 (30 lines)

Prices are subject to alteration without notice.

Telegrams:
Amplifiers, 'Phone, London

A. C. COSSOR LTD., COSSOR HOUSE, HIGHBURY GROVE, LONDON, N.5.

MAZDA RADIO VALVES

BATTERY TYPES.

H.F. SCREENED PENTODES

Type	Rating					Typical Operating Conditions						*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conduct-ance	Anode Volts	Screen Volts	Grid Bias	Anode Current (mA.)	Mutual Conduct-ance	Anode A.C. Resist. (megs)		
SP 141	1.4	0.05	90	90	0.9	82	82	0	1.8	0.8	0.6	MO820	9/-
SP 210	2	0.1	150	150	1.7	120	120	1.0	1.1	1.2	2.0	BR712	9/-
VP 210	2	0.1	150	150	1.4	120	60	1.5	1.2	0.8	1.3	BR712	9/-
SP 22	2	0.1	150	150	1.7	120	120	1.0	1.1	1.2	1.35	MO812	9/-
VP 22	2	0.1	150	150	1.4	120	60	1.5	1.2	0.8	1.3	MO812	9/-
VP 23	2	0.05	150	150	1.3	120	60	1.5	1.45	1.08	1.45	MO812	9/-
A.C. MAINS TYPES.													
AC/SP1	4	1.0	250	250	2.7	200	200	3.0	4.9	2.65	—	BR714	10/6
AC/SP3	4	1.0	250	250	7.5	250	100	1.7	7.9	7.0	0.55	BR715	15/-
AC/VP1	4	0.65	250	250	3.0	250	200	2.8	7.5	2.0	1.0	BR714	10/6
AC/VP2	4	0.65	250	250	3.0	250	200	2.8	7.5	2.0	1.0	BR715	10/6
VP 41	4	0.65	250	250	3.0	250	200	2.7	7.7	2.0	1.3	MO813	10/6
SP 41	4	0.95	250	250	8.5	200	200	1.5	10.9	8.5	0.7	MO813	10/6
SP 42	4	0.95	200	200	9.0	200	115	1.25	20.0	—	—	MO813	10/6
A.C./D.C. TYPES.													
VP 1321	13	0.2	250	250	3.0	200	200	2.8	7.4	2.0	1.0	BR714	10/6
VP 1322	13	0.2	250	250	3.0	200	200	2.8	7.4	2.0	1.0	BR715	10/6
VP 133	13	0.2	200	200	3.1	150	150	2.7	8.0	2.1	0.7	MO313	10/6

BATTERY TYPES.

FREQUENCY CHANGERS

Type	Rating						Typical Operating Conditions						*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conduct-ance	Ampli-fication Factor	Anode Volts	Screen Volts	Grid Bias	Anode Current	Conversion Conduct'ce (mA/V)	Anode A.C. Resis. (Megs)		
FC 141	1.4	0.05	90	90	Osc.0.55 Tet. 0.6	— —	75 82	— 45	— 0	1.2 0.55	0.25	0.6	MO821	10/6
TP 22	2	0.25	150	150	T. 1.4 P. 1.3	34 —	100 120	— 60	— 1.5	0.8 1.2	0.45	0.035 1.6	BR92	10/6
TP 23	2	0.25	150	150	T. 2.1 P. 1.2	20 —	80 120	— 60	— 1.5	2.5 0.55	0.25	0.012 1.6	BR732	10/6
TP 25	2	0.2	150	150	T. 1.7 P. 1.06	18 —	80 120	— 60	— 1.5	2.5 0.53	0.26	0.013 1.3	MO816	10/6
TP 26	2	0.2	150	150	T. 1.3 P. 1.55	28 —	65 103	— 65	— 2.0	0.9 1.2	0.55	0.03 1.4	MO816	10/6
A.C. MAINS TYPES.														
AC/TP	4	1.25	250	250	T. 1.4 P. 3.4	30 —	150 250	— 200	— 5.0	1.5 6.5	0.7	0.025 0.9	BR93	11/6
AC/TH1	4	1.3	250	250	T. 5.3 H.3.1	16 —	80 250	— 100	— 3.0	4.5 3.0	0.75	0.007 1.6	BR736	11/6
TH 41	4	1.3	250	250	T. 5.3 H.3.1	16 —	80 250	— 100	— 3.0	4.5 3.0	0.75	0.007 1.6	MO817	11/6
A.C./D.C. TYPES.														
TP 2620	26	0.2	250	250	T. 1.4 P. 3.4	30 —	150 200	— 200	— 5.0	1.5 6.5	0.65	0.025 0.7	BR93	11/6
TH 2320	23	0.2	250	250	T. 5.3 H.3.0	16 —	100 250	— 100	— 3.0	4.0 3.0	0.75	0.007 1.2	BR736	11/6
TH 2321	23	0.2	250	250	T. 5.3 H.3.0	16 —	100 175	— 100	— 3.0	4.0 3.0	0.65	0.007 1.0	BR736	11/6
TH 233	23	0.2	250	250	T. 5.3 H.3.0	16 —	100 175	— 100	— 3.0	4.0 2.6	0.65	0.007 1.3	MO817	11/6

TUNING INDICATORS

Type	Rating				Typical Operating Conditions				For Use on :	*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Target Volts	Anode Volts	Anode Current	Target Current	Bias for Zero Angle			
ME41	4	0.5	250	250	250	0.25	1.2	22.5	A.C. Mains	MO818	8/6
ME920	9	0.2	200	200	175	0.16	2.7	19.0	AC/DC Mains	BR737	8/6
ME91	9	0.2	200	200	175	0.16	2.7	19.0	AC/DC Mains	MO818	8/6

MAZDA VALVE DATA—*continued*

DIODES

Type	Fil. Volts	Fil. Current	Specification	*Wireless World* Base Number	Price
V914	4	0.3	A.C. Mains Double Diode	BR52	9/-
DD41	4	0.5	A.C. Mains Double Diode (separate Cathodes)	MO84	9/-
DD620	6	0.2	AC/DC Double Diode	BR52	9/-
DD207	2	0.075	Battery Double Diode	BR42	9/-

DIODE TRIODE

Type	Rating						Typical Operating Conditions				*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Mutual Conduct-ance	Amp. Factor	Anode A.C. Resist. (ohms)	H.T. Volts	Grid Bias	Anode Current	Load Resis-tance		
H.141D	1.4	0.05	90	0.48	65	135,000	82	0	0.065	500,000	MO819	7/6
BATTERY TYPES				**DOUBLE-DIODE TRIODES**								
HL21/DD	2	0.15	150	1.5	32	21,000	120	1.5	0.5	50,000	BR59	7/6
L21/DD	2	0.1	150	1.9	19	10,000	120	3.0	0.8	50,000	BR59	7/6
L22DD	2	0.1	150	1.9	19	10.000	120	3.0	0.8	50,000	MO88	7/6
HL23DD	2	0.05	150	1.2	25	21,000	120	1.5	0.6	50,000	MO88	7/6
A.C. MAINS TYPES												
AC/HL.DD	4	1.0	250	2.6	36	13,800	250	2.7	2.0	50,000	BR77	9/6
HL41DD	4	0.65	250	2.5	30	12,000	250	3.1	2.2	50,000	MO89	9/6
HL42DD	4	0.65	250	2.9	23	8,000	200	1.25	2.8	50,000	MO89	9/6
A.C./D.C. TYPES												
HL/DD1320	13	0.2	250	2.0	30	15,000	250	2.7	2.0	50,000	BR77	9/6
HL133DD	13	0.2	250	2.5	32	12,800	150	2.2	1.25	50,000	MO89	9/6

BATTERY TYPES.

TRIODES

Type	Rating						Typical Operating Conditions				*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Mutual Conduct-ance	Ampli-fication Factor	Impedance	H.T. Volts	Grid Bias	Anode Current	Load Resistance		
HL2	2	0.1	150	1.5	32	21,000	120	1.5	0.4	75,000	BR47	4/9
L2	2	0.1	150	1.9	19	10,000	120	1.5	1.0	50,000	BR47	4/9
HL22	2	0.1	150	1.5	32	21,000	120	1.5	0.4	75,000	MO85	4/9
HL23	2	0.05	150	1.5	32	21,000	120	1.5	0.5	50,000	MO85	4/9
A.C. MAINS TYPES.												
AC/HL	4	1.0	200	3.0	35	11,700	250	3.4	2.0	50,000	BR54	7/6
AC/2HL	4	1.0	200	6.5	75	11,500	250	1.2	2.5	50,000	BR54	7/6
HL41	4	0.65	250	3.5	36	10,300	250	3.1	2.2	50,000	MO86	7/6
AC/P	4	1.0	200	3.75	10	2,650	200	15.0	5.0	8,000	BR54	7/6
AC/P1	4	1.0	200	3.7	5.4	1,450	200	27.5	25.0	10,000	BR54	9/6
AC/P4	4	1.0	700	7.0	20	2,860		Special Triode			BR56	17/6
P41	4	0.95	250	8.0	17	2,120		Special Triode			MO86	9/6
V312	4	0.65	200	2.5	30	12,000		Special Triode			BR55	25/-
A.C./D.C. TYPES.												
HL1320	13	0.2	250	3.0	30	10,000	200	2.0	1.8	50,000	BR75	7/6
HL133	13	0.2	250	3.4	36	10,600	165	1.9	1.5	50,000	MO87	7/6

A.C. MAINS TYPES (Directly Heated)

OUTPUT TRIODES

Type	Rating						Typical Operating Conditions					*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Mutual Conduct-ance	Amp. Factor	Anode A.C. Resist. (ohms)	Anode Volts	Grid Bias	Anode Current	Optimum Load (Ohms)	Power Output (Watts)		
PP3/250	4	1.0	300	6.5	6.5	1,000	300	37.0	48	3,000	4.2	BR47	9/6
PA 20	2	2.0	300	6.5	6.5	1,000	300	36.0	48	3,000	4.2	BR47	9/6
PP5/400	4	2.0	400	6.0	9,0	1,500	400	32.0	62	2,700	6.0	BR47	20/-
PA 40	4	2.0	450	10.0	4.25	425	450	96.0	*110	*4,000	*40.0	BR47	20/-
							* Two valves in push-pull.						
A.C./D.C. TYPE (Indirectly Heated)													
PP 3521	35	0.2	250	10	6.0	600	175	22.5	60	2,800	1.5	BR74	9/6

MAZDA VALVE DATA—*continued*

OUTPUT PENTODES

BATTERY TYPES

Type	Rating					Typical Operating Conditions						*Wireless World* Base Number	Price
	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conductance	Anode Volts	Screen Volts	Grid Bias	Anode Current	Optimum Load (Ohms)	Power Output (Watts)		
Pen 141	1.4	0.1	90	90	1.75	82	82	8.1	5.0	10,000	0.21	MO814	9/-
Pen 24	2	0.3	150	150	5.7	120	120	3.3	5.0	15,000	0.44	MO814	9/-
Pen 25	2	0.15	150	150	4.5	120	120	3.6	5.0	14,000	0.4	MO814	9/-
Pen 220	2	0.2	150	150	2.5	120	120	4.5	5.0	17,000	0.34	BR512	9/-
*QP 230	2	0.3	150	150	3.0	120	120	9.6	4.65	17,000	0.86	BR723	12/6
*QP 240	2	0.4	150	150	4.0	120	103	9.0	3.0	17,000	1.1	BR91	17/6
*QP 25	2	0.2	120	120	3.0	110	110	8.6	4.25	16,000	0.94	MO822	12/6

* Double Pentodes.

A.C. MAINS TYPES

Type	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conductance	Anode Volts	Screen Volts	Grid Bias	Anode Current	Optimum Load (Ohms)	Power Output (Watts)	*Wireless World* Base Number	Price
AC/Pen	4	1.0	250	250	2.5	250	250	15.0	32	7,500	3.3	BR719	10/6
AC.2/Pen	4	1.75	250	250	8.0	250	250	5.3	32	6,700	3.5	BR719	10/6
AC.2/Pen.DD	4	2.0	250	250	8.0	250	250	5.3	32	6,700	3.5	BR724	12/6
AC.4/Pen	4	1.75	250	250	11.0	250	250	8.75	64	3,300	6.9	BR78	12/-
AC.5/Pen	4	1.75	250	250	9.0	250	250	8.5	40	5,200	4.85	BR78	10/6
AC.5/Pen.DD	4	2.0	250	250	9.0	250	250	8.5	40	5,200	4.85	BR710	12/6
AC.6/Pen	4	1.75	330	220	8.5	310	210	6.9	63	Special		BR739	15/-
Pen.44	4	2.1	275	275	11.0	260	270	11.1	70	3,000	8.0	MO810	12/-
Pen.45	4	1.75	250	250	9.0	250	250	8.5	40	5,200	4.85	MO810	10/6
Pen.45.DD	4	2.0	250	250	9.0	250	250	8.5	40	5,200	4.85	MO815	12/6
Pen.46	4	1.75	330	220	8.5	315	210	6.9	63	Special		MO811	15/-

A.C./D.C. TYPES

Type	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conductance	Anode Volts	Screen Volts	Grid Bias	Anode Current	Optimum Load (Ohms)	Power Output (Watts)	*Wireless World* Base Number	Price
Pen.383	38	0.2	200	200	12.0	155	175	10.0	64	2,500	3.6	MO810	10/6
Pen.3520	35	0.2	250	250	7.0	200	200	8.0	40	4,400	3.0	BR719	10/6
Pen.3820	38	0.2	200	200	12.0	155	175	10.0	64	2,500	3.6	BR78	10/6
Pen.DD4020	40	0.2	250	250	7.0	200	200	6.3	32	5,400	2.5	BR724	12/6
Pen.DD4021	45	0.2	200	200	12.0	155	175	10.0	64	2,500	3.6	BR710	12/6
Pen.453.DD	45	0.2	200	200	12.0	155	175	10.0	64	2,500	3.6	MO815	12/6

RECTIFIERS

Type	Fil. Volts	Fil. Current	Half or Full Wave	Max. Volts per Anode	Max. Current	*Wireless World* Base Number	Price
UU 4	4	2.2	Full	350	120	BR43	9/-
UU 5	4	2.3	Full	500	120	BR43	9/-
UU 6	4	1.4	Full	350	120	MO83	9/-
UU 7	4	2.3	Full	350	120	MO83	9/-
UU 8	4	2.8	Full	350	250	MO83	15/-
U 4020	40	0.2	Half	250	120	BR51	9/-
U 403	40	0.2	Half	250	120	MO81	9/-
U 21	2	1.85	Half	4,500	5	BR45	15/-
U 22	2	2.0	Half	4,500	5	MO82	15/-
MU 2	2	3.1	Half (M.V.)	5,000	5	BR44	20/-

SPECIAL TYPES

THYRATRONS

Type	Fil. Volts	Fil. Current	*Max. Output Volts	Max. Peak Current (m.A.)	Control Ratio	Gas Voltage Drop	*Wireless World* Base Number	Price
T 31	4	1.5	120	500	20	40	BR56	20/-
T 41	4	1.5	120	500	20	40	MO86	10/6

* Peak—peak scan.

ACORNS

Type	Fil. Volts	Fil. Current	Max. Anode Volts	Max. Screen Volts	Mutual Conductance	Amplification Factor	Impedance	Designation	Price
A 40	4	0.25	200	—	2	25	12,500	Triode	45/-
A 41	4	0.25	250	100	2	—	—	Pentode	50/-

SPECIAL TELEVISION DIODE

D 1	4	0.2	Peak Inverse Anode Volts 500 Peak Anode Current 50 mA.	10/6

Mazda Valves are manufactured in Great Britain for The British Thomson-Houston Co., Ltd., London and Rugby, and distributed by The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.

Mullard

THE · MASTER · VALVE

CHARACTERISTICS AND OPERATING DATA

Vf = Filament or Heater Voltage.
If = Filament or Heater Current.
Va = Anode Voltage.
Vg2 = Auxiliary Grid or Screen Voltage.
Vg = Control Grid Voltage.
Ia = Anode Current.
Ri = Anode Impedance.
G = Amplification Factor.
S or Sc = Mutual or Conversion Conductance.
Wo = Audio Output.
C = Clear Bulb.
M = Metallised Bulb.

1.4 VOLT RANGE

Type	Description	*Wireless World* Base Number	Working Conditions					Characteristics at Working Conditions				Optimum Load	Price
			If.	Va.	Vg2	−Vg.	Ia.	Ri.	G.	S. or Sc.	Wo		
DK1	Heptode Frequency Changer (M.) ..	SC**8**23	0.05	90	90‡	0	0.55	600,000	—	0.25	—	—	10/6
DF1	H.F. Pentode (M.)	SC**8**13	0.05	90	90	0	1.2	1,500,000	1,160	0.75	—	—	9/-
DAC1	Single Diode Triode (M.)	SC**8**9	0.05	90	—	0	0.14	240,000	65	0.275	—	—	7/6
DL2	Output Pentode (C.)	SC**8**15	0.1	90	90	7.5	7.5	115,000	180	1.55	0.24	8,000	9/-
DL1	Output Pentode (C.)	SC**8**15	0.05	90	90	3.0	4.0	300,000	375	1.25	0.17	22,500	9/-

2 VOLT RANGE

Type	Description	*Wireless World* Base Number	If.	Va.	Vg2	−Vg.	Ia.	Ri.	G.	S. or Sc.	Wo	Optimum Load	Price
TH2	Triode Hexode Frequency Changer	BR**7**32	0.23	135	60	5.0	0.95	600,000	—	0.43	—	—	10/6
FC2	Octode Frequency Changer ..	BR**7**29	0.1	135*	70†	0	0.95	—	—	0.2	—	—	10/6
FC2A	Octode Frequency Changer ..	BR**7**29	0.13	135*	45‡	0.5	0.7	2,500,000	—	0.27	—	—	10/6
VP2	Vari-mu H.F. Pentode	BR**7**12	0.18	135	135	0–7	3.0	400,000	—	1.5	—	—	9/-
VP2B	Vari-mu H.F. Pentode	BR**7**17	0.14	135	60	1.5	2.0	1,300,000	—	1.4	—	—	9/-
SP2	H.F. Pentode	BR**7**12	0.18	135	135	0	3.0	700,000	1,200	1.8	—	—	9/-
PM12A	Screened Tetrode (M. or C.) ..	BR**4**8	0.18	135	75	0	2.0	330,000	500	1.5	—	—	9/-
PM12	Screened Tetrode (M. or C.) ..	BR**4**8	0.15	150	75	—	4.25	180,000	200	1.1	—	—	9/-
PM12M	Vari-mu Screened Tetrode (M. or C.)	BR**4**8	0.18	150	90	0–7	2.5	—	—	1.4	—	—	9/-
2D2	Double-diode Detector	BR**5**2	0.09	125	—	—	0.5	—	—	—	—	—	5/6
TDD2A	Double-diode Triode	BR**5**9	0.12	135	—	1.5	1.95	25,000	30	1.2	—	—	7/6
TDD2	Double-diode Triode	BR**5**9	0.1	150	—	5.5	2.5	12,000	16.5	1.4	—	—	7/6
PM1A	High Impedance Triode (C.) ..	BR**4**7	0.1	150	—	1.0	1.0	41,600	50	1.2	—	—	4/9
PM1HF	Medium Impedance Triode (C.) ..	BR**4**7	0.1	150	—	3–4.5	1.5	22,500	18	0.8	—	—	4/9
PM1HL	Medium Impedance Triode (M. or C.)	BR**4**7	0.1	135	—	1.5	2.3	23,400	28	1.2	—	—	4/9
PM2HL	Medium Impedance Triode (M. or C.)	BR**4**7	0.1	135	—	1.5	2.2	21,500	30	1.4	—	—	4/9
PM1LF	Medium Impedance Triode (C.) ..	BR**4**7	0.1	150	—	7.5	4.0	12,000	11	0.9	—	—	4/9
PM2DX	Medium Impedance Triode (M. or C.)	BR**4**7	0.1	135	—	4.5	2.0	18,000	18	1.0	—	—	4/9
PM2DL	Driver for Class B (M.)	BR**4**7	0.1	135	—	4.5	2.0	12,000	18	1.5	—	—	4/9
PM2A	Output Triode	BR**4**7	0.2	135	—	6.0	5.0	6,000	12	2.0	0.15	7,000	6/-
PM2	Output Triode	BR**4**7	0.2	150	—	12.0	6.6	4,400	7.5	1.7	—	9,000	6/-
PM202	Super-power Triode (replaces PM252)	BR**4**7	0.2	150	—	12–15	14.0	2,000	7	3.5	—	3,700	11/6
PM22	Output Pentode	BR**4**10/**5**12	0.2	150	150	10.0	15.0	—	—	1.3	—	8,000	16/6
PM22A	Output Pentode	BR**4**10/**5**12	0.15	135	135	4.5	5.6	150,000	—	2.2	0.34	19,000	9/-
PM22D	High Sensitivity Output Pentode ..	BR**5**12	0.3	135	135	2.4	5.0	—	—	3.0	0.3	24,000	9/-
PM2B	Class B Double-triode	BR**7**6	0.2	120	—	0	—	—	—	—	1.25	14,000	10/6
PM2BA	Class B Double-triode	BR**7**6	0.2	120	—	4.5	—	—	—	—	1.45	14,000	10/6
QP22A	Q.P.P. Double Pentode	BR**9**1	0.45	135	135	12.0	3.0	—	—	4.0	1.4	16,000	12/6
QP22B	Q.P.P. Double Pentode	BR**7**23	0.3	135	135	11.7	3.8	—	—	3.1§	1.33	14,700	12/6

* Va = Vg2 = 135 V. † Vg3 + 5 = 70 V. ‡ Vg3 + 5 = 45 V. § S at Va = Vg2 = 100 V, and Vg1 = 0.

SPECIAL TYPES. (All these types are in clear bulbs)

Type	Description	*Wireless World* Base Number	Working Conditions						Characteristics at Working Conditions				Optimum Load	Price
			Vf	If	Va	Vg2	−Vg	Ia	Ri	G	S or Sc	Wo		
AT4	Acorn Triode	—	4.0	0.25	200	—	6.0	4.5	12,500	25	2.0	—	—	50/-
AP4	Acorn Pentode	—	4.0	0.2	250	100	3.0	2.0	3,500,000	5,000	1.4	—	—	60/-
4671	Acorn Triode	—	6.3	0.15	180	—	5.0	4.5	12,500	25	2.0	—	—	45/-
4672	Acorn Pentode	—	6.3	0.15	250	100	3.0	2.0	1,500,000	2,100	1.4	—	—	50/-
DA1	Amplifying Triode for Deaf Aids ..	DA**4**1	2.0	0.05	40	—	0.25	0.25	80,000	32	0.4	—	—	15/-
DA2	Output Triode for Deaf Aids ..	DA**4**1	2.0	0.05	40	—	2.15	1.25	13,600	6.9	0.5	—	—	15/-
DA3	Output Triode for Deaf Aids ..	DA**4**1	2.0	0.05	40	—	2.8	1.8	7,600	4.7	0.62	—	—	15/-
DAS1	Amplifying Tetrode for Deaf Aids ..	DA**4**2	2.0	0.06	120	60	2.7	1.5	500,000	—	0.58	—	—	17/6
DC51	Amplifying Triode These types are specially designed for use in Deaf Aid Apparatus.	DA**4**1	1.5	0.067	45	—	0	0.34	66,000	25	0.38	—	—	15/-
DF51	Amplifying Pentode	DA**4**3	1.5	0.067	45	13.5	0	0.125	—	—	0.17	—	—	17/6
DD51	Output Triode	DA**4**1	1.5	0.067	45	—	3.0	1.7	10,000	5	0.5	—	—	15/-
DL51	Output Pentode	DA**4**3	1.5	0.134	45	45	1.5	1.6	85,000	128	1.5	—	—	17/6

PREPARED BY THE MULLARD WIRELESS SERVICE CO., LTD., CENTURY HOUSE, LONDON, W.C.2.

CHARACTERISTICS AND OPERATING DATA FOR Mullard Master Valves—contd.

INDIRECTLY HEATED A.C. MAINS VALVES. Vf = 4.0 V.

Type	Description	*Wireless World* Base Number	Working Conditions					Characteristics at Working Conditions				Optimum Load	Price
			If.	Va.	Vg2	−Vg.	Ia.	Ri.	G.	S. or Sc.	Wo		
TV4	Tuning Indicator	SC828	0.3	250	—	0–5	—	—	—	—	—	—	9/-
TV4A	Tuning Indicator	SC828	0.3	250	—	0–21	—	—	—	—	—	—	9/-
TH4	Triode Hexode Frequency Changer	BR733	1.0	250	70	1.5	4.0	1,500,000	—	1.0	—	—	11/6
TH4B	Triode Heptode Frequency Changer (replaces TH4A).	BR733	1.45	250	100	2.5	3.25	1,500,000	—	0.75	—	—	11/6
FC4	Octode Frequency Changer	BR731	0.65	250	90†	1.5	1.6	—	—	0.6	—	—	11/6
VP4	Vari-mu H.F. Pentode	BR516/714	1.0	200	100	2–50	4.5	1,000,000	2,000	2.3	—	—	10/6
VP4A	Vari-mu H.F. Pentode	BR516/714	1.2	200	100	2.0	4.25	1,400,000	3,500	2.5	—	—	10/6
VP4B	Vari-mu H.F. Pentode	BR715	0.65	250	250	3.0	11.5	—	—	2.0	—	—	10/6
SP4	H.F. Pentode (M. or C.)	BR516/714	1.0	200	100	2.0	3.0	2,200,000	5,000	2.3	—	—	10/6
SP4B	H.F. Pentode	BR715	0.65	250	250	2.4	4.0	2,000,000	6,800	3.4	—	—	10/6
MM4V	Vari-mu Screened Tetrode	BR510	1.0	200	110	1.5	6.0	—	—	2.5	—	—	11/6
				200	110	40.0	0.15	—	—	0.01			
S4VA	Screened Tetrode (M. or C.)	BR510	1.0	200	110	1.5	2.75	500,000	1,000	2.0	—	—	10/6
S4VB	Screened Tetrode (M. or C.)	BR510	1.0	200	110	1.5	4.6	300,000	750	2.5	—	—	10/6
2D4A	Double-diode	BR52	0.65	200	—	—	0.8	—	—	—	—	—	5/6
2D4B	Double-diode with separate Cathodes	BR72	0.35	200	—	—	0.8	—	—	—	—	—	5/6
TDD4	Double-diode Triode	BR77	0.65	250	—	7.0	4.0	13,500	27	2.0	—	—	9/6
904V	High Impedance Triode (M.)	BR54	0.65	200	—	2.0	2.2	20,600	72	3.5	—	—	7/6
354V	Medium Impedance Triode (M.or C.)	BR54	0.65	250	—	4.5	6.5	11,500	40	3.5	—	—	7/6
244V	Medium Impedance Triode (M.)	BR54	0.65	200	—	5.5	5.5	9,000	25	2.8	—	—	9/-
164V	Medium Impedance Triode (C.)	BR54	0.65	200	—	8.5	13.0	3,640	16.4	4.5	—	—	14/-
TT4	Low Impedance Triode (replaces 104V).	BR54	1.0	250	—	16.0	20.0	3,300	10.5	3.2	0.5	10,000	10/-
TT4A	Low Impedance Triode	BR54	1.0	250	—	9.0	20.0	4,400	18.0	4.1	0.4	5,000	17/6
Pen 4VA	Output Pentode	BR514/719	1.35	250	250	22.0	36.0	40,000	—	2.8	3.8	6,000	10/6
Pen A4	Output Pentode (replaces Pen 4VB)	BR719	1.95	250	250	5.8	36.0	50,000	—	9.5	3.8	8,000	10/6
Pen B4	Output Pentode	BR719	2.1	250	275	14.0	72.0	22,000	—	8.5	8.8	3,500	12/-
Pen 4DD	Double-diode Output Pentode	BR725	2.25	250	250	6.0	36.0	50,000	—	9.5	4.3	7,000	12/6
Pen 428	Output Pentode	BR719	2.1	375	275	20.5	62.0	—	—	8.0	8.0	6,500*	25/-

† Vg3 + 5 = 70 V. * Data for 2 × Pen 428 in Class AB push-pull.

DIRECTLY HEATED A.C. OUTPUT VALVES. Vf = 4.0 V. unless otherwise stated

Type	Description	*Wireless World* Base Number	Working Conditions					Characteristics at Working Conditions				Optimum Load	Price
			If	Va	Vg2	−Vg	Ia	Ri	G	S	Wo		
AC044	Triode	BR47	1.0	300	—	38.0	50	1,200	6.0	5.0	3.5	2,300	9/6
AC042	Triode	BR47	2.0V 2.0A	300	—	38.0	50	1,200	6.0	5.0	3.5	2,300	9/6
PM24	Pentode	BR410/512	0.15	150	150	11.0	20	—	—	1.75	—	8,000	20/-
PM24A	Pentode	BR512	0.275	300	200	22.5	20	—	—	2.0	—	10,000	15/-
PM24M	Pentode	BR512	1.1	250	250	17.0	30	43,000	130.0	3.0	2.8	7,000	10/6
PM24B	Pentode	BR512	1.0	400	300	40.0	30	—	—	2.1	—	8,000	22/6
PM24E	Pentode	BR512	2.0	500	200	35.0	50	—	—	4.0	—	7,000	45/-
D024	Triode	BR47	1.85	400	—	40.0	63	1,070	8.0	7.5	7.1	3,200	20/-
D025	Triode	BR47	6.0V 1.1A	400	—	112.0	63	800	3.0	3.75	—	4,000	30/-
D026	Triode	BR47	2.0	400	—	92.0	63	950	3.6	3.8	7.5	3,000	25/-
D030	Triode	BR47	1.85	500	—	140.0	60	890	3.1	3.5	—	—	25/-

A.C. RECTIFIERS

Type	Description	*Wireless World* Base Number	Vf	If	Max. Va (R.M.S.)	Max. Rectified Output (mA)	Price
DW2	Directly-heated F.W. Rectifier	BR42	4.0	1.0	250—0—250	60	9/-
DW4/350	Directly-heated F.W. Rectifier (replaces DW3)	BR42	4.0	2.0	350—0—350	120	9/-
DW4/500	Directly-heated F.W. Rectifier (replaces DW4)	BR42	4.0	2.0	500—0—500	120	9/-
IW2	Indirectly-heated F.W. Rectifier	BR43	4.0	1.2	250—0—250	60	9/-
IW3	Indirectly-heated F.W. Rectifier	BR43	4.0	2.4	350—0—350	120	9/-
IW4/350	Indirectly-heated F.W. Rectifier	BR43	4.0	2.0	350—0—350	120	9/-
IW4/500	Indirectly-heated F.W. Rectifier (replaces IW4)	BR43	4.0	2.4	500—0—500	120	10/6
FW4/500	Directly-heated F.W. Rectifier	BR42	4.0	3.0	500—0—500	250	15/-

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CHARACTERISTICS AND OPERATING DATA FOR **Mullard Master Valves**—*contd.*

DC/AC VALVES. Pin Bases ; P Base (8 contact) and V Base (5 contact)

Type	Description	*Wireless World* Base Number	Working Conditions						Characteristics at Wkg. Condns.				Optimum Load	Price
			Vf	If	Va	Vg2	−Vg	Ia	Ri	G	S or Sc	Wo		
EM1	Tuning Indicator (replaces TV6)	SC828	6.3	0.2	250	—	0–5	—	—	—	—	—	—	9/-
TH21C	Triode Hexode Frequency Changer.	BR736	21.0	0.2	250	70	1.5	4.0	1,500,000	—	1.0	—	—	12/6
TH30C	Triode Heptode Frequency Changer (replaces TH22C).	BR736	29.0	0.2	250	100	2.5	3.25	1,500,000	—	0.75	—	—	11/6
FC13	Octode Frequency Changer ..	SC825	13.0	0.2	200	90†	1.5	1.6	—	—	0.6	—	—	11/6
FC13C	Octode Frequency Changer ..	BR731	13.0	0.2	200	90†	1.5	1.6	—	—	0.6	—	—	11/6
VP13A	Vari-mu H.F. Pentode ..	SC818	13.0	0.2	200	100	2.0	4.0	—	2,200	2.2	—	—	10/6
VP13C	Vari-mu H.F. Pentode ..	BR715	13.0	0.2	200	200	2.0	9.0	—	—	2.2	—	—	10/6
SP13	H.F. Pentode	SC818	13.0	0.2	200	100	2.0	3.3	1,300,000	3,000	2.2	—	—	10/6
SP13C	H.F. Pentode	BR715	13.0	0.2	200	200	2.2	2.5	2,500,000	7,000	2.8	—	—	10/6
2D13A	Double-diode Detector ..	BR52	13.0	0.2	200	—	—	0.8	—	—	—	—	—	7/6
2D13C	Double-diode Detector ..	BR52	13.0	0.2	200	—	—	0.8	—	—	—	—	—	7/6
HL13	Medium Impedance Triode (M.)	SC88	13.0	0.2	200	—	3.7	5.0	12,000	40	3.3	—	—	7/6
HL13C	Medium Impedance Triode (M.)	BR75	13.0	0.2	200	—	3.7	5.0	12,000	40	3.3	—	—	7/6
TDD13C	Double-diode Triode	BR77	13.0	0.2	200	—	5.0	4.0	13,500	27	2.0	—	—	9/6
Pen26	Output Pentode	SC817	24.0	0.2	200	100	19.0	40.0	—	—	3.1	3.0	5,000	10/6
Pen36C CL33	Output Pentode ..	BR719 IO826	35.0	0.2	200	200	9.0	40.0	—	—	8.0	4.0	4,000	10/6
Pen40DD	Double-diode Output Pentode..	BR725	44.0	0.2	200	200	8.5	45.0	—	—	8.0	4.0	4,500	12/6
CBL1 CBL31	Double-diode Output Pentode	SC821 IO830	44.0	0.2	200	200	8.5	45.0	35,000	—	8.0	4.0	4,500	12/6
CL4	Output Pentode..	SC817	33.0	0.2	200	200	8.5	45.0	35,000	—	8.0	4.0	4,500	10/6
CL6	Output Pentode.. ..	SC817	35.0	0.2	200	100	9.5	45.0	19,000	—	8.0	4.0	4,500	10/6

† Vg3 + 5 = 70 V.

DC/AC RECTIFIERS

Type	Description	*Wireless World* Base Number	Vf	If	Max. Anode Volts (R.M.S.)	Max. Rectified Output (mA)	Price
CY1 CY31	Half Wave Rectifier (replaces UR1)	SC82 IO86	20	0.2	250	75	9/-
UR1C	Half Wave Rectifier	BR51	20	0.2	250	75	9/-
CY2 CY32	Multiple Rectifier (replaces UR3)	SC84 IO87	30	0.2	250—0—250	120	10/6
UR3C	Multiple Rectifier	BR71	30	0.2	250—0—250	120	9/-

"E" SERIES (SIDE CONTACT). Vf = 6.3 V. unless otherwise stated

Type	Description	*Wireless World* Base Number	Working Conditions					Characteristics at Wkg. Condns.				Optimum Load	Price
			If.	Va.	Vg2	−Vg.	Ia.	Ri.	G.	S. or Sc.	Wo		
EM1	Tuning Indicator	SC828	0.2	250	—	0–5	—	—	—	—	—	—	9/-
EM3	Tuning Indicator	SC828	0.2	250	—	0–21	—	—	—	—	—	—	9/-
EM4	Tuning Indicator	SC829	0.2	250	—	0–16	—	—	—	—	—	—	9/-
ECH2	Triode Heptode Frequency Changer	SC826	0.95	250	100	2.5	3.25	1,500,000	—	0.75	—	—	11/6
ECH3 ECH33	Triode Hexode Frequency Changer.	SC826 IO836	0.2	250	100	2.0	3.0	1,300,000	—	0.65	—	—	11/6
EK2	Octode Frequency Changer ..	SC825	0.2	250	200§	2.0	1.0	2,000,000	—	0.55	—	—	11/6
EK3	Octode Frequency Changer ..	SC825	0.72	250	100	2.5	2.5	2,000,000	—	0.65	—	—	12/6
EF5	Vari-mu H.F. Pentode	SC818	0.2	250	100	3–50	8.0	1,200,000	2,000	1.7	—	—	11/6
EF6 EF36	H.F. Pentode	SC818 IO824	0.2	250	100	2.0	3.0	2,500,000	4,500	1.8	—	—	11/6
EF8 EF38	Low Noise H.F. Pentode ..	SC819 IO829	0.2	250	250†	2.5	8.0	450,000	—	1.8	—	—	10/6
EF9 EF39	Sliding Screen H.F. Pentode	SC818 IO824	0.2	250 250	100 250	2.5 49.0	6.0 —	1,250,000 10,000,000	— —	2.2 0.0045	— —	—	10/6
EB4	Double-diode (separate Cathodes)..	SC85	0.2	200	—	—	0.8	—	—	—	—	—	10/6
EAB1	Triple-diode	SC86	0.2	200	—	—	0.8	—	—	—	—	—	7/6
EBC3 EBC33	Double-diode Triode ..	SC811 IO813	0.2	275	—	6.25	5.0	15,000	30	2.0	—	—	9/6
EFM1	L.F. Amplifier and Tuning Indicator (M.).	SC827	0.2	250	—	—	—	—	—	—	—	—	15/-
EBF2	Double-diode H.F. Pentode (M.) ..	SC821	0.2	250	100‡	2.0	5.0	1,300,000	—	1.8	—	—	12/6
EL2 EL32	Output Pentode	SC817 IO828	0.2	250	250	18.0	32.0	70,000	—	2.8	3.6	8,000	11/6
EL3 EL33	Output Pentode	SC816 IO826	0.9	250	250	6.0	36.0	50,000	—	9.0	4.5	7,000	10/6
EL6 EL36	Output Pentode	SC816 IO826	1.3	250	250	7.0	72.0	17,000	—	15.0	8.0	3,500	12/-
EBL1 EBL31	Double-diode Output Pentode	SC821 IO830	1.5	250	250	6.0	36.0	50,000	—	9.5	4.3	7,000	12/6

§ Vg3 + 5 = 50 V. † Vg2 = 0 ; Vg3 = 250. ‡ Rg2 = 95,000 ohms.

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CHARACTERISTICS AND OPERATING DATA FOR **Mullard Master Valves**—*contd.*

"E" SERIES RECTIFIERS

Type	Description	*Wireless World* Base Number	Vf	If	Anode Voltage (R.M.S.)	Rectified Output (mA)	Price
AZ1 AZ31	Directly-heated F.W. Rectifier	SC81 IO82	4.0	1.1	300—0—300	100	9/-
AZ2 AZ32	Directly-heated F.W. Rectifier	SC81 IO82	4.0	2.0	300—0—300	160	9/-
AZ3	Indirectly-heated F.W. Rectifier	SC83	4.0	2.0	350—0—350	120	9/-
EZ2	Indirectly-heated F.W. Rectifier	SC83	6.3	0.4	350—0—350	60	10/6

OCTAL TYPES

Type	Description	Price	Type	Description	Price
1A7G	Battery Pentagrid Frequency Changer	10/6	6F5G	High-μ Triode	7/6
1C5G	Battery Output Pentode	9/-	6F6G	Output Pentode	10/6
1C7G	Battery Pentagrid Frequency Changer	10/6	6H6G	Double-Diode (separate cathodes)	5/6
1F5G	Battery Output Pentode	9/-	6J5G	Triode	7/6
1F7G	Battery Double-Diode Pentode	11/6	6J7G	H.F. Pentode	10/6
1H4G	Battery Triode	6/-	6K5G	High-μ Triode	7/6
1H5G	Battery Single-Diode Triode	7/6	6K7G	Vari-μ H.F. Pentode	10/6
1H6G	Battery Double-Diode Triode	7/6	6L5G	Triode	7/6
1J6G	Battery Class B Double Triode	9/6	6L6G	Beam Power Tetrode	15/-
1N5G	Battery H.F. Pentode	9/-	6L7G	Pentagrid Mixer	10/6
			6N6G	Double Output Triode	15/-
5U4G	D.H. Full-Wave Rectifier	15/-	6N7G	Class B Double Triode	15/-
5V4G	I.H. Full-Wave Rectifier	9/-	6Q7G	Double-Diode Triode	9/6
5X4G	D.H. Full-Wave Rectifier	15/-	6R7G	Double-Diode Triode	9/6
5Y3G	D.H. Full-Wave Rectifier	9/-	6S7G	Vari-μ H.F. Pentode	10/6
5Y4G	D.H. Full-Wave Rectifier	9/-	6U7G	Vari-μ H.F. Pentode	10/6
5Z4G	I.H. Full-Wave Rectifier	9/-	6V6G	Beam Power Tetrode	10/6
			6X5G	I.H. Full-Wave Rectifier	9/-
6A8G	Pentagrid Frequency Changer	11/6			
6B8G	Double-Diode Pentode	12/6	25A6G	Output Pentode	10/6
6C5G	Triode	7/6	25L6G	Beam Power Tetrode	10/6
6D8G	Pentagrid Frequency Changer	11/6	25Z6G	I.H. Rectifier Doubler	9/-

U.X. and U.Y. TYPES

Type	Description	Price	Type	Description	Price
1A4	Battery Vari-μ H.F. Pentode	9/-	25Y5	Full-Wave Rectifier	9/-
1A6	Battery Pentagrid Frequency Changer	10/6	25Z5	I.H. Rectifier Doubler	9/-
1C6	Battery Pentagrid Frequency Changer	10/6	27	I.H. Triode	7/6
1F4	Battery Output Pentode	9/-	30	D.H. Triode	6/-
1F6	Battery Double-Diode Pentode	11/6	32	D.H. H.F. Tetrode	9/-
1-v	Half-Wave Rectifier	9/-	33	Output Pentode	16/6
			34	Vari-μ H.F. Pentode	9/-
2A3	D.H. Output Triode	9/6	35	Vari-μ H.F. Tetrode	10/6
2A5	Output Pentode	10/6	36	H.F. Tetrode	10/6
2A6	Double-Diode High-μ Triode	9/6	37	Triode	7/6
2A7	Pentagrid Frequency Changer	11/6	39/44	Vari-μ H.F. Pentode	10/6
2B7	Double-Diode H.F. Pentode	12/6	41	Output Pentode	10/6
			42	Output Pentode	10/6
5Z3	D.H. Full-Wave Rectifier	15/-	43	Output Pentode	10/6
			45	D.H. Output Triode	9/6
6A3	Output Triode	9/6	47	D.H. Output Pentode	10/6
6A4	D.H. Output Pentode	10/6	56	Triode	7/6
6A6	Class B Double Triode	15/-	58	Vari-μ H.F. Pentode	10/6
6A7	Pentagrid Frequency Changer	11/6	71A	D.H. Output Triode	9/6
6B5	Double Output Triode	15/-	75	Double-Diode Triode	9/6
6B7	Double-Diode Pentode	12/6	76	Triode	7/6
6C6	H.F. Pentode	10/6	77	H.F. Pentode	10/6
6D6	Vari-μ H.F. Pentode	10/6	78	Vari-μ H.F. Pentode	10/6
6E5	Tuning Indicator	8/6	79	Class B Double Triode	10/6
6F7	Triode Pentode	11/6	80	D.H. Full-Wave Rectifier	9/-
6U5/6G5	Tuning Indicator	8/6	83	Full-Wave Mercury Vapour Rectifier	17/6
			84	I.H. Full-Wave Rectifier	9/-
12A5	Pentode	10/6	85	Double-Diode Triode	9/6
12A7	I.H. Rectifier Pentode	12/6	89	Output Pentode	10/6
12Z3	I.H. Half-Wave Rectifier	9/-			
15	H.F. Pentode	9/-	2101	Battery Output Pentode	9/-
18	Output Pentode	10/6	2102	Battery Double-Diode Triode	7/6
19	D.H. Class B Double Triode	9/6	2103	Battery Double Output Pentode	12/6
24A	H.F. Tetrode	10/6	2151	Output Pentode	12/-

PREPARED BY THE MULLARD WIRELESS SERVICE CO., LTD., CENTURY HOUSE, LONDON, W.C.2.

Osram Valves

MADE IN ENGLAND

H.F. PENTODES AND TETRODES (BATTERY DIRECTLY HEATED TYPES)

Type	Description	Filament		Type of Base	*Wireless World* Base No.	Anode Volts max.	Screen Volts max.	Mutual Conductance mA/volt	As amplifier under conditions of max. anode and screen volts			Price
		Volts	Current amps.						Approx. Grid Bias Volts	Average Anode Current mA.	Average Screen Current mA.	
S23	*Short Grid Base Tetrode*	*2*	*0.1*	*4-pin*	BR48	*150*	*70*	*1.1*	*–1.5*	*1.3*	*0.6*	*9/–*
VS24	*Variable-Mu-Tetrode ..*	*2*	*0.15*	*4-pin*	BR48	*150*	*75*	*1.5*	*0*	*4.5*	*0.5*	*9/–*
VP21	*Variable-mu Pentode ..*	*2*	*0.1*	*7-pin*	BR712	*150*	*60*	*1.1*	*0*	*2.8*	*0.7*	*9/–*
W21	Variable-mu Pentode ..	2	0.1	4-pin or 7-pin	BR49 BR712	150	150	1.4	0	3.6	1.2	9/–
Z14	Short Grid Base Pentode	1.4	0.05	Octal	IO821	90	90	0.75	0	1.2	0.3	9/–
Z21	Short Grid Base Pentode	2	0.1	4-pin or 7-pin	BR49 BR712	150	150	1.7	–0.5	1.7	0.6	9/–
S12	Miniature Tetrode for "Deaf Aid," etc. ..	2	0.06	Midget 4-pin	DA42	100	30	0.7	0	2.5	0.4	17/6

SHORT GRID BASE H.F. PENTODES, AND TETRODES WITH PENTODE CHARACTERISTICS (WITH INDIRECTLY HEATED CATHODE)

Type	Filament		Type of Base	*Wireless World* Base No.	Anode Volts max.	Screen Volts max.	Mutual Conductance mA/volt (working point)	As amplifier under conditions of max. anode and screen volts				Connected as Triode		Price
	Volts	Current amps.						Approx. Grid Bias Volts	Bias Resist. Ohms	Average Anode Current mA.	Average Screen Current mA.	Amplification Factor	Impedance. Ohms	
MSP4	*4*	*1.0*	*7-pin* *Also 5-pin*	BR714 BR510	*250*	*100*	*2.4*	*–1.75*	*400*	*3.3*	*1.0*	—	—	*10/6*
KTZ41	4	1.5	7-pin	BR740	250	250	7.5 12.0	–2.5 –1.5	244 65	8.0 18.0	2.25 5.25	80	6,250	12/6
Z62*	6.3	0.45	Octal	IO824	300	150	7.5	–2	160	10.0	2.3	38	4460	12/6
KTZ63	6.3	0.3	Octal	IO828	250	125	1.23	–3	1,200	2.0	0.5	21	10,500	10/6
KTZ73M	6†	0.16	Octal	IO825	250	100	1.5	–3	1,000	2.0	0.25	—	—	10/6

* Short seal type, suitable for ultra-short wave amplifiers. † Suitable for use with 6.3 v. transformer, or 6-volt accumulator, or series operation at 0.16 amp.

"VARIABLE-MU" PENTODES, AND TETRODES WITH PENTODE CHARACTERISTICS (WITH INDIRECTLY HEATED CATHODE)

Type	Filament		Type of Base	*Wireless World* Base No.	Anode Volts max.	Screen Volts max.	Mutual Conductance mA/volt at working point	As amplifier under conditions of max. anode and screen volts				Price
	Volts	Current amps.						Min. Grid Bias Volts	Bias Resist. Ohms	Average Anode Current mA.	Average Screen Current mA.	
VMP4G	*4*	*1.0*	*7-pin*	BR714	*250*	*100*	*2.7*	*–2*	*150*	*8.0*	*5.0*	*10/6*
W42	*4*	*0.6*	*7-pin*	BR721	*250*	*125*	*1.5*	*–3*	*300*	*7.6*	*1.9*	*10/6*
KTW63	6.3	0.3	Octal	IO828	250	125	1.5	–3	300	7.6	1.5	10/6
KTW61 KTW61M }	6.3	0.3	Octal	IO824 IO825	250	80	2.9	–3	300	8.0	2.3	10/6
KTW73M	6†	0.16	Octal	IO825	250	100	1.7	–3	300	6.5	1.3	10/6

† Suitable for use with 6.3 v. transformer, or 6-volt accumulator, or series operation at 0.16 amp.

Types normally supplied for servicing purposes only, shown in italics. Suffix M indicates metallised bulb.

OSRAM VALVES (continued)

FREQUENCY CHANGERS

Type	Description	Filament		D§ or I‡	Type of Base	*Wireless World* Base No.	Conversion Conductance micromhos	Anode Volts max.	Screen Volts max.	Oscillator Anode Volts max.	Under conditions of max. anode, screen and osc. anode volts					Price
		Volts	Current amps.								Total Cathode Current mA.	Control Grid Volts	Oscillator Grid Peak Volts	Bias Resistance Ohms	Conversion Impedance megohms	
X14	Heptode	1.4	0.05	D	Octal	IO832	230	90	45	90	1.47	0	10	—	0.2	10/6
X22	Heptode	2	0.15	D	7-pin	BR730	350	150	70	150 through 20,000 ohms	9.0	0	20	—	0.65	10/6
*X23**	*Triode-Hexode*	*2*	*0.3*	*D*	*7-pin*	BR732	*250*	*150*	*60*		*4.5*	*−1.5*	*6*	—	*0.016*	*10/6*
X24	Triode-Hexode	2	0.2	D	7-pin	BR732	250	150	60		4.5	−1.5	6	—	0.016	10/6
MX40	*Heptode*	*4*	*1.0*	*I*	*7-pin*	BR728	*500*	*250*	*100*	250 through 10,000 to 30,000 ohms	*5.85*	*−3*	*10*	*500*	*0.5*	*11/6*
X41	Triode-Hexode	4	1.0	I	7-pin	BR733	640	250	80		8.5	−1.5	12	300	0.75	11/6
X61M	Triode-Hexode	6.3	0.3	I	Octal	IO836	520	250	100		10.0	−3	10	300	0.7	11/6
X63 } X63M }	Heptode	6.3	0.3	I	Octal	IO833	500	250	100		9.5	−3	25	300	0.31	11/6
X65	Triode-Hexode	6.3	0.3	I	Octal	IO836	225	250	100		11.0	−3	10	300	2.5	11/6
X71M	Triode-Hexode	15	0.16	I	Octal	IO836	520	250	100		10.0	−3	10	300	0.7	11/6
X73M	Heptode	6†	0.16	I	Octal	IO833	500	250	80		8.0	−3	10	350	0.4	11/6

* Replaced by X24. † Suitable for use with 6.3 v. transformer, or 6-volt accumulator, or series operation at 0.16 amp.
§ Directly heated. ‡ Indirectly heated.

DIODES AND DIODE-TRIODES

Type	Filament		D (directly) or I (indirectly) heated	Type of Base	*Wireless World* Base No.	Anode Volts max.	Amplification Factor	Impedance Ohms	Mutual Conductance mA/volt	As amplifier under conditions of max. anode volts				Price
	Volts	Current amps.								Approx. Grid Bias Ohms	Bias Resistance Ohms	Average Anode Current mA.	Optimum Load Ohms	
HD14	1.4	0.05	D	Octal	IO812	90	66	240,000	0.275	0	—	0.14	500,000	7/6
*HD23**	*2*	*0.15*	*D*	*5-pin*	BR59	*150*	*40*	*28,600*	*1.4*	*−1.5*	—	*1.7*	*150,000*	*7/6*
HD24	2	0.1	D	5-pin	BR59	150	40	28,600	1.4	−1.5	—	1.7	150,000	7/6
D41	*4*	*0.3*	*I*	*5-pin*	BR52	*Double diode*							—	*5/6*
D42	*4*	*0.6*	*I*	*4-pin*	BR412	*Single diode (low impedance)*						*15 max.*	—	*10/-*
D43	*4*	*0.6*	*I*	*4-pin*	BR413			,, ,,	,,	,,		,,		*10/-*
D63	6.3	0.3	I	Octal	IO87	Double diode (separate cathodes)—						2 max. per diode	—	5/6
MHD4	4	1.0	I	7-pin	BR77	250	40	18.200	2.2	−4	1,000	4.0	30,000	9/6
DH63 } DH63M }	6.3	0.3	I	Octal	IO813	250	70	58,000	1.2	−3	2,000	1.1	250,000	9/6
DL63	6.3	0.3	I	Octal	IO813	250	36	22,500	1.6	−3	1,500	4.2	50,000	9/6
DH73M	6†	0.16	I	Octal	IO813	250	44	22,000	2.0	−3	1,000	4.5	100,000	9/6

* Replaced by HD24. † Suitable 'or use with 6.3 v. transformer, or 6-volt accumulator, or series operation at 0.16 amp.

TRIODES

Type	Filament		D (directly) or I (indirectly) heated	Type of Base	*Wireless World* Base No.	Anode Volts max.	Amplification Factor	Impedance Ohms	Mutual Conductance mA/volt	As amplifier under conditions of max. anode volts				Power output (single valve) watts	Price
	Volts	Current amps.								Approx. Grid Bias Volts	Bias Resist. Ohms	Average Anode Current mA.	Optimum Load Ohms		
HL2	2	0.1	D	4-pin	BR47	150	27	18,000	1.5	−3	—	1.75	—	—	4/9
L21	2	0.1	D	4-pin	BR47	150	16	8,900	1.8	−6	—	2.2	—	—	4/9
LP2	2	0.2	D	4-pin	BR47	150	15	4,170	3.6	−6	—	5.6	—	0.1	6/-
P2	2	0.2	D	4-pin	BR47	150	7.5	2,150	3.5	−12	—	14.0	—	0.2	10/-
H12*	2	0.06	D	} midget { } 4-pin {	DA41	100	26	21,600	1.2	−1.5	—	0.6	250,000	—	15/-
L12*	2	0.06	D		DA41	45	4.8	6,000	0.8	−4.5	—	1.9	12,000	0.012	15/-
MH4	*4*	*1.0*	*I*	*5-pin*	BR54	*250*	*40*	*11,100*	*3.6*	*−4*	*750*	*5.0*	*50,000*	—	*7/6*
MHL4	*4*	*1.0*	*I*	*5-pin*	BR54	*250*	*20*	*8,000*	*2.5*	*−8*	*1,000*	*8 0*	*20,000*	—	*7/6*
ML4	*4*	*1.0*	*I*	*5-pin*	BR54	*250*	*12*	*2,860*	*4.2*	*−16*	*1,000*	*14.0*	*7,000*	—	*10/-*
H63	6.3	0.3	I	Octal	IO810	250	100	66,000	1.5	−2	2,000	1.0	200,000	—	7/6
L63	6.3	0.3	I	Octal	IO89	250	20	7,700	2.6	−8	800	9.0	50,000	—	7/6
PX4	4	1.0	D	4-pin	BR47	300	5	830	6.0	−42	900	50.0	4,000	3.5†	9/6
PX25	*4*	*2.0*	*D*	*4-pin*	BR47	*400*	*9.5*	*1,265*	*8.0*	*−31*	*530*	*62.5*	*3,200*	*5.5*	*20/-*
DA30	4	2.0	D	4-pin	BR47	500	4	580	6.9	−134	—	60.0	6,000	11**	25/-
DA100	6	2.7	D	Special	L41	1,000	5.5	1,410	3.9	−150	—	100	6,800	30†	168/-

*** Miniature valves for "deaf-aid," etc. † See below for push-pull data. ** Normally used in push-pull; total output Class AB1, 45 watts.**

Types normally supplied for servicing purposes only, shown in italics. Suffix M indicates metallised bulb.

OSRAM VALVES (continued)

OUTPUT PENTODES, AND TETRODES WITH PENTODE CHARACTERISTICS

Type	Filament		D (directly) or I (indirectly) heated	Type of Base	*Wireless World* Base No.	Anode Volts max.	Screen Volts max.	Mutual Conductance mA/volt	Average Anode Current mA.	Average Screen Current mA.	Approx. Grid Bias Volts	Bias Resist. Ohms	Optimum Load (single valve) Ohms	Approx. Power output (single valve) watts	Price
	Volts	Current amps.													
N14	1.4	0.1	D	Octal	IO822	90	90	1.55	7.5	1.6	−7.5	700	8,000	0.25	9/–
KT2	*2*	*0.2*	*D*	*5-pin*	BR512	*150*	*150*	*2.5*	*7.5*	*1.7*	*−4.5*	—	*17,000*	*0.5*	*9/–*
KT21	*2*	*0.3*	*D*	*5-pin*	BR512	*150*	*150*	*5.3*	*5.0*	*1.2*	*−2.5*	—	*19,000*	*0.75*	*9/–*
KT24	2	0.2	D	5-pin	BR512	150	150	3.2	10.0	2.0	−3.2	250	10,000	0.8	9/–
						120	120		5.0	1.0	−2.7	450	20,000	0.39	
QP21‡	2	0.4	D	7-pin	BR723	150	150	2.3	3.5	0.9	Code	—	25,000*	1.0	12/6
											V & W −9.8 to −9.5				
											X −8.8				
MKT4	*4*	*1.0*	*I*	*5-pin* *7-pin*	BR514 BR719	*250*	*225*	*3.0*	*32*	*5.0*	*−13.5*	*300*	*8,000*	*2.5*	*10/6*
KT41	4	2.0	I	7-pin	BR719	250	250	10.5	40	8.5	−4.4	90	6,000	4.2	10/6
KT61	6.3	0.95	I	Octal	IO826	250	250	10.0	40	7.5	−4.4	90	6,000	4.3	10/6
KT63	6.3	0.7	I	Octal	IO826	250	250	2.5	34	5.5	−16.5	420	7,000	3.0	10/6
KT66	6.3	1.27	I	Octal	IO826	250‖	250§	6.3	85	6.3	−15	170	2,200	7.25	15/–
KT32	26	0.3	I	Octal	IO826	135	135	9.0	75	5.0	−7.6	95	1,300	3.5	12/–
KT33C	*13* *26*	*0.6* *0.3*	*I*	*Octal*	IO819	*200*	*200*	*10.0*	*60*	*10.0*	*−13.2*	*188*	*3,000*	*5.0*	*12/–*
KT35	13 26	0.6 0.3	I	Octal	IO819	200	200	10.0	50	8.5	−11.5	200	4,000	4.3	10/6
KT72	15	0.16	I	Octal	IO826	175	175	2.5	30	6.0	−12.5	300	6,000	2.0	10/6

‡ Double Pentode. ‖ 400 v. max. in push-pull. § 300 v. max. in push-pull. * Anode to anode. Output tetrodes with pentode characteristics have been shown with pentode base connections.

LOW FREQUENCY AMPLIFYING VALVES: PUSH-PULL DATA

Type	Description	Filament		*Wireless World* Base No.	Amplification Factor	Impedance Ohms	Mutual Conductance mA/volt	Operating data for push-pull stage (Class AB2)*							Price (each)
		Volts	Current amps.					Anode Volts	Screen Volts	Grid Volts	Anode Current per valve mA.	Peak Input Voltage Grid to Grid	Anode to Anode Load Ohms	Total Power Output Watts	
PX4	Triode	4.0	1.0	BR47	5	830	6.0	300	—	−45	50	90	6,000	10.0	9/6
B63	Double Triode (as 6A6)‡	6.3	0.8	UX76	—	—	—	300	—	0	17.5	70	10,000	10.0	15/–
DET19	Double Triode (as RK34)‡	6.3	0.8	UX77	—	—	3.4	300	—	−15	30	100	10,000	13.0	20/–
KT61	Tetrode	6.3	0.95	IO826	—	—	10.5	250	250	−6	28	14	10,000	8.6	10/6
KT66	Beam Tetrode	6.3	1.27	IO826	—	—	6.3	400	300	−30	60	76	2,800	50	15/–
KT66	connected as Triode				8	1,450	5.5	400	—	−38	62.5	84†	4,000	14.5	
DA41	Triode (as TZ40)‡	7.5	2.5	UX46	62	17,500	3.6	1,000	—	0	22	220	6,900	175	£2/15/0
DA100	Triode	6.0	2.7	L41	5.5	1,410	3.9	1,000	—	−146	100	500	8,000	200	£8/8/0
DA250	Triode	10.0	2.0	Special	16	2,290	7.0	2,500	—	−130	80	360	12,000	800	£16/16/0

‡ American types. † Grid not driven positive in this case. * Both halves of one valve in case of Double Triodes.

RECTIFYING VALVES

Type	Description	Type of Rectification	Type of Base	*Wireless World* Base No.	Filament		Max. Anode Volts R.M.S.	Max. D.C. Output Volts at Max. Current	Max. D.C. Output Current mA.	D.C. Output at Half Current, Volts	D.C. Output at Half Current mA.	Price
					Volts	Current amps.						
U10	Directly Heated..	Bi-phase	4-pin	BR42	4.0	1.0	250	260	100	270	50	9/–
U12/14	Directly Heated..	Bi-phase	4-pin	BR42	4.0	2.5	500	540	120	620	60	9/–
MU12/14	Indirectly Heated	Bi-phase	4-pin	BR43	4.0	2.5	500	540	120	600	60	9/–
U16	Directly Heated..	Single phase	4-pin	BR44	2.0	1.0	5,000	6,400	5.0	—	—	15/–
U17	Directly Heated..	Single phase	4-pin	BR44	4.0	1.0	2,500	2,950	30	—	—	15/–
U18	Directly Heated..	Bi-phase	4-pin	BR42	4.0	3.4	500	520	250	600	125	15/–
U20	Directly Heated..	Bi-phase	4-pin	BR42	4.0	3.75	850	1,050	125	1,100	62.5	15/–
U30	*Indirectly Heated.*	*Bi-phase*	*7-pin*	BR738	*26* *13*	*0.3* *0.6*	*200*	*182*	*120*	*212*	*60*	*9/–*
U31	Indirectly Heated	Single phase	Octal	IO86	26	0.3	250	280	100	D.C. volts drop 20 v. at 120 mA.		9/–
U50	Directly Heated..	Bi-phase	Octal	IO82	5.0	2.0	350	325	120	380	60	9/–
U52	Directly Heated..	Bi-phase	Octal	IO82	5.0	3.0	500	500	200	565	100	15/–
U71	Indirectly Heated	Single phase	Octal	IO86	30	0.16	250	250	75	D.C. volts drop 18 v. at 75 mA.		9/–
GU50	Mercury Vapour..	Single phase	4-pin	BR44	4.0	3.0	1,500	1,270	250*	1,300	125*	25/–

* Delayed switching of anode volts essential.

Types normally supplied for servicing purposes only, shown in italics. Suffix M indicates metallised bulb.

OSRAM VALVES (continued)

TUNING INDICATORS (" TUNERAY ")

Type	Description	Filament		Type of Base	*Wireless World* Base No.	Anode Voltage (through 1 megohm)		Target Voltage max.	Target Current mA.	Triode Current	Triode Grid Voltage for 0° Shadow angle	Price
		Volts	Current amps.			max.	min.					
Y61* *Y63*	For A.C. Sets	6.3	0.3	Octal	IO838	250	180	250	4.5	0.25	−22	8/6
Y62* *Y64*	For D.C./A.C. Sets	6.3	0.3	Octal	IO838	250	80	250	4.5	0.25	−22	8/6

* Y61 and Y62 are in tubular bulbs and replace Y63 and Y64 respectively.

OSRAM BARRETTERS (CURRENT REGULATORS)

OSRAM Barretter Type	Mean Current Rating (amps.)	Voltage Range	Type of Base	Price
202	0.2	120—200	4-pin	8/6
251	*0.25*	*100—180*	*4-pin*	*12/6*
301	0.3	138—221	E.S. cap	8/6
302	0.3	112—195	E.S. cap	8/6
303	0.3	86—129	E.S. cap	8/6
304	0.3	95—165	E.S. cap	8/6

OSRAM PILOT OR DIAL LAMPS

Cat. No. of Lamp	Description	Type of Receiver for which suitable	Price each
O.S.45	2.5v. 0.3A 12 mm. round	2v. Battery Sets ..	3½d.
O.S.50	3.5v. 0.15A 12 mm. round	2v. Battery Sets & Fuses	3½d.
O.S 55	3.5v. 0.3A 12 mm. round	A.C. sets with 4v. transformer*	3½d.
O.S.70	6.2v. 0.3A 15 mm. round	AC sets with 4v. transformer .. .. DC/AC sets with 0.2A valves	4½d.
O.S.75	6.5v. 0.3A 12 mm. round	DC/AC sets with 0.3A valves .. .. AC sets with 6.3v. transformer	4½d.
O.S.7588	8v. 1.6 watt M.E.S. Indicator..	AC Sets	1/6

* Between centre tap and one side; or two lamps in series across 4-volt winding.

MISCELLANEOUS TYPES

Type	Description	Filament		D or I	Base	Anode Volts	Screen Volts	Mutual Conductance mA/volt	Impedance ohms	Price
		Volts	Current Amps.							
HA1	Acorn Triode	4	0.25	I	—	180	—	1.7	11,700	45/-
HA2	Acorn Triode (American 955) ..	6.3	0.15	I	—	180	—	2.0	12,500	45/-
ZA1	Acorn Pentode	4	0.25	I	—	250	100	1.4	—	50/-
ZA2	Acorn Pentode (American 954).	6.3	0.15	I	—	250	100	1.4	—	50/-
A373	Peak Voltmeter Diode	1.8	1.6	D	S.E.S.	2,000	—	—	—	60/-
A577	Voltmeter Triode	4	1.0	I	5-pin	250	—	2.0	3,000	60/-
A537	Low Noise Triode	4	0.4	I	Sm. side cont.	150	—	1.55	10,000	50/-
4053	Cathode Ray Oscillograph Tube (Vacuum Type).	4	1.0	I	9-pin	500	1½in. dia. screen			45/-
4081	Cathode Ray Oscillograph Tube (Vacuum Type).	4	1.0	I	9-pin	800	2¾in. dia. screen			55/-
GTIC	Gasfilled Relay	4	1.3	I	5-pin	500	Max. current 1.0 amp peak, 0.5 amp. R.M.S., 0.3 amp. average			25/-

. Types normally supplied for servicing purposes only, shown in italics. Suffix M indicates metallised bulb.

Full technical data and characteristic curves on these and other specialised types of Osram valves, available on request to:— The Osram Valve Technical Dept., The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

TUNGSRAM VALVES

British Tungsram Radio Works, Ltd., West Road, Tottenham, N.17

Sole Distributors to the Trade: Siemens Electric Lamps and Supplies, Ltd., 38-39 Upper Thames Street, London, E.C.4

4-VOLT A.C. RANGE

(English and Side Contact Based)

Type No.	Description C = Clear M = Metallised	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	W_0¶ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
TH4A	Triode Hep. F. Ch. M	1.5	275	100	Vm	3.2	1.5 MΩ	0.75†	6.0‖	8‡	BR736	—	11/6
TH4B	Triode Hep. F. Ch. M	1.5	275	100	Vm	3.2	1.5 MΩ	0.75†	4.5‖	8‡	BR736	—	11/6
TX4	Triode Hex. F. Ch. M	1.0	300	80	Vm	5.5	1.0 MΩ	1.5†	1.0‖	15‡	BR733	—	11/6
TP4	Triode Pen. F. Ch. M	1.2	250	200	Vm	6.5	1.0 MΩ	0.7†	1.4‖	3‡	BR93	—	11/6
VO4 & VO4s ...	Octode F. Ch. ... M	.65	250	70	Vm	1.6	1.0 MΩ	0.6†	1.5‖	8.5‡	BR731	SC825	11/6
MH4105/71 &.../73 ...	Heptode F. Ch. M/C	1.0	250	100	Vm	3.5	1.36MΩ	1.2†	0.52‖	20‡	BR728	CO74	11/6
HP4106c (or HP4105)	Pentode R.F. Vm ... M	1.0	250	100	Vm	5.0	1.2 MΩ	3.5	—	—	BR714	BR516	10/6
HP4101c	Pentode R.F. ... M	1.0	250	100	20.0	3.5	2.0 MΩ	3.5	—	—	BR714	BR516	10/6
HP4115 (or AF2) ...	Pentode R.F. Vm ... M	1.0	250	100	Vm	4.5	1.4 MΩ	3.2	—	—	BR714	BR516	10/6
VP4 & VP4s ...	Pentode R.F. Vm ... M	.65	250	100	Vm	8.0	1.2 MΩ	1.8	—	—	BR715	SC818	10/6
VP4B & VP4C ...	Pentode R.F. Vm ... M	.65	250	250	Vm	11.5	1.0 MΩ	4.0	—	—	BR715	BR714	10/6
SP4 & SP4s	Pentode R.F. ... M	.65	250	100	2.0	3.0	2.0 MΩ	2.4	—	—	BR715	SC818	10/6
SP4B	Pentode R.F. ... M	.65	250	250	3.0	2.9	2.0 MΩ	4.0	—	—	BR715	—	10/6
AS4125	Tetrode R.F. ... M	1.0	200	100	Vm	3.0	0.25MΩ	3.0	—	—	BR510	—	10/6
AS4120	Tetrode R.F. M/C	1.0	200	100	2.0	3.0	0.33MΩ	3.0	—	—	BR510	—	10/6
HL4+ & HL4G ...	Triode ... M/C	.65	250	—	0	5.0	10,000Ω	3.5	—	—	BR54	BR75	7/6
LL4 & LL4C ...	Triode C	1.2	350	1,000§	10.0	18.0	2,000Ω	3.5	1.0	11,000	BR54	BR56	7/6-17/6§
DDT4 & DDT4s ...	Duo Diode Triode... M	.65	250	—	0	5.0	13,000Ω	3.6	—	—	BR77	SC811	9/6
DD4 & DD4s ...	Duo Diode ... ... M	.65	200	—	—	0.8	15,000Ω	—	—	—	BR52	SC51	5/6
DD4D	Duo Diode (sep.caths)M	.5	200	—	—	4.0	10,000Ω	—	—	—	BR72	—	5/6
D418	Diode ... ... M	.18	200	—	—	5.0	3,000Ω	—	—	—	BR46	—	5/6
PP4 & PP4s	Output Pentode ... C	1.1 *f*	250	250	15.0	34.0	—	3.5	2.8	7,500	BR512	SC815	10/6
APP4A & APP4As...	Output Pentode ... C	2.0	250	250	16.5	35.0	—	3.5	3.0	7,000	BR722	SC817	10/6
APP4B & APP4Bs...	Output Pentode ... C	2.0	250	250	6.0	36.0	—	10.0	3.6	7,000	BR719	SC816	10/6
APP4C	Op. Triple Grid ... C	2.0	250	250	6.0	36.0	—	10.0	4.0	7,000	BR713	—	10/6
APP4G & APP4G*...	Output Pen (low cap.)C	2.0	250	250	6.0	36.0	—	10.0	4.0	7,000	BR721	BR720	15/-
APP4E & APP4Es ..	Output Pentode ... C	2.1	375	275	15.0	72.0	—	8.5	8.0	3,500	BR719	SC816	12/-
DDPP4B & DDPP4M	Duo Diode Pentode . C	2.0	250	250	6.0	36.0	—	10.0	3.6	7,000	BR724	BR725	12/6
P12/250	Output Triode ... C	1.0 *f*	300	—	33.0	48.0	850Ω	6.0	2.5	2,400	BR47	—	9/6
P15/250 & P15/250s	Output Triode ... C	1.0 *f*	350	—	45.0	60.0	660Ω	6.0	4.0	2,300	BR47	SC87	10/6
VME4	Magic Eye Vm ... C	.3	250	250	Vm	0.1	—	—	—	1MΩ	BR737	—	8/6
ME4s	Magic Eye C	.5	250	250	5.0	0.1	—	—	—	2MΩ	SC828	—	8/6
APV4 & IRV120/350s	Full Wave Rec. ... C	2.0	350	—	—	120	—	—	—	—	BR43	SC83	9/-
RV120/350 & ......s	Full Wave Rec. ... C	2.4 *f*	350	—	—	120	—	—	—	—	BR42	SC81	9/-
RV120/500 & ......s	Full Wave Rec. ... C	2.4 *f*	500	—	—	120	—	—	—	—	BR42	SC81	9/-
RV200/600	Full Wave Rec. ... C	2.8 *f*	600	—	—	200	—	—	—	—	BR42	—	15/-

0.2 AMP. UNIVERSAL A.C./D.C. TYPES

(English and Side Contact Based)

Type No.	Description C = Clear M = Metallised	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	W_0¶ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
TX21...	Triode Hexode F.Ch. M	21	250	80	Vm	5.5	1.0 MΩ	1.0†	1.5‖	15‡	BR733	—	11/6
TX29...	Triode Hep. F. Ch. M	29	250	100	Vm	3.2	1.5 MΩ	0.75†	5.5‖	8‡	BR736	—	11/6
TH30...	Triode Hep. F. Ch. M	30	250	100	Vm	3.2	1.5 MΩ	0.75†	4.5‖	8‡	BR736	—	11/6
VO13 & VO13s ...	Octode F. Ch. ... M	13	250	70	Vm	1.6	1.0 MΩ	0.6†	1.5‖	8.5‡	BR731	SC825	11/6
VP13K & VP13s ...	Pentode R.F. Vm ... M	13	250	100	Vm	8.0	1.2 MΩ	1.8	—	—	BR716	SC818	10/6
VP13B	Pentode R.F. Vm ... M	13	250	200	Vm	10.0	1.0 MΩ	3.5	—	—	BR715	—	10/6
HP13 & HP13s ...	Pentode R.F. Vm ... M	13	250	100	Vm	8.0	1.0 MΩ	3.5	—	—	BR715	SC818	10/6
SP13 & SP13s ...	Pentode R.F. ... M	13	250	100	2.0	3.0	2.0 MΩ	2.4	—	—	BR715	SC818	10/6
SP13B	Pentode R.F. ... M	13	250	200	3.0	3.0	2.0 MΩ	4.0	—	—	BR715	—	10/6
HL13 & HL13s ...	Triode ... ... M	13	250	—	4.5	5.0	10,000Ω	3.0	—	—	BR75	SC88	7/6
DDT13 & DDT13s ...	Duo Diode Triode... M	13	250	—	0	4.0	10,000Ω	3.6	—	—	BR77	SC811	9/6
DD13 & DD13s ...	Duo Diode ... ... M	13	200	—	—	0.8	15,000Ω	—	—	—	BR52	SC51	5/6
DD6	Duo Diode ... ... M	6.3	200	—	—	0.8	15,000Ω	—	—	—	BR52	—	5/6
PP13s	Output Pentode ... C	13	200	200	14.0	25.0	—	3.5	1.8	8,000	SC817	—	10/6
PP24 & PP24s ...	Output Pentode ... C	24	200	100	11.0	40.0	—	8.0	3.0	5,000	BR720	SC817	10/6
PP34 & PP34s ...	Output Pentode ... C	34	200	200	7.5	45.0	—	8.5	3.2	4,400	BR720	SC817	10/6
PP35	Output Pentode ... C	35	200	200	7.5	45.0	—	8.5	3.2	5,000	BR719	—	10/6
PP36	Op. Triple Grid ... C	36	200	200	7.5	45.0	—	8.5	3.2	5,000	BR713	—	10/6
PP37 & CL6	Output Pentode ... C	37	200	100	9.5	45.0	—	8.5	3.5	4,500	BR720	SC817	10/6
DDPP39 & DDPP39M	Duo Diode Pentode C	39	200	200	7.5	45.0	—	8.5	3.2	4,400	BR724	BR725	12/6
CBL1...	Duo Diode Pentode C	39	200	200	7.5	45.0	—	8.5	3.2	4,400	SC821	—	12/6
ME6s	Magic Eye C	6.3	200	200	0	1.2	—	—	—	2MΩ	SC828	—	8/6
V20 & V20s	Single-Path Rectifier C	20	250	—	—	80.0	—	—	—	—	BR51	SC82	9/-
PV29 & PV29s ...	Two-Path Rectifier . C	25	125	—	—	120	—	—	—	—	BR71	SC84	9/-
V30	Single-Path Rectifier C	30	275	—	—	120	—	—	—	—	BR51	—	9/-
PV30 & PV30s ...	Two-Path Rectifier . C	30	275	—	—	120	—	—	—	—	BR71	SC84	9/-

RF Floating screen potential derived from dropping resistance.

§ Where two type numbers are shown, the alternative Base No. or Price applies only to the second type.

† Conversion conductance in the case of mixer valves (mA/V).

¶ Average Ia at full output (mA).

Vm Variable-mu.

‡ Optimum heterodyne voltage in the case of mixer valves (r.m.s.).

‖ Triode slope in the case of frequency changer valves (mA/V).

f Directly heated filament.

TUNGSRAM VALVES (continued).

1.4-VOLT ALL-DRY BATTERY RANGE

(Octal and Side Contact Based)

Type No.	Description C = Clear M = Metallised	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	Wo‖ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
1A7-G & DK1 ...	Pentagrid F. Ch. C/M	0.05f	90	45	Vm	0.55	0.6 MΩ	0.25†	—	7‡	IO832	SC823	10/6
1N5-G & DF1 ...	Straight R.F. Pen. C/M	0.05f	90	90	0	1.2	1.5 MΩ	0.75	—	—	IO821	SC813	9/-
1H5-G & DAC1 ...	Diode-Triode C/M	0.05f	90	—	0	0.14	0.24MΩ	0.275	—	—	IO812	SC89	7/6
1A5-G & DL1 ...	Economy Pentode... C	0.05f	90	90	4.5	4.0	—	0.85	0.115	25,000	IO822	SC815	9/-
1C5-G & DL2 ...	Output Pentode ... C	0.1 f	90	90	7.5	7.5	—	1.55	0.240	8,000	IO822	SC815	9/-
1Q5-GT	Beam Pentode ... C	0.1 f	90	90	4.5	9.1	—	2.1	0.270	8,000	IO822	—	9/-
3Q5-GT	Beam Pen. (2.8 volt) C	0.05f	90	90	4.5	7.5	—	1.8	0.250	8,000	IO818	—	9/-

2-VOLT BATTERY RANGE

(English and Side Contact Based)

Type No.	Description C = Clear M = Metallised	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	Wo‖ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
VO2 & VO2s ...	Octode F. Ch. ... M	0.13f	135	60	Vm	0.7	2.0 MΩ	0.27†	0.9‖	8.5‡	BR730	SC824	10/6
VX2 & VX2s ...	Hexode Mixer-Ampl. M	0.13f	135	60	Vm	1.0	1.0 MΩ	1.4	—	—	BR717	SC822	9/-
DG210/o	Double Grid F. Ch. C	0.13f	100	20	1.5	1.0	5,000Ω	1.0	—	—	BR57	—	15/-
VP2B & VP2Bs ...	Grid Top Vm Pen. M	0.05f	135	135	Vm	2.5	2.0 MΩ	0.65	—	—	BR711	SC814	9/-
VP2D	Grid Top Vm Pen. M	0.1 f	120	60	Vm	1.3	1.0 MΩ	2.0	—	—	BR711	—	9/-
HP211c	Anode Top Vm Pen. M	0.13f	150	150	Vm	2.6	2.0 MΩ	1.7	—	—	BR712	BR49	9/-
SP2B & SP2Bs ...	Grid Top R.F. Pen. M	0.05f	135	135	0.5	2.6	1.3 MΩ	0.8	—	—	BR711	SC814	9/-
SP2D...	Grid Top R.F. Pen. M	0.1 f	120	60	1.0	1.0	1.0 MΩ	1.7	—	—	BR711	—	9/-
HP210c	Anode Top R.F. Pen. M	0.13f	150	150	1.0	1.9	2.0 MΩ	1.9	—	—	BR712	BR49	9/-
SE211c	Vm Screen Grid M/C	0.13f	150	75	Vm	1.0	1.0 MΩ	1.5	—	—	BR48	—	9/-
SS210c	Straight Scrn. Grid M/C	0.13f	150	75	0.9	1.5	1.5 MΩ	1.4	—	—	BR48	—	9/-
HL2 & HL2s ...	Triode Osc. or Det. M/C	0.13f	135	—	1.5	1.2	20,000Ω	1.5	—	—	BR47	SC87	4/9
HR210	Triode H.F. or Det. M/C	0.13f	135	—	1.5	1.2	23,000Ω	1.3	—	—	BR47	—	4/9
HR2 & HR2s ...	Triode R.C. or Det. C	0.065f	135	—	1.5	1.2	40,000Ω	0.6	—	—	BR47	SC87	4/9
LD210	Triode L.F. or Det. M/C	0.13f	150	—	4.5	3.0	14,000Ω	1.3	—	—	BR47	—	4/9
DDT2 & DDT2A ...	Double Diode Triode M	0.1 f	135	—	2.5	1.0	21,000Ω	1.4	—	—	BR59	BR59x	7/6
DDT2B & DDT2Bs	Double Diode Triode M	0.1 f	135	—	4.5	2.5	16,000Ω	1.0	—	—	BR59	SC810	7/6
LL2 & LL2s... ...	Driver Triode ... C	0.2 f	135	—	2.5	3.0	11,000Ω	2.6	0.055	25,000	BR47	SC87	4/9
LP220	Low Power Triode... C	0.2 f	150	—	6.0	5.0	3,500Ω	3.5	0.200	7,500	BR47	—	6/-
P215	Power Triode ... C	0.15f	150	—	12.0	8.0	3,300Ω	1.5	0.260	7,000	BR47	—	6/-
SP220	Super Power Triode C	0.2 f	150	—	18.0	14.0	2,200Ω	3.0	0.360	6,700	BR47	—	6/-
CB215 & CB215s ...	Cl. B. Double Triode C	0.22f	135	—	0	12.0¶	—	2.0	1.700	10,000	BR76	SC812	9/6
CB220	Cl. B. Double Triode C	0.25f	150	—	3.0	15.0¶	—	2.0	2.000	10,000	BR76	—	9/6
PP2 & PP2s... ...	Economy Pentode... C	0.14f	135	135	5.0	7.0	—	2.1	0.440	19,000	BR513	SC815	9/-
PP215 & PP215s ...	Low Voltage Pen. ... C	0.15f	90	90	4.5	8.0	—	1.7	0.250	14,000	BR512	SC815	9/-
PP225 & PP225s ...	Large Pentode ... C	0.26f	135	135	12.0	18.0	—	2.0	0.900	6,000	BR512	SC815	9/-

x Diodes reversed.

6.3-VOLT "E" RANGE

(Side Contact and "Footless" Based)

Type No.	Description C = Clear M = Metallised	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	Wo‖ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
ECH2	Triode Heptode F. Ch. M	.95	250	100	Vm	3.2	1.5 MΩ	0.75†	5.5‖	7‡	SC826	—	11/6
ECH3	Triode Hexode F. Ch. M	.2	250	RF	Vm	3.0	1.0 MΩ	0.65†	2.8‖	10‡	SC826	—	11/6
ECH11	Footless Triode Hex. M	.2	250	RF	Vm	3.0	1.0 MΩ	0.65†	2.8‖	10‡	FO85	—	11/6
EK2	Auto. Octode F. Ch. M	.2	250	50	Vm	1.0	1.0 MΩ	0.55†	1.5‖	15‡	SC825	—	11/6
EK3	Beam Octode F. Ch. M	.65	250	100	Vm	2.5	2.0 MΩ	0.65†	4.5‖	12‡	SC825	—	11/6
EF5	Vm R.F. Pen. ... M	.2	250	100	Vm	8.0	1.2 MΩ	1.7	—	—	SC818	—	10/6
EF6	Straight R.F. Pen. .. M	.2	250	100	2.0	3.0	2.5 MΩ	2.0	—	—	SC818	—	10/6
FF8	Vm R.F. Hexode ... M	.2	250	250	Vm	8.0	0.4 MΩ	1.8	—	—	SC819	—	10/6
EF9	Log R.F. Pentode... M	.2	250	RF	Vm	6.0	1.5 MΩ	2.2	—	—	SC818	—	10/6
EF11	Footless Vm Pen. ... M	.2	250	RF	Vm	6.0	1.5 MΩ	2.2	—	—	FO82	—	10/6
EF12	Footless St. R.F. Pen. M	.2	250	100	2.0	3.0	2.5 MΩ	2.0	—	—	FO82	—	10/6
EBF2	Duo Diode R.F. Pen. M	.2	250	RF	Vm	5.0	1.5 MΩ	1.8	—	—	SC821	—	11/6
EBF11	Footless DD RF Pen. M	.2	250	RF	Vm	5.0	1.5 MΩ	1.8	—	—	FO84	—	11/6
EBC3	Duo Diode Triode... M	.2	275	—	6.2	5.0	15,000Ω	2.0	—	—	SC811	—	9/6
EAB1	Triple Diode ... M	.2	200	—	—	0.8	15,000Ω	—	—	—	SC86	—	5/6
EB4	Duo Diode ... ... M	.2	200	—	—	0.8	15,000Ω	—	—	—	SC85	—	5/6
EBL1	D.D. Output Pen.... M	.2	250	250	6.0	36.0	—	10.0	3.6	7,000	SC821	—	12/6
EL2	Output Pentode ... C	.2	250	250	18.0	32.0	—	2.8	3.6	8,000	SC817	—	10/6
EL3	Output Pentode ... C	1.2	250	250	6.0	36.0	—	10.0	3.6	7,000	SC816	—	10/6
EL5	Output Pentode ... C	1.35	250	250	10.0	72.0	—	8.5	8.8	3,500	SC816	—	13/6
EL6	Output Pentode ... C	1.4	250	250	7.0	72.0	—	15.0	8.2	3,500	SC816	—	12/-
ELL1	Double Pentode ... C	.45	250	250	22.0	2 x 15	—	1.3	5.5	16,000	SC820	—	12/-
EFM1	Vm Pen. Magic Eye. C	.2	250	RF	Vm	1.0	—	1.0	—	—	SC827	—	12/-
EM1	Magic Eye C	.2	250	250	Vm	0.7	—	—	—	—	SC828	—	8/6
EM4	Double Magic Eye .. —	.2	250	250	Vm	0.75	—	—	—	—	SC829	—	8/6
CL6	Output Pen. (37 v)... C	.2	200	100	8.5	45.0	—	8.0	4.0	4,500	SC817	—	10/6
CBL1...	D.D.O.P. Pen. (39 v) C	.2	200	200	7.5	45.0	—	8.0	4.0	4,500	SC821	—	12/6
EZ2	Vibrator Rec. F.W. C	.4	400	—	—	60.0	—	—	—	—	SC83	—	9/-
EZ3	Vibrator Rec. F.W. C	.65	400	—	—	100.0	—	—	—	—	SC83	—	9/-
EZ4	Large Rec. F.W. ... C	.9	400	—	—	175.0	—	—	—	—	SC83	—	20/-

TUNGSRAM VALVES (continued).

INTERNATIONAL AND AMERICAN TYPES

(Octal and UX Based.) **(See separate table for 1.4-volt types.)**

Type No.	Description C = Clear M = Metallised	VH Volts	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	Wo‖ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
6A8G & 6A7	Pentagrid F. Ch. ... C	6.3	0.3	250	100	Vm	3.5	0.36MΩ	0.52†	1.2‖	20‡	IO834	UX73	11/6
6B8G & 6B7	Duo Diode Vm R.F. Pen C	6.3	0.3	250	100	Vm	10.0	0.6 MΩ	1.2	—	—	IO830	UX71	11/6
6E8G... ...	Triode Hexode F. Ch.... M	6.3	0.3	250	100	Vm	3.3	1.0 MΩ	0.65†	2.8‖	10‡	IO836	—	11/6
6F6G & 42 ...	Output Pentode ... C	6.3	0.7	250	250	16.5	34.0	—	2.65	3.0	7,000	IO827	UX69	10/6
6H6G ...	Duo Diode (sep. Caths.) C	6.3	0.3	100	—	—	4.0	10,000Ω	—	—	—	IO87	—	5/6
6J5G	Triode Osc., A.F. ... C	6.3	0.3	250	—	8.0	9.0	7,000Ω	2.6	0.15	4,000	IO89	—	7/6
6J7G & 77 ...	Screened R.F. Pen., Det. C	6.3	0.3	250	125	3.0	2.0	1.0 MΩ	1.2	—	—	IO825	UX67	10/6
6J8G	Triode Heptode F. Ch. C	6.3	0.3	250	100	Vm	1.2	4.0 MΩ	0.29†	—	10‡	IO836	—	11/6
6K7G & 78 ...	Screened Vm R.F. Pen. C	6.3	0.3	250	125	Vm	10.0	0.6 MΩ	1.65	—	—	IO824	UX67	10/6
6K8G... ...	Screened Beam F. Ch.... C	6.3	0.3	250	100	Vm	2.5	0.6 MΩ	0.35†	3.0‖	7.5‡	IO837	—	11/6
6L6G ...	Beam Power Tetrode ... C	6.3	0.9	250	250	14.0	72.0	—	6.0	6.5	2,500	IO817	—	15/–
6L7G ...	Pentagrid Mixer ... C	6.3	0.3	250	150	3.0	3.3	1.0 MΩ	0.35	—	12‡	IO834	—	11/6
6Q7G ...	Duo Diode Triode ... C	6.3	0.3	250	—	3.0	1.1	58,000Ω	1.2	—	—	IO813	—	9/6
6TH8G ...	Triode Hexode F. Ch. ... M	6.3	0.6	250	100	Vm	5.5	1.0 MΩ	1.0	1.5‖	15‡	IO836	—	11/6
6U5G & 6U5...	Vm Magic Eye... ... C	6.3	0.3	250	250	Vm	0.24	—	—	—	1 MΩ	IO838	UX611	8/6
6U7G & 6D6...	Vm R.F. Pen. ... C/M	6.3	0.3	250	100	Vm	8.2	0.8 MΩ	1.6	—	—	IO824	UX67	10/6
6V6G ...	Beam Power Tetrode ... C	6.3	0.45	250	250	12.5	45.0	—	4.1	4.3	5,000	IO817	—	10/6
6X5G... ...	I.H. Rectifier Vibr. ... C	6.3	0.63	350	—	—	100	—	—	—	—	IO85	—	9/–
5Y3G & 80 ...	D.H. Rectifier C	5.0	2.0 *f*	350	—	—	125	—	—	—	—	IO82	UX41	9/–
5Z4G & 80A...	I.H. Rectifier C	5.0	1.5	350	—	—	125	—	—	—	—	IO84	UX42	9/–
5T4G & 5X4G	Large Rectifier... ... C	5.0	2.0 *f*	450	—	—	250	—	—	—	—	IO82	IO83	10/6– 15/–§
5U4G & 5Z3...	Large Rectifier... ... C	5.0	2.0 *f*	450	—	—	250	—	—	—	—	IO82	UX41	15/–
25A6G & 43...	Output Pentode ... C	25.0	0.3	180	135	20.0	38.0	—	2.5	2.75	5,000	IO827	UX69	10/6
25L6G ...	Output Pentode ... C	25.0	0.3	200	100	8.5	45.0	—	8.0	4.0	4,500	IO817	—	10/6
25Y5G & 25Y5	AC/DC Rectifier ... C	25.0	0.3	275	—	—	100	—	—	—	—	IO87	UX61	9/–
25Z6G & 25Z5	AC/DC Rectifier ... C	25.0	0.3	125	—	—	100	—	—	—	—	IO87	UX61	9/–

MISCELLANEOUS TYPES

(Octal, UX and English Bases.) **(Some older types may be listed as alternatives in International tables.)**

Type No.	Description C = Clear M = Metallised	VH Volts	IH Amps.	Va	Vsg	Vg	Ia mA.	Ri Ohms or Megohms	Sc† mA/V.	Wo‖ Watts	Opt.‡ Load Ohms	*Wireless World* Base No.	Alternative *Wireless World* Base No.§	Price
2A5	Output Pentode ... C	2.5	1.75	250	250	16.5	34.0	—	2.65	3.0	7,000	UX69	—	10/6
2A6	Duo Diode Triode ... C	2.5	0.8	250	—	2.0	0.8	90,000Ω	1.1	—	—	UX64	—	9/6
2A7	Pentagrid F. Ch. ... C	2.5	0.8	250	100	Vm	3.5	0.36MΩ	0.52†	1.2‖	20‡	UX73	—	11/6
2B7	Duo Diode R.F. Pen. ... C	2.5	0.8	250	100	Vm	10.0	0.6 MΩ	1.2	—	—	UX71	—	11/6
6C5G* & 76 ...	Triode C	6.3	0.3	250	—	13.5	5.0	10,000Ω	1.45	1.0	4,000	IO89	UX52	7/6
6C6	R.F. Pen., Det. ... C	6.3	0.3	250	100	3.0	2.0	1.0 MΩ	1.22	—	—	UX67	—	10/6
6G5G & 6G5...	Magic Eye C	6.3	0.3	250	250	Vm	0.24	—	—	—	1 MΩ	IO838	UX611	8/6
PX2100 or 10	Large Triode C	7.5	1.25*f*	450	—	32.0	18.0	5,000Ω	1.6	1.6	10,000	UX44	UX41	9/6
18	AC/DC Output Pen. ... C	14.0	0.3	200	200	12.0	40.0	—	2.65	2.5	7,500	UX69	—	10/6
19	Cl. B. Double Triode ... C	2.0	0.26*f*	150	—	3.0	15.0¶	—	2.0	2.0	10,000	UX62	—	9/6
24A	Screened Tetrode ... C	2.5	1.75	250	90	3.0	4.0	0.4 MΩ	1.05	—	—	UX56	—	10/6
33	Output Pentode ... C	2.0	0.26*f*	135	135	12.0	18.0	—	2.0	1.0	6,000	UX54	—	9/–
35 & 51 ...	Vm Screened Tetrode ... C	2.5	1.75	250	90	Vm	6.5	0.4 MΩ	1.05	—	—	UX56	—	10/6
45	Output Triode ... C	2.5	1.5 *f*	275	—	56.0	36.0	—	2.05	2.0	4,600	UX44	—	9/6
47	Output Pentode ... C	2.5	1.75*f*	250	250	16.5	31.0	—	2.5	2.7	7,000	UX54	—	10/6
P25/450 & 50	Large Triode C	7.5	1.25*f*	450	—	84.0	55.0	1,800Ω	2.1	4.6	4,400	BR47	UX44	20/–
57	R.F. Pentode C	2.5	1.0	250	100	3.0	2.0	1.0 MΩ	1.22	—	—	UX67	—	10/6
58 & 58M ...	Vm R.F. Pentode C/M	2.5	1.0	250	100	Vm	8.2	0.8 MΩ	1.6	—	—	UX67	UX67	10/6
75	Duo Diode Triode ... C	6.3	0.3	250	—	2.0	0.8	90,000Ω	1.1	—	—	UX64	—	9/6
81	Half Wave Rectifier ... C	7.5	1.25*f*	700	—	—	85.0	—	—	—	—	UX43	—	17/6
PP2101 ...	Output Pentode ... C	2.0	0.14*f*	135	135	5.0	7.0	—	2.1	0.44	19,000	UX54	—	9/–
PV25 ...	Double Rectifier ... C	25.0	0.3	275	—	—	100	—	—	—	—	BR71	—	9/–
PVB6 ...	Automobile Rect. Vibr. C	6.3	0.63	400	—	—	100	—	—	—	—	BR52	—	9/–
DDPP6B ...	Duo Diode Output Pen. C	6.3	1.4	250	250	6.0	36.0	—	10.0	3.6	7,000	BR724	—	12/6
PP13A ...	AC/DC Output Pentode C	13.0	0.3	200	200	12.0	40.0	—	2.65	2.5	7,500	BR719	—	10/6
PP6BG & PP6C	Output Pentode ... C	6.3	1.2	250	250	6.0	36.0	—	10.0	3.6	7,000	IO826	BR713	10/6

OTHER TYPES

0.18-AMP. UNIVERSAL AC/DC

	Wireless World Base No.	Price		*Wireless World* Base No.	Price
MH1118	CO74	11/6	R2018	BR54	9/6
HP2118	BR510/714	12/6	P2018	BR54	13/–
HP2018	BR510/714	12/6	PP2018	BR514/719	13/6
HP1118	CO72	10/6	PP4118	CO73	10/6
HP1018	CO72	10/6	PV3018	CO71	9/–
DD818	BR53	5/6	V2118	BR51	10/–

LARGE POWER AND TRANSMITTING TYPES

Large Power Triodes		Transmitting Pentodes and Triodes		Rectifiers (Vacuum and Gas)
O15/400	P60/500	APP4G	OQ15/600	V21/7000
P25/500	OP70/1000	OS12/500	OQQ25/800	PV75/1000
P26/500	O75/1000	OS12/501	OP38/600	PV100/2000
P27/500	P100/1000	OS18/600	OQQ55/1500	RG250/1000
P28/500	P100/1250	OS40/1250	OQ71/1000	RG250/3000
P30/500	O240/2000	OS125/2009	OQQ150/3000	RG1000/3000
OP37/600	O250/2000		O300/3000	
	O1500/5000			

RF Floating screen potential derived from dropping resistance.

§ Where two type numbers are shown, the alternative Base No. or Price applies only to the second type.

† Conversion conductance in the case of mixer valves (mA/V).

¶ Average Ia at full output (mA).

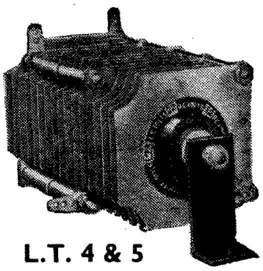
Vm Variable-mu.

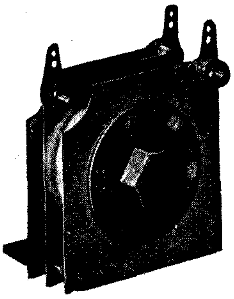
‡ Optimum heterodyne voltage in the case of mixer valves (r.m.s.).

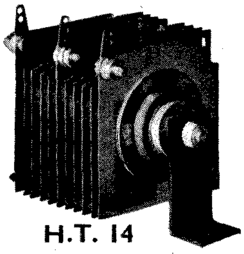
‖ Triode slope in the case of frequency changer valves (mA/V).

f Directly heated filament.

WHEN RELIABILITY comes first


L.T. 4 & 5

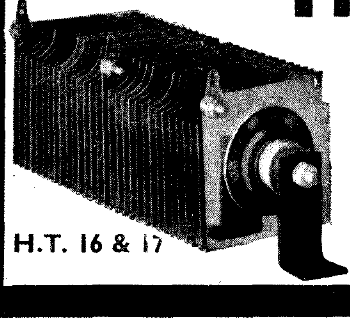

L.T. 7, 8 & 9

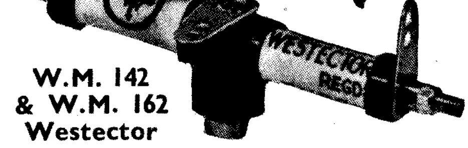

H.T. 14

Type	Condenser Capacity mfd.	Condenser Rating Volts	Type of Rectifier	Max. Input		Normal Rect. Current mA.	Unsmoothed Volts	
				Volts RMS	Current mA.		Full Current	Half Current
H.T.14	4+4 4	200	V.D. H.W.	80 135	60 30	20	140	170
H.T.15	4+4 4	200	V.D. H.W.	140 250	120 80	30	230	315
H.T.16	4+4 4	400	V.D. H.W.	240 400	200 90	60	330	515
H.T.17	8+8 8	250	V.D. H.W.	150 250	300 150	100	225	350
H.T.17 for Class B	8	350	H.W.	150	40	25	150	175
2×H.T.17	6+6	500	V.D.	300	550	120	530	620
H.1	100	12	H.W.	3.5	15	10	3.6	4
H.10	10	50	H.W.	35	15	10	36	40
H.50	2	250	H.W.	175	15	10	180	205
H.75	2	400	H.W.	260	15	10	270	305
H.100	1	500	H.W.	350	15	10	360	410
H.176	0.5	1,100	H.W.	620	15	10	650	730
J.10	10	250	H.W.	80	3	2	80	—
J.20	5	500	H.W.	160	3	2	160	—
J.50	2	650	H.W.	400	3	2	400	—
J.100	1	1,250	H.W.	800	3	2	800	—
J.176	0.5	2,000	H.W.	1,400	3	2	1,400	—
2×H.120	0.5 +0.5	700	V.D.	480	30	10	870	1,000
2×H.176	0.25+0.25	1,000	V.D.	720	30	10	1,300	1,500
10×H.176	0.05+0.05	5,000	V.D.	3,600	30	10	6,500	7,500
2×J.10	10+10	250	V.D.	80	6	2	170	—
2×J.50	2+2	650	V.D.	400	6	2	850	—
2×J.100	1+1	1,250	V.D.	800	6	2	1,700	—
4×J.125	0.5+0.5	3,000	V.D.	1,700	6	2	4,000	—
2×J.176	0.5+0.5	2,000	V.D.	1,400	6	2	3,000	—
10×J.176	0.1+0.1	12,000	V.D.	7,000	6	2	15,000	—
W.4	0.0001	—	Detector (H.W.)	24	—	0.25	—	—
W.6	0.0001	—	Detector (H.W.)	36	—	0.25	—	—
W.X.1	0.0001	—	Detector (H.W.)	6	—	0.1	—	—
W.X.6	0.0001	—	Detector (H.W.)	36	—	0.1	—	—
W.M.142	0.0002	—	Detector (F.W.)	24+24	—	0.5	—	—
W.M.162	0.0002	—	Detector (F.W.)	36+36	—	0.5	—	—
					Amps.	Amps.		
L.T.4	—	—	B.	11	1.5	1	6	—
L.T.5	—	—	B.	22	1.5	1	12	—
L.T.7	—	—	C.T.	4+4	0.42	½	2	—
L.T.8	—	—	C.T.	8+8	0.42	½	6	—
L.T.9	—	—	C.T.	16+16	0.42	½	12	—
L.T.10	—	—	B.	20	3	2	12	—
L.T.11	—	—	B.	11	5.5	4	6	—
A.4	—	—	B.	14	3	2	9	—

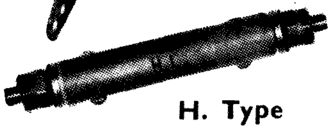
V.D.—Voltage doubler. H.W.—Half-wave. B.—Bridge. C.T.—Centre-tapped.

Westinghouse metal rectifiers


H.T. 16 & 17


W.M. 142 & W.M. 162 Westector

W. 4 & W. 6 Westector

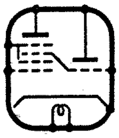

H. Type

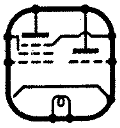
Send 3d. to Dept. W.W., Westinghouse Brake & Signal Co. Ltd., Pew Hill House, Chippenham, Wilts, for a copy of "The All Metal Way" which contains full details, circuits and curves

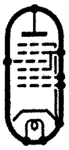
Valve Symbols

AS USED IN "WIRELESS WORLD" CIRCUIT DIAGRAMS

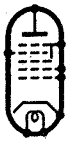
(Including Cathode-ray Tube, Barretter and Tuning Indicator Symbols)


Triode-hexode.

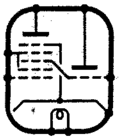

Triode-pentode.


Octode.

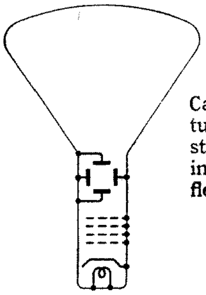

Pentagrid.


Heptode.


Class B valve.

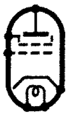

Triode-heptode.


Voltage-doubling rectifier.


Cathode-ray tube (electrostatic focusing and deflection).


RF low-noise valve.

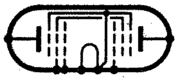

RF pentode.


RF tetrode.

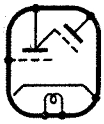

Double diode.


Double diode (split cathode).


Double-diode-triode.


QPP output valve.


Directly-coupled double triode.

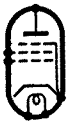

Cathode-ray tuning indicator.

As a general rule symbols for indirectly heated (mains) valves are shown, although directly heated (battery) equivalents for most types are available. These battery valves are represented by replacing the heater and cathode symbols by the directly heated filament symbol which is given.

The general symbols for cathode-ray tubes relate to the all-electrostatic and all-magnetic types. When the two methods of deflection or focusing are combined in a single tube, the symbols are modified in the obvious manner.


Triode.

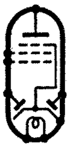

Output tetrode.

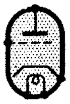

Output pentode.


Half-wave rectifier.

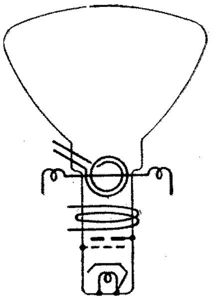

Full-wave rectifier.


Directly-heated cathode (filament).


Double-diode output pentode.


Gas-filled triode.


Barretter.


Cathode-ray tube (magnetic focusing and deflection).

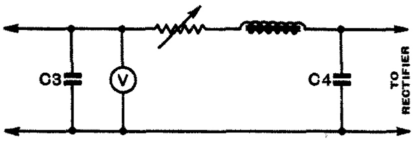
Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE THE OPINIONS OF HIS CORRESPONDENTS

Probe Valve Voltmeter

THE letter from Mr. Harris in your March issue was very interesting, and the meter is certainly of more general use, I imagine, as arranged for operation from the AC mains, but as it is shown in your paper, it is only capable of giving an approximation, even from moment to moment, as no account is taken of the wide changes which occur in the mains voltage.

By the simple addition of a voltmeter to read the HT supply, and an adjustable resistance to set the supply to whatever the meter was calibrated at, the equipment at once changes class, being then capable of extremely accurate calibration, with the certainty that the readings will remain so, especially if all the resistances carrying power are of heavy rating, and that no unnecessary cramping of the components causes an excessive change of temperature, which, in turn, would cause the value of the resistances to change quite widely, and in doing so, would alter the actual amplification given by the valve.



Showing the addition of a monitoring voltmeter and regulating rheostat in the HT supply circuit.

It may be that this point about the resistances is rather carrying care to excess, but, after all, there is no object in making up such an instrument as a valve voltmeter, if lab. work is not intended, and if it is, then no reasonable care taken is wasted effort.

Galashiels. BRYAN GROOM.

" Dangerous Catch Phrases "

MR. E. H. R. GREEN, writing in the March *Wireless World*, selects a sentence of mine as the text for a plea against confusing and inexact statements. With this plea I am emphatically in agreement; so it is a little embarrassing to be picked out as the horrid example, even in as gentle a manner as Mr. Green's. It is therefore some relief to me to find that in over half a column of criticism only one and a half lines properly apply to my quoted sentence. This is the comment "an electric field fluctuating at radio frequencies is not an electro-*static* field." Granted, with apologies. That is why I try very hard to avoid the popular American term "static" (meaning atmospherics or interference). But it is very difficult.

The remainder of Mr. Green's letter objects to statements about (a) the electric field, in radiomagnetic radiation, preponderating, and (b) screening round a frame aerial being to shut out the electric part of the radiation. He is perfectly justified in protesting against such ideas. They were not contained, however, in my sentence, which was "Designers have been finding that frame aerials, properly screened, are helpful against types of interference in which the electrostatic field predominates." There is no mention of radiation. The types of interference referred to are those generated well within a wavelength of the receiving aerial, which is therefore relatively little concerned with the *radiation* field. Mr. Green will agree, surely, that (to take an extreme case) between the plates of a condenser the electric field predominates over the magnetic?

Neither was I guilty of presenting an erroneous explanation of how screened frame aerials exclude interference, for I merely said they are helpful against it—a belief with which Mr. Green apparently agrees.

M. G. SCROGGIE.

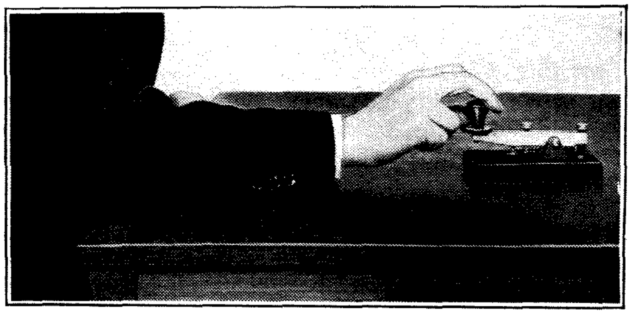
Morse Key Manipulation

WITH reference to the letter in the current issue regarding morse key manipulation, it may be of interest to quote instructions of the leading code teacher of the United States.

"Place your key well back on the table—18 inches or more—so your *elbow will not extend over the edge*. Pressure on the edge tends to obstruct blood circulation to the fingers, to weaken the ulnar nerve and render it less responsive. Continued pressure eventually will help to induce cramps, 'glass arm.'"

While these instructions undoubtedly apply to the American type of key, built low on the table, they seem to give a less comfortable position of operation for the higher type used over here.

The real test viz., that of actual transmission over prolonged periods, is a point for those more experienced than I, but I should not be surprised to find that it is finally resolved into a question of personal comfort.



The American method seems better adapted to the low type of key, with cranked bar, as used in U.S.A., than to the higher British key, here illustrated.

London, N.12. W. F. THOMSON.

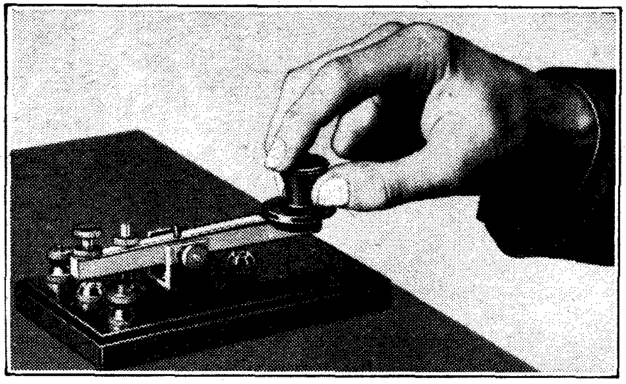
I WAS greatly interested in the letter from "Radiophare" concerning the correct way to hold a morse key, but I find myself unable to agree with him.

His method would be correct if the middle finger, instead of resting on the top of the knob, were to rest on the flange, or rather to be wedged between the underside of the knob and the top of the flange. In this manner, the middle finger is in a position to assist the thumb in returning the key to normal after each depression, thus giving proper control of the key on its upward as well as on its downward movement.

It may be argued that it is the function of the backspring to return the key to the normal position after each depression, as is undoubtedly the case in "Radiophare's" method of key-holding. This belief is erroneous, however, and is responsible for much slovenly and hard-to-read sending of a type which is apt to be mistaken for speed by the uninitiated. The function of the backspring is to *assist* in returning the key to normal, but it should no more be allowed to take entire charge of the operation than it should be dispensed with altogether.

H. WEST.

Kingston-on-Thames.



This photograph has been taken to illustrate Mr. West's contentions.

Learning Morse

IN view of the impetus which the war has given to the study of Morse, I should like to hear the opinion of experts on a fundamental point of great importance, as follows:

According to the generally accepted system of Morse teaching, sending speed is determined by the time-duration of the dits and dahs, and of the intervals between elements, letters and words. These all bear standardised ratios to one another—ratios which must never be varied, no matter what the sending-speed may be. One interesting point which emerges under this system is that the dits of a beginner sending correctly at, say, 5 WPM, will be of longer duration than the dahs of an expert sending at speed.

In practice it is exceedingly difficult to preserve all these ratios correctly over wide ranges of speed, and it is painfully easy to lapse unconsciously into faulty sending. Some of the sending by amateurs on the short waves is dreadful to listen to, and there are even certified "instructors" whose sending is far from perfect. Some people can send beautifully at speed, but cannot keep their ratios correct when sending slowly. Anyone possessing a gramophone record on which fairly fast Morse has been recorded with *perfect sending* can get a valuable lesson in ear-training by running his reproducing turntable at a very slow speed. He will then hear every dit, dah and interval in perfectly proportioned "slow-motion." I have underlined the words "perfect sending" because unfortunately there are commercial records on sale in which the senders have taken all sorts of liberties, presumably with the idea of "helping" the beginner.

So much for the "generally accepted" system. Now, there is a correspondence course of wide popularity which teaches an entirely different method. This course lays down that (a) there is only one length of dit, and one length of dah, whether the sending-rate be 5 WPM or 40 WPM; (b) there is no *measurable* interval between the elements composing a symbol, no matter how slow the sending-speed; and (c) sending-speed is governed entirely by the time-intervals between letters and words. Under this method, the beginner is taught to make an "s" as rapidly as possible, i.e., making each of his dits as brief as possible and leaving the shortest possible interval between them. The time-unit of his "s" gives him his "dah," and enables him to build up all other symbols. In practice, under this system, when sending at 5 WPM with an ordinary straight key, there is an interval of about 1½ seconds between each letter, and about 3 seconds between each word. At 10 and 15 WPM the letter-intervals become reduced respectively to about ¾ second and about ½ second, and so on, the word-intervals being, of course, reduced in proportion. Actually, the student is taught to *count* his intervals, the counting-rate being the rate of his stream of dits.

Personally, I think that the principle of aiming at constant-length dits and dahs has a great deal to commend it. It seems rather a pity, though, that its advocates should claim that "there is only one length of dit, and one length of dah, whether the sending-rate be 5 WPM or 40 WPM." A beginner, using an ordinary straight key, cannot possibly send at such a high speed as 40 WPM, and therefore, on a literal reading of the claim, he would have to become an expert with the "bug" before he could learn the true sound of an "s"! However, this is only a point of academic exactitude, and I fancy that if beginners were, from the very outset, taught their symbols as they sound when being sent at, say, 25 WPM, then, when listening to 5 WPM sending, they would find it actually *easier* to recognise the various symbols, owing to the long intervals between them.

This system is a very interesting one, but the fact remains that it is *not* generally taught by the G.P.O., Army, Navy, etc., nor is it in general use on the Continent. Therefore, its advocates go too far, I think, when they state that people who vary the length of their dits and dahs in order to alter their speed "have not been properly trained."

As the two systems appear to be diametrically opposed on fundamental principles, I hope that experts will contribute their views through your columns.

London, W.4. C. F. N. LEAHY.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
America			
WNBI (Bound Brook)..	17.78	16.87	5.0, 6.0.
WCBX (Wayne) ..	11.83	25.36	7.30§‡, 9.30§‡, 11.50§‡.
WCBX	17.83	16.83	2.0, 3.0†, 4.15, 5.0†.
WGEO (Schenectady) ..	9.53	31.48	9.30†, 10.55§‡, 11.15†.
WGEA (Schenectady) ..	15.33	19.57	2.0, 9.30, 10.55§‡, 11.15†.
WPIT (Pittsburgh) ..	15.21	19.72	6.0.
WRUL (Boston) ..	6.04	49.67	12.0 midnight‡.
WRUL	11.79	25.45	9.30§‡.
WRUW (Boston) ..	11.73	25.58	12.0 midnight‡.
WRUW	15.13	19.83	9.30§‡.
WLWO (Cincinnati) ..	6.06	49.50	7.25 a.m., 12.0 midnight‡.
Australia			
VLQ (Sydney)	9.61	31.22	9.15 a.m.
VLQ2	11.87	25.27	9.15 a.m.
VLR (Melbourne) ..	9.58	31.32	10.0 a.m., 2.50.
VLR3	11.88	25.25	9.50.
China			
XGOY (Chungking) ..	11.90	25.21	12.10, 11.0.
Finland			
OFD (Lahti)	6.12	49.02	12.45 a.m., 2.15 a.m., 8.55 a.m.§, 7.15, 10.30.
OFD	9.50	31.58	12.45 a.m., 2.15 a.m., 8.55 a.m.§, 7.15, 10.30.
OIE	15.19	19.75	12.45 a.m., 2.15 a.m., 7.15, 10.30.
France			
— (Paris-Mondial) ..	9.52	31.51	2.0 a.m., 5.30 a.m., 6.15 a.m.
TPA4	9.68	30.99	9.15 a.m., 8.30.
TPA4	11.72	25.60	2.0 a.m., 5.30 a.m., 6.15 a.m.
—	11.84	25.33	4.45.
TPA3	11.88	25.25	2.0 a.m., 5.30 a.m., 6.15 a.m. 9.15 a.m., 8.30.
TPB6	15.13	19.83	4.45.
TPB3	17.85	16.81	12.0 noon.
French Indo-China			
FZR (Saigon)	11.78	25.47	12.0 noon, 4.45.
Germany			
DJC (Zeesen)	6.02	49.83	8.0, 10.15.
DXM	7.27	41.27	12.15 a.m.
DJI	7.29	41.15	11.15.
DJA	9.56	31.38	12.15 a.m., 7.15.
DXB	9.61	31.22	8.15, 9.15.
DJL	15.11	19.85	10.15 a.m., 2.15.
DJB	15.20	19.74	5.15.
Hungary			
HAT4 (Budapest) ..	9.12	32.88	12.30 a.m.†, 1.30 a.m.§.
HAS3	15.37	19.52	3.55†.
Ireland			
Athlone	9.59	31.28	6.45, 10.0 (10.5 Sun.).
—	17.84	16.82	6.45, 10.0 (10.5 Sun.).
Italy			
I2RO3 (Rome)	9.63	31.15	4.0 a.m., 7.35 a.m., 7.28, 10.15‖.
I2RO9	9.67	31.02	12.30 a.m.
I2RO4	11.81	25.40	4.0 a.m., 4.40, 8.25.
I2RO6	15.30	19.61	4.0 a.m., 7.35 a.m., 12.15, 8.25.
I2RO8	17.82	16.84	12.15, 4.40.
Japan			
JVW (Tokio)	7.25	41.34	9.5.
JZJ	11.80	25.42	9.5.
Manchukuo			
MTCY (Hsinking) ..	11.77	25.49	7.30, 10.0.
Rumania			
Bucharest	9.28	32.33	10.55‡.
Russia			
RW96 (Moscow) ..	6.03	49.75	1.0 a.m., 9.0, 11.0, 11.30.
RWG	7.36	40.76	10.30.
RKI	7.52	39.89	10.30, 11.30.
—	8.07	37.17	9.0, 10.30, 11.30.
RW96	9.52	31.51	9.0, 11.0, 11.30.
RAL	9.60	31.25	1.0 a.m., 9.0, 10.30, 11.30.
—	11.90	25.21	12.0 noon.
RNE	12.00	25.00	1.0 a.m., 4.0†, 11.30.
RKI	15.04	19.95	1.0 a.m.
RW96	15.41	19.47	9.0 a.m.
Spain			
FET1 (Valladolid) ..	7.07	42.43	9.45.
Sweden			
SBO (Motala)	6.06	49.50	10.45.
SBU	9.53	31.48	10.45.
SBT	15.15	19.80	7.15.
Turkey			
TAP (Ankara)	9.46	31.70	8.15.
TAQ	15.20	19.74	1.15.
Yugoslavia			
YUA (Belgrade) ..	6.10	49.18	8.30, 10.30.
YUC	9.50	31.58	10.30.

The times of the transmission of news in English for Europe from the B.B.C. short-wave station are given in Current Topics, page 260.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Estonia			
Tartu	731	410.4	10.5.
Finland			
Lahti 1	166	1,807	12.45 a.m., 10.30.
France			
Radio-Paris	182	1,648	9.30.
" Radio 37 "	832	360.6	6.45, 9.15, 10.45.
L'Ile de France ..	1,204	249.2	6.45, 9.15, 10.45.
Germany			
Bremen 2	224	1,339	10.15 a.m., 2.15, 5.15, 8.15, 9.15, 11.15.
Bremen 1	758	395.8	12.15 a.m., 10.15 a.m., 2.15, 5.15, 7.15, 8.15, 9.15, 11.15.
Hamburg	904	331.9	12.15 a.m., 10.15 a.m., 2.15, 5.15, 7.15, 8.15,9.15, 11.15.
Hungary			
Budapest 1	546	549.5	11.10.
Kassa	1,158	259.1	11.10.
Ireland			
Radio-Eireann	565	531	6.45‡, 10.0 (10.5 Sun.).
Italy			
Rome 1	713	420.8	12.30 a.m., 7.28, 10.15.‖
Milan 1	814	368.6	12.30 a.m., 7.28.
Latvia			
Madona	583	514.6	10.0 (Tues. and Fri.).
Kuldiga	1,104	271.7	10.0 (Tues. and Fri.).
Norway			
Oslo	260	1,154	11.0†.
Rumania			
Radio-Romania.. ..	160	1,875	10.55‡.
Bucharest	823	364.5	10.55‡.
Russia			
Moscow 1	172	1,744	11.0, 11.30.
Sweden			
Motala	216	1,389	10.45‡.
Stockholm	704	426.1	10.45‡.
Falun	1,086	276.2	10.45‡.

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted. ‖ **Approx, time.**

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

SHORT-WAVE VAGARIES

N.P.L. Reports

THE behaviour of ultra-short waves was discussed in papers presented as official communications of the National Physical Laboratory before the I.E.E. at the beginning of April. Describing a preliminary investigation of direction finding at wavelengths between 2 and 3 metres, Drs. Smith-Rose and Hopkins found average errors which decreased with distance from about 10 degrees at one mile to about 3.5 degrees at 20 miles. Both rotating loop and Adcock spaced-aerial receivers were used. When the direction-finder was operated in a wooden hut an octantal error of from 2 to 5 degrees was observed. This was found to be due to reflections from the wooden walls; the nature of the wood and direction of the grain entered into the matter. The substitution of grainless building board greatly reduced the error.

An experimental investigation on the propagation of waves between 2 and 3 metres was described by Dr. McPetrie and Mr. J. A. Saxton, while Dr. McPetrie and Miss A. C. Stickland discussed reflection curves and propagation characteristics of radio waves along the earth's surface.

FREQUENCY MODULATION

The Position in America

THE growing interest in frequency-modulated broadcasting in America is exemplified by the fact that, whilst there are 22 FM stations operating or under construction, there were at the middle of March 68 pending applications for stations.

At the time of going to press, the findings of the Federal Communications Commission following its protracted investigation into the present situation were unknown. Proponents of the system are seeking F.C.C. permission to introduce "full commercial operation of FM broadcasting as a corollary of 'standard' broadcasting, without restrictions," says *Broadcasting*.

The basic issue is the F.C.C.'s ability or inability to allocate sufficient channels in the frequency bands above 25 Mc/s to permit the establishment of a nation-wide FM service.

In anticipation of the outcome of the investigation, at least half a dozen of the major manufacturers are producing FM receivers.

SAFETY AT SEA

Wartime Measures

IN view of the danger to ships resulting from enemy action the Ministry of Shipping has issued wartime safety measures, among which is the recommendation that an alternative aerial should be fitted for use in the event of failure of the main aerial.

At a meeting of the wireless companies and marine superintendents it was recommended that the funnel should be used for mounting the emergency aerial where practicable, as it is desirable that it should be as high as possible so as to secure an effective range of not less than 100-150 miles. The meeting also recommended that the aerial should include a loading coil inside the cabin, a separate lead-in insulator, and a change-over switch.

PROF. BRANLY'S DEATH

The Passing of a Pioneer

PROFESSOR EDOUARD BRANLY, the French wireless pioneer, who in his native country was known as the father of radio, died in Paris on March 24th, in his 96th year. He will doubtless be remembered as the inventor of the coherer, although it would probably be more correct to say that by inventing the decoherer he enabled S. A. Varley's coherer to be used by Marconi in developing a practical system of wireless telegraphy.

In an interview with a *Wireless World* contributor in 1926 Branly said modestly, "I suppose I did help the progress of radiotelegraphy. For years I studied the conductibility of isolated bodies, and at last, in this very building, I made my first discovery.

"In making my experiments I placed in the corner of the yard opposite my laboratory a spark coil, and in my laboratory a tube filled with soft iron filings, closed at both ends by two conductor stoppers communicating by means of a cell and a bell. Although the circuit was closed the bell did not ring, but as soon as the current entered the spark coil the bell rang continuously. The principle of wireless telegraphy was thus found, for it was possible to collect the waves transmitted by the spark coil without using a metallic conductor. I noticed that this conductibility, once started, continued, and in order to make it cease I had to tap the tube slightly."

IMPORTING APPARATUS

Foreign Sets Banned

THE Board of Trade recently announced that until further notice no applications will be considered for licences authorising the importation of accumulators and parts thereof, complete wireless receivers, or complete chassis, from foreign countries other than France. This notice does not apply to goods to be imported for re-export or for use in the export trade.

An earlier order prohibited from March 25th the import of "wireless apparatus (including valves) and parts therefor." Commenting on the new order *The Wireless and Electrical Trader* says: "It is obvious from the wording of the official announcement that the Import Licensing Department of the Board of Trade *will* consider applications for the importation of radio components and valves—a matter of concern to some set-makers."

AMERICAN TELEVISION

Stalemate

THE television position in the U.S.A. at the present time is somewhat obscure. The F.C.C. announced at the end of February that from September 1st television stations would be permitted "limited commercial" operation, although the actual allocations of channels for the transmitters was deferred until the outcome of the investigation into the frequency-modulation situation was made known.

It is now learned that the F.C.C. has announced its intention of suspending this concession in order to counteract the move on the part of some manufacturers to flood the market with televisors. The F.C.C. is anxious to avoid encouraging the sale of receivers until standards of transmission are agreed upon.

B.B.C. NEWS ON SHORT WAVES

WE give below the times (B.S.T.) of the transmission of news in English for Europe from the B.B.C. short-wave station.

From GSA, 6.05 Mc/s (49.59 metres), and GSW, 7.23 Mc/s (41.49 metres), at 12.30, 1.30, 7.15, 9.0, 10.0 and 11.45 a.m., and 12.30, 2.15, 5.0, 7.0 and 11.0 p.m.

From GRX, 9.69 Mc/s (30.96 metres), at 12.30, 1.30, 7.15, 9.0 and 10.0 a.m., and 7.0 and 11.0 p.m.

From GSE, 11.86 Mc/s (25.29 metres), at 11.45 a.m. and 12.30, 2.15 and 5.0 p.m.

MARCONI MEMORIAL

Site of Pioneer Transmitter

To mark the site of what Marconi called the world's first permanent wireless station a memorial stone has been erected on ground adjacent to the site of the original Royal Needles Hotel, Alum Bay, in the Isle of Wight, where Marconi and his assistants carried out experiments which constituted some of the more important phases of their pioneer work. The station was erected under Marconi's personal supervision by his assistant, Mr. George Kemp, and was completed on December 5th, 1897.

The memorial consists of a grey Cornish granite column, 5ft. 9in. high, on which are four bronze plaques inscribed with a brief history of this pioneer transmitting station.

THE U.I.R.

Mr. A. R. BURROWS, who since 1925 has successively held the positions of secretary-general and director of the Geneva office of the International Broadcasting Union (Union Internationale de Radiodiffusion), is reported to be leaving Geneva and returning to London. He will be remembered by many as "Uncle Arthur" in the early days of the B.B.C., when he was programme director.

It is understood that the war has so restricted the activities of the U.I.R. that the entire organisation will probably be transferred to the Union's wavelength checking centre in Brussels, which, under M. Raymond Braillard, is still continuing its work of policing the ether.

FROM ALL QUARTERS

New P.M.G.

Major G. C. Tryon, who with the reshuffle of the Government relinquished the post of Postmaster-General for that of Chancellor of the Duchy of Lancaster, had been at the head of the Post Office since 1935. Mr. W. S. Morrison, the new P.M.G., was previously Minister of Food and Chancellor of the Duchy of Lancaster. The P.M.G.'s salary is £3,000 a year.

Television From a 'Plane

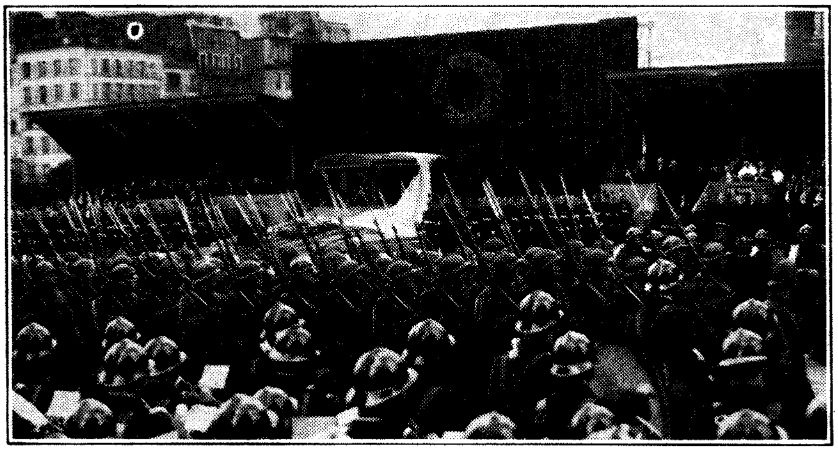
Thanks to the "vestpocket" television O.B. units referred to in our last issue, New York televiewers were able to receive a bird's eye view of the metropolis from a television-equipped aeroplane. The transmissions from the 'plane, which were radiated on a wavelength of 1.04 metres, were picked up on the roof of the R.C.A. building whence they were relayed via co-axial cable to the N.B.C. transmitter W2XBS in the Empire State Building for retransmission on the normal frequency.

News From U.S.A.

At the time of going to press the C.B.S. news bulletins, etc., broadcast by WCBX on the 25-metre band during the early evenings, are being relayed by WCAB on 15.27 Mc/s (19.65 metres)—a frequency generally better received at that time of day.

Broadcasting in Ireland

The report on broadcasting by Radio Eireann for last year was recently issued. This shows an increase of 17,464 licence-holders, the present total being 166,275. The income from licences, which cost 10s., is augmented by sponsored programmes, which last year amounted to 15.7 per cent. of the programme time.



WIRELESS PIONEER HONOURED A state funeral, at which President Lebrun was present, was accorded Professor Edouard Branly on March 30th. Troops are seen marching past the catafalque in front of Notre Dame, Paris.

I.E.E. Meetings

A discussion on wartime standardisation will be opened by Mr. P. R. Coursey at 6 p.m. on Tuesday, April 23rd, at an informal meeting of the I.E.E. Wireless Section. At the monthly Section meeting at 6 p.m. on Wednesday, May 1st, Mr. A. D. Hodgson will deliver a paper on "Civil Air Transport Communication." The annual general meeting of the Institution will be held on May 9th.

Speed of Wireless Waves

Data given by Drs. F. T. Farmer and H. B. Mohanty in their paper read before the Physical Society on April 4th, showed that the velocity of propagation of wireless waves along the ground (classically accepted as equal to that of light) is in fact within a few per cent. of that velocity. It was concluded that the experiments of other workers which indicated a much lower velocity were subject to some error.

B.I.R.E.

The annual general meeting of the British Institution of Radio Engineers will be held on Wednesday, April 24th, at 6.0 p.m. at the Federation of British Industries, 21, Tothill Street, London, S.W.1. Immediately after the meeting (at 7.0) Mr. P. G. A. H. Voigt will give a paper on "Sound Reproduction." An open invitation is extended to readers of *The Wireless World*.

French P.M.G.

M. Jules Julien, the French Minister of Posts, Telegraphs and Telephones in M. Daladier's Government, has retained his post in M. Reynaud's recently formed Cabinet.

Iceland

The Icelandic broadcasting corporation, Rikisutvarpid, has announced that the introduction of the 100-kW long-wave Reykjavik transmitter last year helped considerably to increase the number of listeners, which, at the end of the year, totalled 16,700 (14 per cent. of the population).

The Television Society

At the twelfth annual general meeting of the Televison Society, Dr. Tierney, the chairman, referred to the severe handicap under which the Society was at present working, but considered it a matter for congratulation that the war had not interfered with the work of installing and furnishing the library and reference room at the headquarters, 17, Featherstone Buildings, London, W.C.1. He also referred to the founding of a television museum.

Scots' Success

Ninety-three per cent. of the entrants from the Edinburgh Branch of the Caledonian Wireless College recently obtained the P.M.G.'s special certificate as radio operators. At the Glasgow Branch the percentage was 90. After 124 hours tuition, which is equivalent to five weeks' day classes, two evening class students succeeded in obtaining certificates

Valve and Circuit Noises

DESIGNING RF AND FREQUENCY CHANGER STAGES FOR HIGH SIGNAL-TO-NOISE RATIO

The principal sources of background noise originating in the receiver itself are discussed and the relative merits of different types of valve as RF amplifiers and frequency changers are compared from this point of view. The special advantages of an RF stage on short waves are explained.

IN urban areas man-made static or atmospherics normally limit the useful sensitivity of a broadcast receiver, due to the background noise becoming objectionable. In more favourably situated districts however, the limit of sensitivity is again reached when the noise voltages generated in the receiver itself reach unpleasant proportions.

Of the sources of noise present in a receiver, the most fundamental and inevitable is thermal agitation of electricity. Next in order comes noise introduced by " shot effect " and ions in the anode current stream of the amplifying valves. Of less fundamental nature and easier to overcome are noises introduced due to feedback of harmonics, modulation hum, etc.

In general the circuits and valve associated with the first amplifying stage will be the prime source of noise, as the signal-to-noise ratio at that point is the lowest. It is proposed, therefore, to limit the scope of this article to a discussion of the noise introduced by thermal agitation, shot, and ion effect in the first two stages of a receiver.

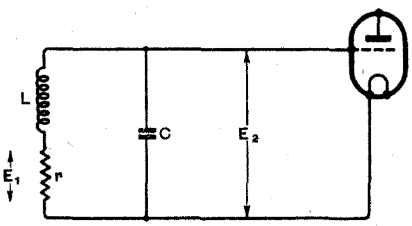


Fig. 1.—Input tuned circuit in which thermal agitation noise may be important.

Thermal agitation or Johnson noise is due to the free charge of any conductor being in random motion in equilibrium with the thermal motion of the molecules of the conductor, and this flow causes a random voltage to be developed across the terminals of the conductor.

The RMS value of this voltage—ET is given by

$$E_T = 7.4 \times T^{\frac{1}{2}} R^{\frac{1}{2}} (\Delta f)^{\frac{1}{2}} \times 10^{-6} \text{ microvolts} \quad (1)$$

where T = absolute temperature of the conductor in degrees Kelvin
R = resistance of conductor (ohms)
Δf = band width of pass band of following amplifier (cycles per second).

From this it will be seen that the RMS noise is proportional to the square roots of both the resistance and band width. For a room temperature of 20°C, equation (1) becomes

$$E_T = 1.27 \, R^{\frac{1}{2}} (\Delta f)^{\frac{1}{2}} \times 10^{-4} \text{ microvolts} \quad .. \quad (2)$$

In the case of a receiver the RF amplifier is usually preceded by a tuned circuit rather than a resistance. The noise produced by a tuned circuit is due to its " dissipative resistance " ; normally this will be almost wholly the effective resistance of the inductance, as the condenser losses are usually small in comparison.

If we let the thermal agitation RMS voltage due to the series resistance r be E_1 (Fig. 1), the voltage across the tuned circuit at resonance is then

$$E_2 = E_1 Q = E_1 \frac{\omega L}{r}$$

$$= 1.27 \times 10^{-4} (\Delta f)^{\frac{1}{2}} r^{\frac{1}{2}} \frac{\omega L}{r}$$

$$= 1.27 \times 10^{-4} (\Delta f)^{\frac{1}{2}} (R_{\text{dyn}})^{\frac{1}{2}} \text{ microvolts} \quad (3)$$

where R_{dyn} is the dynamic resistance of the tuned circuit, i.e. $\frac{\omega^2 L^2}{r}$. When Δf is sufficiently large to cause appreciable variation in the voltage step-up of the tuned circuit, the effective value of R_{dyn} will have to be obtained by integration.

Fig. 2 gives curves from which it is possible to obtain the noise voltage produced by a given resistance for different values of the band width Δf. At this stage it is appropriate to specify more definitely what is meant by the effective bandwidth Δf.

Fig. 3 illustrates, say, the response of a superhet up to the second detector. Δf is defined by the width of the rectangle having the same height as the peak of the curve and having the same area as that bounded by

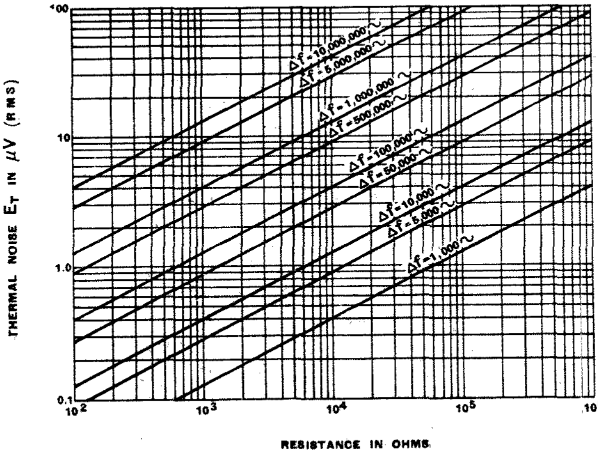


Fig. 2.—Thermal noise voltages at room temperature (292° K.) may be read from these curves when the resistance of the circuit and the band width of the succeeding amplifier is known.

Valve and Circuit Noises—

the response curve. For the noise at the output of the AF amplifier the overall band width, including the AF amplifier, must be allowed for.

Due to the random rate of arrival of electrons at the anode of an amplifying valve, a fluctuating current is superimposed on the mean anode current. This fluctuating current is called the Shot or " Schrott " Effect, and will produce a noise voltage across any impedance in the anode circuit, according to normal circuit laws. The presence of space charge, by reducing the extent of the fluctuations, reduces the noise output. The RMS value of the noise current due to the shot effect is given by

$$Is = 5.63\, I_a^{\frac{1}{2}}(\Delta f)^{\frac{1}{2}}\, F \times 10^{-4} \text{ microvolts} \quad .. \quad (4)$$

This is equivalent to a noise voltage at the grid of

$$Es = 5.63\, \frac{I_a^{\frac{1}{2}}}{g}(\Delta f)^{\frac{1}{2}}\, F \times 10^{-4} \text{ microvolts} \quad .. \quad (5)$$

In the above expressions

I_a = anode current

g = mutual conductance

Δf = effective bandwidth

F = reduction factor due to space charge.

It will be noticed that, as in the case of thermal noise, the output voltage is proportional to the square root of the band width. The above expression is true for a diode and triode. In the case of diodes and triode amplifiers working under emission saturation conditions, the factor F is equal to one; for a triode working under space charge conditions, the factor F drops to about $\frac{1}{4}$ to $\frac{1}{5}$.

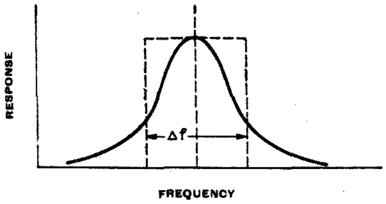


Fig. 3.—In calculating thermal noise, the band width, Δ, should be taken as the width of the rectangle having the same height and area as the overall resonance curve of the receiver.

The case of a multi-grid amplifying valve in which the grids collect current is very much more complicated. For example, in the case of a pentode the random variation in the collection of current by the screen grid increases the noise above that of a triode to an extent depending on the percentage of mean screen current to the mean anode current. The lower the ratio of the screen current to anode current, the nearer will the noise for a pentode approach that of an equivalent triode. Over a limited range of operating conditions the increase in noise for a given valve, due to screen current, may be taken into account by an appropriate increase in the value of F. For straight RF pentodes F will be about $\frac{1}{2}$. In the case of variable-mu valves portions of the cathode will be working under conditions of less space charge blanketing, due to their increased current density, and the value of F will be increased. (See table).

The shot noise produced by a frequency changer valve may be obtained by plotting the noise produced for different steady biases on the modulating electrode and then integrating these results over the oscillator cycle.

In a radio receiver where we connect a tuned circuit to the grid of the first RF amplifying valve, the effective noise at the first grid will be the sum of the thermal noise of the tuned circuit and the equivalent shot noise at the grid. In the case of voltages consisting of completely random impulses, the total effective noise may be obtained by taking the square root of the sum of the squares of the individual components. So that the effective RMS voltage applied to the grid of the first valve

$$E_{eff} = \sqrt{E_T^2 + E_s^2}$$

It will be seen from equation (5) that the equivalent grid shot noise voltage E_s can only be quoted for a specified bandwidth. However, by equating equations (2) and (5) it is possible to remove this limitation, and replace the effect of shot noise at the grid by an equal voltage produced by thermal agitation in a resistance of a suitable value. This resistance is known as the equivalent noise resistance R_{eq}, and is given by

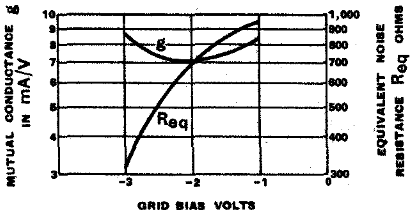


Fig. 4.—Variation of equivalent noise resistance with grid volts and screen current in a typical high slope straight pentode.

$$R_{eq} = 19.8\, \frac{I_a}{g^2}\, F^2 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (6)$$

If we express I_a in milliamperes and g in mA/V, then

$$R_{eq} \doteqdot 20{,}000\, \frac{I_a}{g^2}\, F^2 \text{ ohms} \quad .. \quad .. \quad .. \quad (7)$$

as R_{eq} is proportional to the square of the noise voltage.

$$(E_{eff})^2 = R_{dyn} + R_{eq} \quad .. \quad .. \quad .. \quad .. \quad (8)$$

This relationship of direct summation makes it very easy to estimate the relative importance of the noise introduced by a given valve.

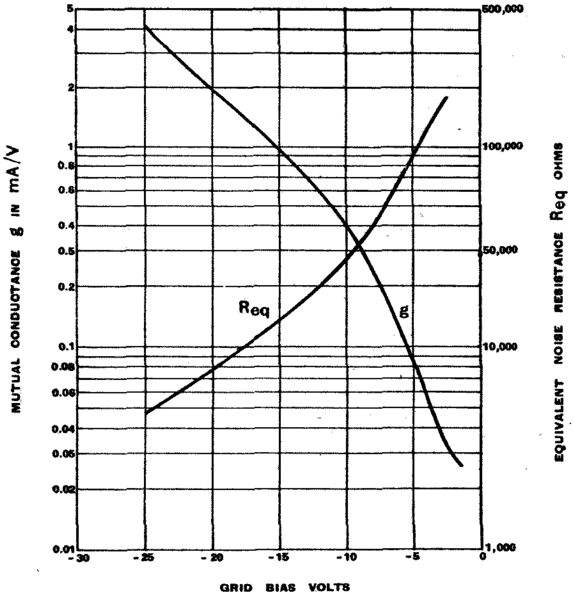


Fig. 5.—Equivalent noise resistance and mutual conductance curves for a typical low screen current variable-mu pentode.

Valve and Circuit Noises—

At this point it is desirable to consider the effect of the noise introduced by the tuned circuit and valve following the first amplifying valve. If we call A_1 the stage gain of the first amplifying valve, and R_{eq2} and R_{dyn2} the equivalent noise resistance and circuit dynamic resistance of the second stage, then these can be replaced in effect by a fictitious resistance R_1 in series with the grid of the first valve. The value of the resistance R_1 to give the same noise output is given by

$$R_1 = \frac{R_{eq2} + R_{dyn2}}{(A_1)^2} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

The total noise voltage at the grid of the first valve is then

$$(E_{eff})^2 = R_{dyn1} + R_{eq1} + \frac{R_{eq2} + R_{dyn2}}{(A_1)^2} \quad \ldots \quad (10)$$

In equation (6) for the value of R_{eq} the factor F^2 remains reasonably constant over a considerable range of operating conditions, so that in a given valve design the goodness of the valve depends upon the factor $\frac{I_a}{g^2}$. Also if one knows the value of R_{eq} under normal operating conditions it is possible to estimate the change in R_{eq} for a reasonable range of alternative initial biases. The errors present with the above method will be greater in the case of variable mu valves than in the case of straight valves.

In order to be able to gauge the relative importance of the various noise sources discussed above, it is necessary to assign actual values to the different resistances.

Equivalent noise resistances have been published on certain valves both for the case of amplifying valves and frequency changers. While the information available is still very meagre, the accompanying table gives some idea of the order of magnitude of the equivalent noise resistance for different types of valves at their normal operating points.

RF AMPLIFIERS

Type of valve	R_{eq} (ohms)	F^2	Mutual conductance, mA/V
Medium slope, variable-mu RF screened pentodes (high screen current type) ...	50,000	0.5	1.7–2.2
Medium slope, variable-mu RF screened pentodes (normal screen current type) ...	12,000 to 15,000	0.3	1.7–2.2
Straight acorn pentodes	6,000	0.3	1.4
Low noise, variable-mu RF screened pentodes (low screen current type)	3,200	0.065	1.8
High slope, variable-mu RF screened pentodes (television type)	3,000	0.3	5.0
High slope, straight RF screened pentodes (television type)	600 to 800	0.25	8.0–9.0

FREQUENCY CHANGERS

Type of Valve	R_{eq}	Conversion conductance, mA/V
Pentagrid mixer (6L7)	200,000	0.4
Pentagrid converter (6SA7)	200,000	0.45
Four beam Octode (EK3)	50,000	0.65
High slope variable-mu screened pentode with g_1 injection (television type) (1853, etc.) ...	15,000	1.4
High slope straight screened pentode with g_1 injection (television type) (1852, etc.) ...	3,000	3.6

The effective values of the dynamic resistances to be used for the calculation of thermal noise vary widely, according to the class of service for which the receiver is designed. In the case of normal broadcast receivers, where the band width correction for R_{dyn} is negligible, the dynamic resistance on the medium and long waves is of the order of 50,000 to 100,000 ohms; on the short-wave band it would be of the order of 5,000 to 10,000 ohms. On the medium- and long-wave bands the gain of the RF valve is usually limited to about five in order to prevent the generation of spurious whistles. In some receivers with alternative aerial tappings or weakly coupled aerial coils gains of the order of ten are encountered.

Let us consider the following popular types of broadcast receiver:

(*a*) Receiver having a single tuned circuit preceding the frequency changing valve.

(*b*) Receiver having a two-tuned circuit band pass filter preceding the frequency changing valve.

(*c*) Receiver having the single aerial tuned circuit followed by an RF amplifying valve, which in turn is coupled to the frequency changer through a single tuned circuit.

For receiver (*a*) on the medium- and long-wave bands we will take a dynamic resistance of 80,000 for a single tuned circuit and 40,000 for a band-pass filter. If we call R_{eff} the effective noise resistance, including all noise sources at the grid of the first valve, for a pentagrid frequency changer $R_{eff} = 80{,}000 + 200{,}000 = 280{,}000$ ohms, and for an octode frequency changer

$$R_{eff} = 80{,}000 + 50{,}000 = 130{,}000 \text{ ohms.}$$

On short waves taking R_{dyn} as 8,000 ohms, $R_{eff} = 208{,}000$ for a pentagrid and 58,000 for octode.

In the case of receiver (*b*) the band filter is usually only employed on the medium- and long-wave bands and not on the short-wave band, therefore

$$R_{eff} = 40{,}000 + 200{,}000$$
$$= 240{,}000 \text{ ohms}$$

for pentagrids and $40{,}000 + 50{,}000 = 90{,}000$ ohms for the octode.

From the above it will be seen that in the case of receivers type (*a*) and (*b*) valve noise on the medium- and long-wave bands is in the majority of cases more important, or as important as circuit noise. On the short-wave band the valve noise is by far the greatest limitation.

By adding an RF stage this state of affairs can be improved. The noise due to the frequency changer and coupling circuit when transferred in series with the grid of the RF valve by equation (10) ranges from 1,300 to 5,000 ohms for the octode, and from 2,500 to 10,000 ohms for the pentagrid, according to whether the gain of the RF stage is 10 or 5.

Valve and Circuit Noises—

On medium and long waves, with a gain of 5 and a medium slope variable-mu pentode

$R_{eff} = 80{,}000 + 15{,}000 + 10{,}000 = 105{,}000$ ohms
for the pentagrid and

$80{,}000 + 15{,}000 + 5{,}000 = 100{,}000$ ohms
for the octode.

Thus, little improvement in noise is obtained by using an RF valve on medium and long waves (except in the case of noisy frequency changers) as the valve noise is then swamped by circuit noise. For the same reason little advantage is obtained by using low noise RF valves. On the short-wave band, however, the position is very different; the RF gain with a medium slope variable-mu valve will average about ten.

$R_{eff} = 8{,}000 + 15{,}000 + 2{,}000 = 25{,}000$ ohms for a pentagrid, and $8{,}000 + 15{,}000 + 580 = 23{,}580$ ohms for an octode.

By the use of a low-noise, variable-mu pentode R_{eff} can be reduced to 13,000 and 11,800 respectively.

As was shown above, an RF stage does not appreciably improve the noise on the medium and long-wave bands, this has led to the marketing of receivers in which the RF stage is switched in on the SW band only. Due to the relatively small signal strength on this band it is possible to use a high-slope straight pentode with a pre-set gain control. High stage gains of the order of 25 may then be realised, and R_{eff} becomes

$8{,}000 + 700 + 300 = 9{,}000$ ohms
for a pentagrid, and $8{,}000 + 700 + 100 = 8{,}800$ ohms for the octode.

In receivers of this type, by the use of a high-gain RF valve, the same state of affairs is reached as on medium and long waves, i.e., the valve noise has become negligible compared with circuit noise.

At very high frequencies, such as are used in television, the input loss of the valve limits the dynamic resistance of the circuit to the order of 1,000 to 2,000 ohms with optimum aerial coupling. As the RF gain is of the order of ten, the frequency changer noise again becomes important, and it is necessary to use a high-slope pentode with the oscillator volts injected into the grid circuit in order to reduce it.

At first sight it might appear that where the noise is mainly introduced by the first circuit an improvement might be obtained by reducing the dynamic resistance of the first circuit, or tapping the grid down. As the signal-to-noise ratio is proportional to

$$\frac{\text{Signal at first grid}}{\text{Noise at first grid}} \times \sqrt{\frac{R_{dy}}{R_{dyn} + R_{eff}}}$$

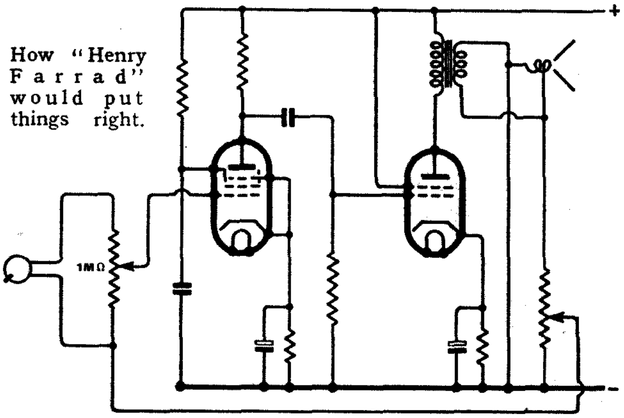
it will be seen that the best signal-to-noise ratio is obtained with the highest dynamic resistance.

Henry Farrad's Solution

(See page 241)

THE idea of using negative feedback is a good one, and so it is a pity to use *positive* feedback, which is what Tony has done! The thing can be traced through by supposing that at some given moment the signal from the pick-up is making the first grid more positive. That causes more anode current, and more voltage drop in the coupling resistor, so the anode moves negative. The second grid, therefore, moves negative, too, and the second anode more positive. The tapping point on the feedback control moves positive, though to a smaller extent, and being connected back to the grid of the first valve it *adds* to the original signal. If this addition is sufficient it sets the whole amplifier into oscillation.

There are various ways of reversing the feedback to make it negative instead of positive, but perhaps the best is to use the secondary of the output transformer, which can be connected either way. There is also the advantage that the transformer is included in the feedback system and its performance improved. And that the potentiometer across the secondary may be much lower resistance than 1 megohm and, therefore, less liable to cause trouble.



How "Henry Farrad" would put things right.

The idea of making the feedback variable and using it as a volume control is all right up to a point, but not if it is desired to fade the volume right down. The effect of negative feedback in reducing amplification is very rapid at first, but falls off as it is increased; and there is a practical limit, particularly in Tony's case, where a good deal of amplification is to be counteracted even for maximum volume. Moreover, if a very large amount of feedback is used there is a risk of oscillation at some very high (probably inaudible) frequency. So it is advisable to use negative feedback only for reducing surplus amplification and improving quality, and an ordinary volume control for reducing volume below maximum.

From the World's Technical Journals

EVEN under the present conditions which make it increasingly difficult to obtain foreign journals, the Abstracts and References section of the April issue of our sister journal *The Wireless Engineer*, contains references to, and abstracts from, nearly 450 articles on wireless and allied subjects which have recently appeared in the world's technical journals. This regular monthly feature, which for easy reference is arranged under fifteen headings, is compiled by the Radio Research Board.

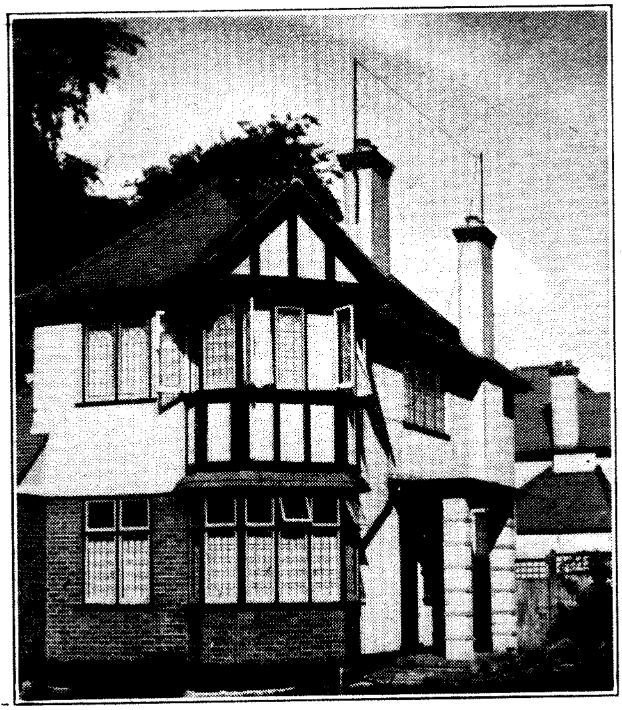
The April issue, which was published on the first of the month, and is obtainable through newsagents or direct from the Publishers, Dorset House, Stamford Street, London, S.E.1, at 2s. 8d., post free, also contains an article which describes a simple single-valve circuit for the time-base of a cathode-ray oscillograph which is adaptable for either saw-tooth or rectangular waveforms. Another article gives the measurement of the input conductance in high-slope RF amplifier valves. A summary of recently accepted wireless patent specifications is also included each month.

All-wave Aerials

WHICH IS THE BEST TYPE FOR PRESENT-DAY LISTENING?

By F. R. W. STRAFFORD (Belling and Lee, Ltd.)

If it were not for the inherent limiting factor of electronic fluctuation noise upon the maximum obtainable sensitivity of a radio receiver, aerials for domestic reception could be relegated to the limbo of forgotten things.



A good or bad aerial can make all the difference between intelligible reception and mere noise. Here, then, are some suggestions for those who take long-distance wartime listening seriously

In a well-designed broadcast receiver a sensitivity of about one microvolt absolute is probably the best which can be attained, and it is therefore necessary that the voltage applied to the input of the receiver, i.e., between the aerial and earth terminals, must exceed this figure if anything like a reasonable programme value is to be assured. A rough estimate of desirable signal voltage for an inherent noise voltage of one microvolt is from ten microvolts absolute and upwards.

Now let us consider the owner of such a receiver who is installed in a typical block of flats, and is attempting to use an indoor aerial. In order to obtain an input voltage from such an aerial of the order of ten microvolts it is generally necessary for the field strength inside the flat to exceed 200 microvolts per metre. Now, on short waves one must expect fluctuations from one's pet station of from perhaps several thousand microvolts per metre to prolonged low values of the order of a few microvolts. Very often the signal voltage will fall below the inherent noise level of the receiver so that the programme is completely masked.

One may also find that the pet station produces an average input voltage to the receiver of a few microvolts for hours or days on end, in which case nothing but unreliable reception will be provided by the indoor aerial. The same sort of argument applies to "mains aerials," and the writer is strongly opposed to the practice of using the electric wiring for this purpose. Not only is the effectiveness of such an aerial extremely poor, but interference which is invariably conveyed by the electric mains is transferred into the receiver with the signal. However, even if we ignore man-made electrical interference, it is undeniable that a good outdoor aerial is essential for consistent reception, particularly on the short waves.

Good outdoor aerials may be subdivided into two very distinct classes: (1) Aerials in which no provision is made to reduce the effect of electrical interference (where it exists), but in which the attainment of high receptive efficiency is the sole aim. (2) Aerials in which provision is made for the reduction of the effects of electrical interference. Such aerial systems are referred to as "anti-interference aerials."

It must be made clear at once in order to clear up certain general misconceptions that an efficiently designed and correctly erected aerial in the first class will, in practically every circumstance, deliver a greater signal voltage to the receiver for a given incident field strength.

The object of the second class of aerial is to reduce the effect of electrical interference which, in certain localities, overrides any but the strongest signals. This reduction is obtained by the careful use of electrostatic screening and electro-magnetic balancing through the agency of transmission lines and matching transformers, either separately or in combination according to circumstances. This results in a considerable reduction of the interfering effects and in general a small but usually appreciable reduction of signal strength. It is therefore clear that the resultant signal-to-interference ratio is usefully increased, rendering hitherto swamped stations audible.

One should here note that an all-wave anti-interference aerial is nothing mysterious, but consists of a system in which cunning transformer design permits operation

All-wave Aerials—
with moderate signal collective efficiency over a relatively wide waveband, say, continuously from 15 to 2,000 metres.

In discussing the problem of choosing an aerial, we will assume, first, that the user is free from the bane of electrical interference, and wishes to make the most of his receiver by providing it with a Class 1 aerial, so we must dwell a little on the types of aerial which may be found therein.

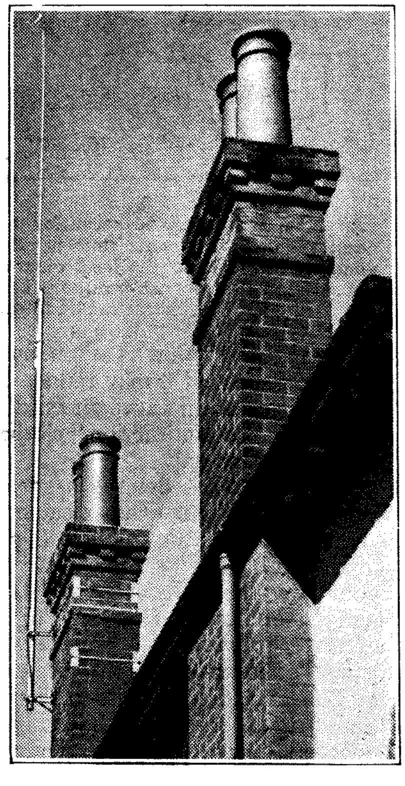
The nature of an inverted "L" aerial is self-evident and too well known to require further introduction. If it can be erected at an average height of about 35ft., with a horizontal span of about 60ft., it is capable of providing a first-class average performance over a very wide waverange. On short waves this aerial will resonate at certain wavelengths. Just as the rocking of a tub of water may cause extra large waves where the outgoing wave meets the incoming wave in step, so the resonant aerial will exhibit a series of hot spots at certain wavelengths. Unfortunately, an equal number of low spots may be noted, since there must be a minimum for every maximum. If such an aerial appears to upset the average reception from the pet short-wave station, a few feet of wire cut from the far end of the aerial may work wonders in this respect and provide a maximum instead of a minimum response.

Directional Properties

Inverted "L" aerials are not directional on medium and long waves if the received waves are substantially vertically polarised. For long-distance medium-wave stations, where quite a lot of the received energy is reflected from the ionosphere (the Heaviside layer is part of this), the aerial may exhibit directional effects. What is more, it may increase the inherent fading of the signal in the following manner.

The direct wave from the transmitter is earthbound and retains substantially vertical polarisation. Only the downlead of the aerial develops a voltage as a result of this wave, the roof portion (by virtue of its capacity to earth) merely helping to drive a little more current through the receiver input circuit. The indirect or sky wave will induce its voltage mainly in the roof of the aerial, and it may so happen that the combined direct and indirect wave voltages may produce a resultant which is lower than that produced by either, since they may be out of phase and partially cancel out.

This sort of fading may even be heard from one of our own broadcasters by listeners in its near vicinity. This is due to a certain amount of unavoidable very high-angle radiation from the transmitting aerial which, under certain ionosphere conditions, is reflected back with very little attenuation and causes the fading referred to if the phase relationships are established.



The inverted "L" aerial is very directional on short wavelengths, the directivity becoming more pronounced in the direction of the roof of the aerial as the shortest waves are approached. For the aerial described the direction would be along the direction of the roof at about 15 metres, but at 50 metres the direction would be substantially at right angles to it. For best reception of North American broadcasts from, say, 13 to 19 metres, it is desirable to erect this form of aerial with the free end of the roof pointing about north-west. This bearing should, incidentally, provide fair reception of 50-metre South American stations.

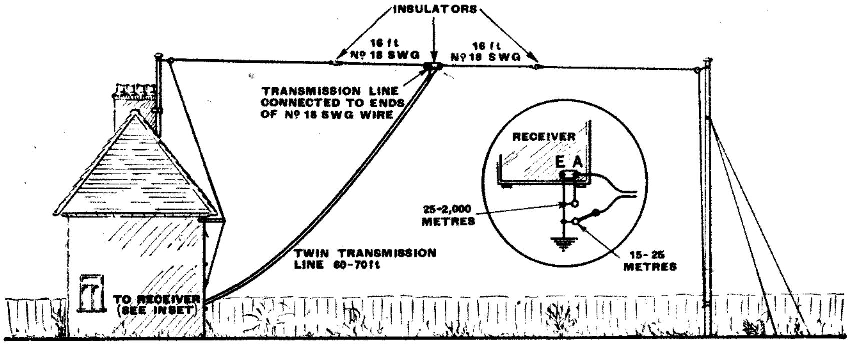
As a general rule, if reception is confined to wavelengths between 13 and 19 metres, aim the aerial along the great circle bearing to your pet stations. If listening on the 49-metre band is desired, aim at right angles to the bearing of the station. The writer does not wish to be brought to book over such generalisations, but experience, backed by theoretical evidence, indicates that best average results will be secured by working on this principle.

Vertical Rod Aerials

A well-erected vertical aerial of some 60ft. total height is, in the writer's opinion, the very best all-round aerial from the combined viewpoints of performance and appearance. It is non-directional at all wavelengths, and, as the writer has previously pointed out,[1] 60ft. of vertical wire will provide greater signal voltage at the receiver input terminals than the same length of wire disposed in any other manner. The chimney-stack of most suburban and country dwellings is erected about 40ft. from ground level. A 12-ft. mast of about 3in. diameter, securely attached to the chimney by appropriate fittings, and carrying a further 12-ft. insulated metal rod, will, with its downlead, provide a nearly vertical aerial of some 60ft. in height. It must be emphasised that care should be taken in disposing the downlead away from roofs, gutterings, pipes and walls, at a distance not less than 12in. This dimension is given as the result of careful measurements in wet weather.

A very important point to be remembered in connection with both the inverted "L" and vertical aerial is that care must be taken to avoid running the lead-in close to interior walls and fittings on its way to the receiver aerial terminal. This has the same effect as shunting a capacity across the input terminals of the receiver, and will reduce the input signal accordingly. In other words, aerial lead-in capacity is only useful when it is in an effective signal field. When it comes out of that field into the house where the field is screened, the capacity becomes harmful and shunts the signal away before it has time to reach the receiver, so to speak.

It is better, therefore, to let the position of the lead-in tube, rather than æsthetic considerations, dictate the receiver position. This is a very important point that is often overlooked; neglect of it may reduce the performance of an excellent outdoor aerial to that of an inferior "clothes-line" arrangement.



A special two-waveband aerial for reducing motor car interference on short waves, and which at the same time is effective on medium and long waves. Switching details are shown in the inset diagram. The twin transmission line may consist of twisted flex or cab-tyre, or, better, of proprietary low-loss cable having a characteristic impedance of some 75-100 ohms.

The author has devised a special aerial falling in the Class 1 category which will not only provide a highly satisfactory performance over the whole waveband from 15 to 2,000 metres, but will, from 15 to 25 metres, provide a considerable degree of immunity from local car ignition interference, with negligible loss of signal strength. The arrangement calls for switching of a simple nature, but no keen listener will object to this.

Fundamentally, the aerial consists of a doublet which, as is well known, consists of two equal lengths of wire separated in the centre and connected by a twin transmission line, the termination of which is connected between the aerial and earth terminals of the receiver, or, better still, to a balanced input circuit centre-tapped to earth.

Such aerials are selective in their receptive properties. In other words, if one wishes to concentrate upon the reception of 20-metre signals, the length of each horizontal wire is cut to 5 metres, so that the total length is 10 metres, just half the wavelength to be received. Such an aerial is said to be resonant in that it exhibits its maximum response in the region of 20 metres and is usually referred to as a "resonant doublet" or "half-wave doublet." In actual practice an aerial designed for optimum response on 20 metres puts up a very good performance both on 16 and 25 metres, two very interesting wavebands at present. Such an aerial is directional at right angles to its horizontal span, and this must be borne in mind when considering one's pet station.

Change-over for Longer Waves

Now this type of aerial has a very poor response on medium and long waves because the pick-up is confined to the downlead. As this comprises two leads, and they are both at about the same instantaneous potential, so far as the signal is concerned, no voltage (or precious little) is applied to the receiver input. If, however, the earthy lead of the transmission line is disconnected and connected to the aerial terminal, together with its neighbour, then the aerial behaves as a very effective "T" aerial from 25 metres upwards. While working from 15 to 25 metres as a doublet, the immunity of the downcoming transmission line to signal pick-up also

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[1] "Vertical or Inverted L Aerials?," *The Wireless World*, June 15th and 22nd, 1939.

All-wave Aerials—

provides the same degree of immunity to interference which is vertically polarised. Since car ignition interference is happily of this nature, the degree of immunity achieved at the expense of negligible signal loss is often very considerable, and certainly more than justifies the erection of this type of aerial. A diagram of the arrangement, giving dimensions and method of switching, is shown in the accompanying drawing.

The writer strongly recommends this aerial for serious short-wave listening in car-infested districts. In order that the aerial should give its maximum response on medium and long waves, it is essential that the transmission line be kept clear, right up to the receiver input terminals, of walls, pipes, and other metal objects by at least 12in., although if the aerial is to be used as a short-wave doublet only this is unimportant.

Anti-interference Aerials

The successful application of anti-interference aerials to all-wave listening is not simple. It is very difficult, in fact probably impossible, to design an anti-interference aerial which will maintain worth-while discriminatory properties over a range from, say, 13 to 2,000 metres, without some severe signal losses occurring at certain parts of the wave coverage. Moreover, one can never guarantee to cure the interference unless it is established at the offset that it is created in very close proximity to the aerial downlead.

No hard-and-fast rule can be laid down in this respect. One is often very agreeably surprised by the beneficial results obtained in circumstances which, at first sight, would appear to be unfavourable to the use of an anti-interference aerial system. Other cases record an opposite effect.

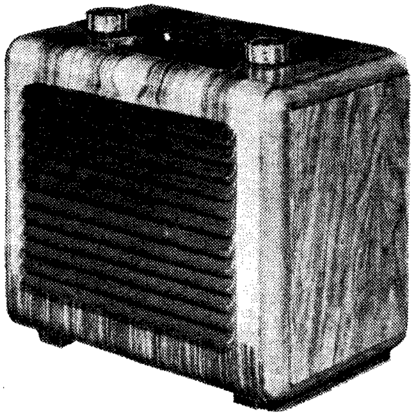
It is always best to obtain expert advice before erecting such aerials. Quite obviously, if the interference is being radiated from a very distant point, say a few hundred yards away, the whole of the aerial must be affected in the same proportion by both signal and noise, and the anti-interference aerial is then little or no assistance in reducing background noises.

The degree of suppression of the interference relative to the signal is invariably greatest on long waves, and gradually falls off as one approaches the short waves. The reasons are complicated. First, the ability to screen or balance the transmission line (downlead) becomes increasingly difficult as the wavelength is reduced, and, secondly, the nature of the interfering electric field changes from a purely inductive effect on long waves to an electro-magnetic wave effect on short waves.

This opens the door to a discussion beyond the scope of this article, involving such mathematical tools as scalar, vector, and retarded potential functions.

The best solution to the general problem of wide-band interference, so far as it affects the short-wave listener who is anxious to get down to the limit of sensitivity of his receiver, is to investigate more fully the nature of the interfering levels around a contemplated house, flat, or "digs" before paying the deposit or signing along the dotted line!

BEETHOVEN "BABY GRAND"



Designed for use on AC or DC mains, this compact new superheterodyne receiver by Beethoven Electrical Equipment, Ltd., Chases Road, London, N.W.10, operated with a trailer aerial and covers short waves from 15.5 to 50 metres, in addition to the usual medium- and long-wave ranges. It weighs only 11½ lbs. and the price is 7 guineas.

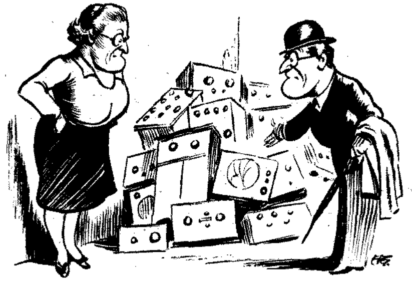
Unbiased

By FREE GRID

Sister Susie's Soldering Sets for Soldiers

THE strange and esoteric forces that seem to govern the female mind have puzzled philosophers for centuries past, and we seem no nearer a solution of the problem now than in the days of long ago when even Solomon, with all his experimental facilities, was compelled to acknowledge that it had got him beat. The mental reactions of women seem the one thing that are not amenable to the universal law of cause and effect, but are completely unpredictable no matter how much data is available.

I have, in all conscience, good enough cause to be aware of this, for, as a result of these female vagaries, I am, at the present moment, encompassed about by as motley a collection of weird and wonderful home-constructed wireless sets as even Poe could have conjured up in his most inspired moments; and all because of an appeal the Editor made in the January issue for special sets to be produced for soldiers.



Surplus sets for soldiers.

Needless to say, the appeal was really directed to wireless manufacturers, and was in the nature of a few suggestions to them as to what types of sets were needed out at the front. I have just re-read this particular Editorial very carefully, and cannot for the life of me see how anybody in his right senses could read into it any other meaning than the one I have mentioned. The Editor reckoned without Mrs. Free Grid and his other female readers, however. Flinging aside their half-knitted sandbags and other war work they raked up all the old moth-eaten wireless blue-prints, both British and foreign, which had been published in the past dozen years or so, and forthwith plunged into an orgy of set construction, using such components as they could lay their hands upon, including, I am chagrined to see, a large amount of experimental gear from my laboratory.

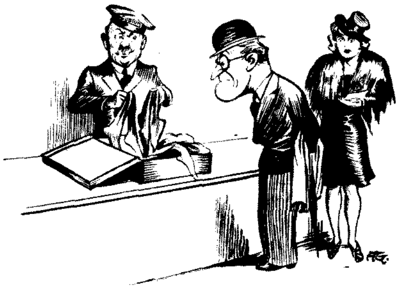
The result of this orgy of set soldering is a collection of receivers which will be about as much use to soldiers on active service as an all-electric or gas-driven refrigerator would be to a traveller in the Sahara, as most of them are intended for mains operation. Apart from that, however, they have obviously been designed and constructed with total disregard for the fact that portability is a vital consideration; in fact, the only thing that can be said in favour of these sets is that they work, although I must confess that the distortion associated with some of them is so horrible that if the enemy heard them across No Man's Land he might well be excused for thinking that a new and horrible weapon for his undoing had been designed.

Perhaps, on second thoughts, the propaganda department of the Ministry of Information may be able to make use of them for conveying this impression to the enemy, and I am accordingly dropping a line to Sir John Reith about it.

Camouflage Up to date

MOST people who have travelled at all extensively between this country and the Continent will have some idea of the art of camouflage, as it is impossible to remain long as a spectator at the customs barrier at Dover without marvelling at the skill which people exhibit in disguising newly purchased articles as old and well-worn ones. The ones who have always compelled my admiration in spite of my strong moral disapprobation are those who belong to what I call the "stark realism" school. They will often get away with it by making no attempt whatever at disguise, the idea being that the customs officer will think that nobody would be such a fool as to try and get a new article through the barrier without disguise, with the result that he passes it over in his eager hunt for more suspicious-looking articles, such as a gross of carefully laddered silk stockings.

That the idea works any one of you can prove to his own satisfaction nowadays, by packing a suitcase full of bombs and dumping it on the reception counter of a cloak-room with a loudly proclaimed, "One bag of bombs." It is a hundred to one that the cloak-room attendant will accept the suitcase with some laughing tribute to your sense of humour, whereas some innocent "commercial," travelling in clocks, who happened to hand in a bag of working samples would probably be arrested on the spot.



How did *they* get there?

Although admitting all this, I must confess that I was very surprised the other day when I happened to pass the Editor's country seat, "somewhere in England," to discover that this "stark realism" system of camouflage had apparently been adopted. Although I knew that my way lay through a district in which his ancestral estate was situated, I had expected to be totally unable to detect it, as I had supposed that his array of MUSA aerials would have been skilfully disguised instead of standing naked and unashamed.

Random Radiations

By "DIALLIST"

Magnetic Disturbances

THOUGH the invaluable "Whitaker" shows that the present sunspot cycle reached its maximum in May, 1937, we have by no means done with the queer pranks in the ether that so often accompany the appearance of large spot-groups on the sun's disc. Last month produced several quite severe thunderstorms in the district where I'm stationed, and there were magnetic disturbances all over the world. The Aurora was seen several times in this country and on one night, at any rate, it provided an unusual spectacle for places in southern Europe. I've never known an Aurora visible here that didn't play havoc with short-wave transmissions, and those of last month ran true to form in this respect. So complete was the "black-out"—the radio, not the A.R.P. black-out—at times that short-wave communication with the U.S.A. was impossible, and even European stations were difficult to find. At one period, when many Continental stations must have been hard at it, I could find no transmission save one from Rome.

The Northern Lights

When an Auroral display is visible or imminent one has generally found that the North American stations are the first to be affected. Faintness, fading, distortion and possibly complete disappearance on their part usually spread to other stations whose transmissions arrive on a Great Circle course with a northerly bearing. Only when the Aurora is seen at places phenomenally far to the southward are stations with easterly or westerly G.C. bearings seriously affected as a rule. The fact that on the night mentioned in the last paragraph the Aurora was seen much beyond its normal southern limit probably accounted for Rome's being the only transmissions that could be received successfully.

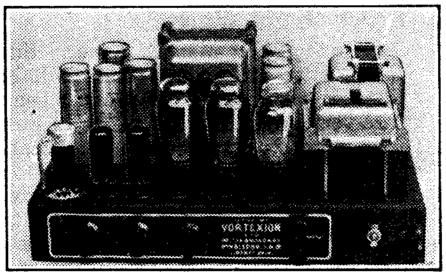
Have We Passed It?

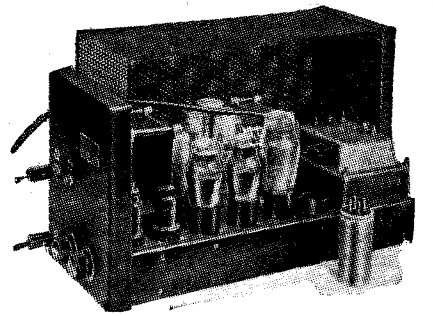
Personally, I don't feel very sure that the sunspot maximum *was* in 1937. Both 1938 and last year contained periods of great sunspot activity, and the present year has so far been much the same. Sunspot maxima do not recur in exact eleven-year cycles as some folk think. Eleven years and a bit is the average time from maximum to maximum. The two previous cycles were distinctly on the short side: 1906.4 – 1917.6 = 9.2 years, and 1917.6 – 1928.4 = 10.8 years. If the present cycle did reach its maximum in 1937 its duration would have been just 9 years. Thus the average for the last three cycles together would be only 9.6 years. It seems possible that the present cycle is showing a kind of "double-humped" maximum, the first peak having been in 1937. At any rate, such big magnetic disturbances as we have had so frequently during the last few months are unusual three whole years after a sunspot maximum. I believe we'll have lots more magnetic upsets yet, with corresponding adventures on the short wavebands.

* * *

No Bad Thing

SOME people don't like the ban on the import of American receiving sets. They feel that progress in receiver design and in the development of valves suitable for amateurs must necessarily be held up here during the war, and that it would be a good thing to import the most up-to-date apparatus and parts from the States. There's possibly something in that, though not enough to worry about. During the war we probably shall concentrate on the small, rather cheap receiving sets, for most people are economising and the demand is for utility types. But that doesn't mean that our designers are blind to what is going on in other countries. They're keeping their eyes open, and when we have achieved victory they'll give us the bigger models again—and with all the improvements. Nor do I believe that it's a bad thing if new types of valves are not produced for a time. We had far too many, anyhow. During the war we shall be able to get rid of a number of unnecessary types, and this pruning will be a good thing. Once peace returns the way will be open for the introduction of any genuinely useful new valves that have been developed. Another good point about this restriction of imports is that it will save our markets from being swamped with foreign receivers whilst our radio industry is so busily engaged in war work. Some fear that they won't be able to get replacements for American sets that they now have; I understand that there will be no great difficulty about





Random Radiations—
getting permission to import valves or other parts for existing sets if they are not obtainable here.

Progress in Wartime

Actually, one mustn't assume that because we are at war there will be little or no progress in wireless gear. The very opposite is likely, for in wartime intensive research and experimental work go forward. Progress will be made right enough, though the results of it may not be shown in the domestic receiver until peace returns. The Great War was responsible for huge advances in wireless. Take valves alone: the "R-type," of honoured memory, was developed, if my recollection isn't at fault, first by our French Allies and later for the War Department. The R.A.F. wanted a valve of low inter-electrode capacity and the first attempts at achieving this were seen in the earliest "test-tube" types, the "C" and "D." These chubby valves were the forerunners of the slim "Vs" and "Qs." Once that war was over amateurs had marvellous chances of obtaining beautiful apparatus at ridiculously low prices by means of the surplus disposal sales—perhaps you remember the Townshend wavemeters, the tuners, the amplifiers, the resistance boxes and so on that we picked up for a song in those far-off days? Much the same thing is bound to happen when the present bit of bother is happily over and done with. All kinds of improvements that have been kept hush-hush will be sprung upon us, and again some lovely apparatus that most of us could never have afforded otherwise will find its way into our wireless dens. Yes, progress is going on and will go on. We'll see the results of it in wireless of all kinds and maybe in television, too, when peace returns.

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Filling the Bill

SEVERAL manufacturers, I am glad to see, have put or are putting on to the market "Wartime Receivers" designed on the lines that I suggested in these notes a while ago. I had the needs of the troops chiefly in mind, but the set that suits them should have a wide appeal amongst the rest of the population. What the troops want—and what they are now able to get—is a small, light receiver at a reasonable price, simple and not too expensive to run and capable of receiving anywhere the home programmes, as well as some of those from abroad on occasion. The kind of receiver most likely to fill the bill is the battery-operated portable superhet. The portable appeals because it is easy to transport and can be brought into action in a moment after a move, since no aerial has to be put up. Opinions are rather divided on the question: Should it be "all-dry" or run from a dry HTB and an accumulator LTB?

The Battery Question

To that question no final answer can be given, for each kind has its special merits—and demerits. The "all-dry" set scores in being absolutely spill-proof, in no matter what position it is placed, and no matter how much it is jolted about. Its great drawback is that its combination battery costs a bit more and must go into the dustbin when run down. The question of cost, though, isn't really so serious as it seems at first sight. In actual working it does not come to a very great deal more than that of dry HTB and accumulator, taking into account the cost of accumulator charging *and* the fact that to keep the set constantly in action two accumulators must be provided. Having used both kinds since the war started, I don't feel that there's a vast amount in it. Both are wonderfully efficient and very satisfactory. It is sometimes urged that you can't always get accumulators charged. That is true, though there is usually some way out. In out-of-the-way spots such as that where I'm writing these notes it is often easier to get accumulators recharged than to obtain replacement batteries for "all-dries."

The Pegasus crest of Amalgamated Wireless of Australasia stands out prominently on the façade of the new A.W.A. building in Sydney. The 165ft. steel tower brings the overall height of the structure, which is the highest in Australia, to 365ft. The broadcasting station 2CH will eventually be housed on the two top floors.

Portables To-day

What a splendid little receiver the modern portable is! The idea of a portable set is almost as old as broadcasting itself. Many of us, in fact, made up contraptions which we proudly called portables in the comparatively early 1920s. And what contraptions they were! Receiver, loud speaker and batteries often formed separate units, housed each in its own case. And do you remember flinging a stone with a string attached to it over a convenient branch of a tree so that a flex-wire aerial could be hauled up? It was the coming of the really economical types of dull-emitter valve and the evolution of a small, light moving-coil loud speaker that made the portables' rise to popularity possible. Many things have surprised me about the portable since I came to use it so much. Not the least of these is the quite amazing amount of volume without severe distortion that can be got from many of them.

Long Ranges

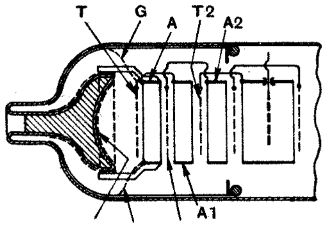
Another surprise is the usefulness of these sets for long-range reception. You'd think that their tiny built-in frames would put them out of the running for that kind of thing; but they don't. You can get all kinds of European stations, and at pretty good strength, too. Portable superhets are not inherently as selective as good ones of the "fixed" type, but, by making full use of the directional properties of the frame, you can do some very pretty work in separating transmissions on neighbouring wavelengths from one another.

Recent Inventions

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns

ELECTRON MULTIPLIERS

THE figure shows a multiplier tube in which the concave photo-sensitive cathode K is made spherical in cross-section. This serves to concentrate the emitted electrons towards the middle of the first "target" electrode T, which is located at a distance equal to the radius of the sphere. The required "bundling" of the electrons is thus ensured without the use of a negatively biased control grid, since the latter, in practice, tends to weaken the attraction of the anode field.



Concave-cathode secondary-emission tube.

The secondary electrons produced as the result of the impact upon the target T are drawn forward by the accelerating cylinder A towards the second target T1, and the process is repeated at the stages T1, A1, etc., until the amplified stream is collected by the final anode.

The discharge space between the cathode K and the target T is screened by a guard G which connects the metal coating on the wall of the tube with that target. The arrangement is stated to reduce the basic "noise" of the cathode, and to eliminate "wall currents" and electron leakage.

Radio-Akt. D. S. Loewe. Convention date (Germany), February 16th, 1937. No. 512711.

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AIRCRAFT DF

IN one known method of radio navigation for aircraft, a pilot can "home" on to distant beacon transmitter by switching-over his receiver, in rapid succession, from a frame aerial to a vertical or non-directional aerial. This produces two "reversed cardioid" curves of reception, the overlapping part of the two curves forming a "guiding line" for the navigator. In addition, it is necessary for him to determine the "sense" of the signals, so as to know whether they are arriving from the front or rear of the machine. For this purpose it is usually necessary for the pilot to throw the machine deliberately off its course, from time to time, and to note the results.

According to the invention a switching device is provided, in combination with a pair of crossed frame-aerials and a single vertical aerial, which allows both the direction and the "sense" of the incoming signal to be ascertained, without requiring the craft to leave the direct "homing" path.

Telefunken ges. für drahtlose Telegraphie m.b.h. Convention date (Germany), February 7th, 1938. No. 512304.

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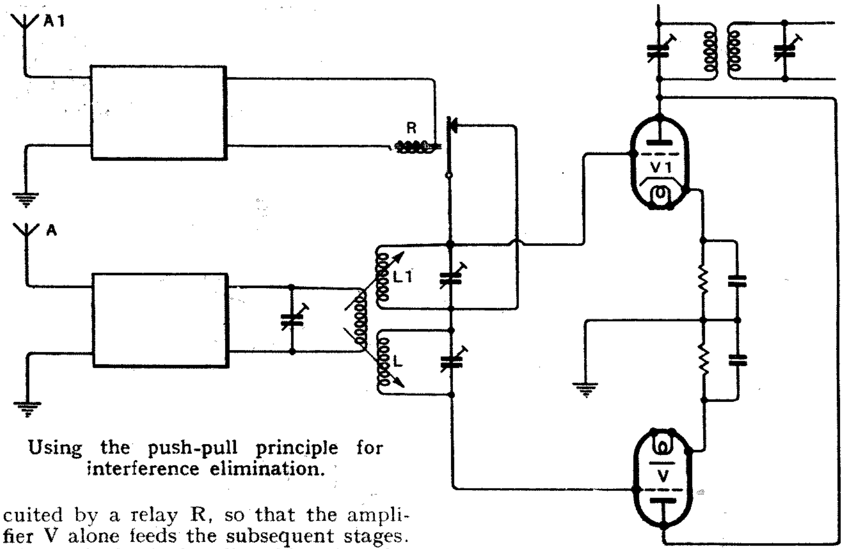
CUTTING-OUT INTERFERENCE

IN one of the latest methods of tackling the interference problem, the receiving circuits are, in effect, thrown out of action by the disturbing impulse, so that neither the disturbance nor the signal can get through during the short time that the disturbance lasts. The interruptions are, however, so rapid that they do not affect the apparent continuity of reception. The invention is concerned with a refinement of such a method, in which the disturbance is utilised to set up a current which is in phase opposition to the signal current, so that it automatically prevents both currents from passing through the set.

As shown in the figure, the signals are received on an aerial A which is coupled in push-pull to the grid circuits L, L1 of two amplifiers V, V1. Normally, however, the circuit L1 is short-circuited by a relay R, so that the amplifier V alone feeds the subsequent stages. The arrival of the disturbing impulse induces voltage in an auxiliary aerial A1 (as well as in the aerial A) and so opens the relay R. The signal plus the disturbance from the aerial A are then fed in push-pull through both the amplifiers V, V1, and so mutually cancel out.



Using the push-pull principle for interference elimination.

Magyar Wolfram Lamp Co., Convention date (Hungary), December 11th, 1937. No. 511669.

TUNING BY TELEPHONE DIAL

IN a known method of switch tuning, a desired station is selected by turning a finger dial of the kind used on an automatic telephone, the names of the stations appearing on a plate at the back of the dial. Provision is also made for setting the dial to a manual tuning position if desired, a centre pointer then showing which station is being tuned in by hand. Usually the wavechange switch is independent of the dial, and is separately operated when necessary.

According to the invention, the dial tuner is connected to the wavechange switch, through a cam slot and link, so that in all positions, except that for manual tuning control, the wavechange switch is automatically set and locked in the appropriate position for the particular station selected.

The General Electric Co., Ltd., and W. H. Peters. Application date, December 30th, 1937. No. 513251.

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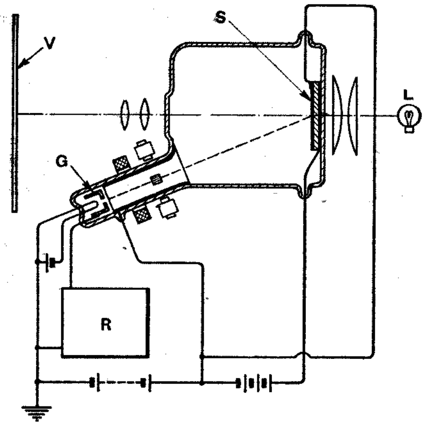
LARGER TELEVISION PICTURES

A CATHODE-RAY television receiver is fitted with a special screen which, instead of being fluorescent, reacts to the scanning stream by developing a condition of variable transparency, from point to point on its surface. The result is that an image of the received picture can be projected from an external lamp, through the screen, on to a large viewing surface, the latter being mounted outside the CR tube so that it is not limited as to size.

The special screen is made of alkali-halide crystals (such as sodium chloride or silver bromide) which, though normally translucent to ordinary light, develop what are called "opacity centres" when scanned, either by a beam of electrons or by X-rays.

As shown in the figure, the special screen S is mounted inside the CR tube, and light is projected through it from an external lamp L. The incoming signals are applied to the control grid G from a receiver R. The modulated scanning beam varies the point-to-point transparency of the screen S in the manner previously explained, and the incoming picture is reproduced on a viewing surface arranged at the opposite side of the tube.

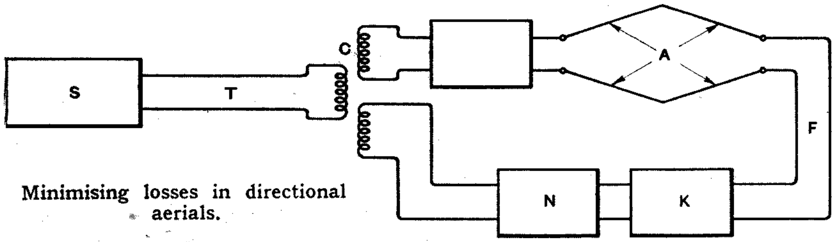


Projecting television pictures.

Scophony, Ltd., and A. H. Rosenthal. Application date, February 3rd, 1938. No. 513776.

DIRECTIONAL AERIALS

RELATES to the type of aerial in which a directive effect is obtained by causing the RF energy supplied to one end of a pair of radiators to travel forward along the wires as a progressive wave. For this purpose the far end of the wires must be "shorted" by a resistance equal to the surge impedance of the system, so as to prevent the energy from setting up a "standing" wave instead of a wave which travels forward in the way required. A certain amount of energy is, of course, dissipated in the terminating resistance, and the object of the invention is to restore this, as far as possible, to the radiating system.



Minimising losses in directional aerials.

The figure shows a directive aerial A of the "rhombic" type fed from an RF source S through a transmission line T. The usual terminating or surge impedance is replaced by a feed-back coupling F, which includes a transformer device K to prevent reflection, and a phase-changing net work N which allows the feed-back energy to reach the input coupling C in the correct phase to reinforce the energy supplied from the source S. The arrangement may also be applied to receiving aerials.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany), May 4th, 1937. No. 514390.

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AUTOMATIC VOLUME CONTROL

THE primary and secondary windings of the input transformer to the second detector of a superhet are connected by a condenser, which serves to balance the interelectrode capacity between the two diodes of the double-diode triode valve used to develop the audio-frequency signal and the AVC voltage.

The selectivity of the AVC circuit is made broad enough to begin to reduce the gain of the set before the signal reaches its normal strength. This prevents any "blasting" that might otherwise occur when tuning-in to a strong station.

The balancing-out of the diode capacities allows the tuning to be kept symmetrical with respect to the incoming carrier, and also gives a flat-topped selectivity curve with steep sides. This improves the fidelity of the set and increases its power of discriminating between two signals on adjacent channels.

Philco Radio and Television Corporation. Convention date (U.S.A.), May 8th, 1937. No. 514486.

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REDUCING NEEDLE SCRATCH

IN a gramophone reproducer needle scratch and surface noise are usually high-pitched, so that their effect can be considerably reduced by using a suitable form of attenuation of the upper audio frequencies. The difficulty is to prevent this from impairing high-note reproduction.

According to the invention the problem can be solved by taking advantage of the fact that the high notes in speech and music are of relatively short duration, as compared with the lower notes, and particularly as compared with needle scratch, which is practically continuous in character though it fluctuates in level.

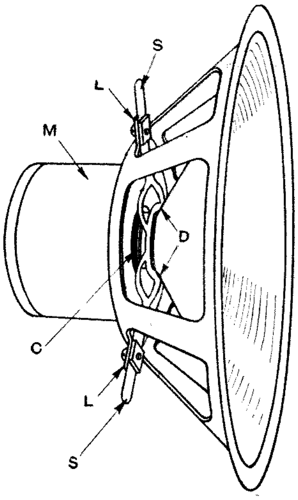
A device is used consisting of two rectifiers in series, the second of which feeds a "storage" condenser of given time-constant. The potential so built-up is used as the control voltage. The action is such that when the noise level is low, the attenuation of the upper audio frequencies is least, though it increases automatically as the noise-level rises.

A. E. Barrett; C. G. Mayo; and H. Davies. Application date, May 23rd, 1938. No. 515070.

o o o o

LOUD SPEAKERS

THE drawing shows a moving-coil loud speaker with the usual conical diaphragm D and magnet M. In order to centre the moving coil C accurately in the gap between the magnets, the small end of the diaphragm is held by a flexible "spider" with three arms S, which extend beyond the main frame as shown, and are secured to lugs L on the frame. Either the lugs L or the arms S are made with elongated holes, so as to allow the moving coil C to be correctly centred before the arms S are clamped in position.



Method of diaphragm centering.

Kolster-Brandes, Ltd., and R. Moore. Application date, March 29th, 1938. No. 513010.

o o o o

TELESCOPIC AERIAL FOR CARS

A TELESCOPIC rod aerial, particularly suitable for a car with a metal roof, is mounted on the cowl of the vehicle, near the windscreen, where it is within easy reach of the driver, so that he can draw it out to full length, for receiving signals. The aerial is built up of several telescopic sections, with the object, apparently, of adjusting its length to signals of different strength.

Transitone Automobile Radio Corpn. (assignées of M. F. Shea and E. A. Speakman). Convention date (U.S.A.), June 17th, 1937. No. 515892.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

When you MUST have

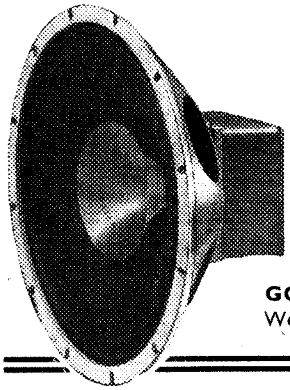
- LEVEL RESPONSE
- WIDE FREQUENCY RANGE
- CRISP TRANSIENT RESPONSE
- FREEDOM FROM HUM

the answer is

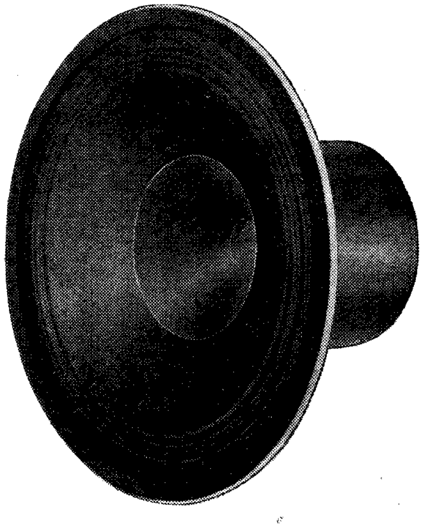
GOODMANS

HIGH-FIDELITY **AUDITORIUM** LOUDSPEAKERS

GOODMANS 10″ *High Fidelity Auditorium Loudspeaker. Power Rating 6 Watts A.C. Peak* ... **£3 - 10 - 0** Transformer (to order) extra.



The fulfilment of these essential demands is made possible by the use of the patented dual exponential type diaphragm (exclusive to Goodmans) incorporating a scientifically designed, light but rigid speech coil and an extremely flexible centring device. This diaphragm, in conjunction with a specially constructed permanent magnet made from nickel-aluminium alloy, gives a fidelity of reproduction which has made **GOODMANS** Auditorium Loudspeakers pre-eminent amongst all quality reproducers.



GOODMANS 12″ *High Fidelity Auditorium Loudspeaker. Power Rating 12 Watts A.C. Peak. As illustrated* **£7 - 13 - 0**

Transformer (to order) extra.

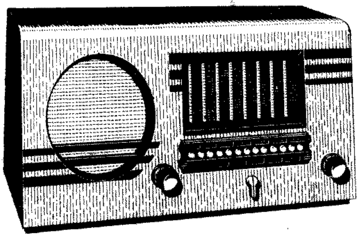
GOODMANS INDUSTRIES LTD., Lancelot Road, Wembley, Middx. *Telephone: WEMbley 4001 (5 lines)*

POST THIS COUPON for 20 page Booklet entitled "The Attainment of an Ideal" giving valuable technical information and data on the principles of Loudspeaker construction. Please enclose 1½d. stamp.
W.W. 5.40. *Attach to your card or letterheading.*

The INTERNATIONAL

117 short-wave stations tuned by name

You select your station—and there it is with the same accuracy as a close-by transmitter, and the standard of fidelity, based on the development of selective inverse feed-back, satisfied the most critical listener. Over 160 stations (117 short-wave) are marked by name on the dial.



The International is a 5-valve, including rectifier, A.C. mains superhet with 6 watt output valve. There are 8 wavebands and bandspread tuning is incorporated. A 10″ mains energised moving coil speaker is utilised and the cabinet is finished in sapele mahogany. Wavelengths are: 13.7-42; 16.5-17.1; 19.4-20.1; 24.8-25.8; 30.6-31.9; 48-50; 180-560; and 850-2000 metres. Cabinet dimensions: 25 × 13½ × 11½. PRICE **16½** Gns.

PYE

PYE LIMITED, RADIO WORKS, CAMBRIDGE

CLASSIFIED ADVERTISEMENTS

THE CHARGE for advertisements in these columns is 12 words or less 3/-, 3d. for every additional word. Each paragraph is charged separately.

ADVERTISEMENTS, with remittance, should reach Dorset House, Stamford Street, S.E.1, not later than first post Wednesday, May 8th, for the June issue, or one day earlier at the Branch Offices, 8-10, Corporation Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham, 2 ; 260, Deansgate, Manchester, 3 ; 26B, Renfield Street, Glasgow, C.2.

SERIES DISCOUNTS are allowed to trade advertisers on orders for consecutive insertions provided a contract is placed in advance, and in the absence of fresh instructions the entire copy is repeated from the previous issue. 3 insertions, 5 per cent.; 6 ins., 10 per cent. ; 12 ins., 15 per cent.

Advertisements received too late for one issue, or crowded out, are published in the first following in which there is space. The Proprietors retain the right to refuse or withdraw advertisements at their discretion.

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

BOX NO. ADVERTISERS should include the words "Box 000 c/o 'The Wireless World'" which must be paid for. An additional 6d. is charged for registration and cost of forwarding replies.

NEW RECEIVERS AND AMPLIFIERS

*

"CHALLENGER RADIO CORPORATION," the best firm for reliable and fully guaranteed ultra-short-wave radio, have on view in London some of the finest receivers ever made; for instance, a five-valve TRF Midget (2 bands) at 75/-; a mains-battery transportable (operating without alteration on A.C., D.C., or batteries), at £8; an 8-valve radiogram chassis with valves and speaker, 4 wave-bands, at £8/8; a 6-valve tuning unit with five wave-bands, including 4½-10 metres, at £8/18/6; tuning unit with output stage and speaker at £11; a 13-valve receiver with five wave-bands, including 5-10 metres, variable selectivity inter-station noise silencer, chassis, valves and auditorium speaker complete, £16/16; an 18-valve twin chassis including such refinements as variable selectivity, contrast expansion, C.W. beat oscillator, variable sensitivity, inter-station noise silencer, with valves and auditorium speaker, £28/17/6; any American valve for 1925-1940 receivers for 6/- each (only firsts such as Raytheon, National Union, &c., supplied). Why not call and handle these receivers at your leisure? There is no obligation to purchase. Alternatively, fully illustrated catalogues will be forwarded on receipt of 1½d. stamp.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point Marble Arch, down Bayswater Rd., turn 5th right. [8787

BAKERS Super Quality Receivers, £11, usual price £22; brand new 10-valve receiver, with tone control, ideal for realistic reproduction.—Bakers Selhurst Radio, 75, Sussex Rd., S. Croydon. [8981

BANKRUPT Bargains.—Brand new 1939 models, makers' sealed cartons, with guarantees, at less 33⅓% below listed prices; also Midgets, portables, car radio; send 1½d. stamp for lists.—Radio Bargains, Dept. W.W., 261-3, Lichfield Rd., Aston, Birmingham. [8921

IMMEDIATE Delivery McMurdo-Silver 15-17, Olympic auto-radiogram, £75; Georgic auto-radiogram, £86; Armstrong AW125PP chassis, £18/15; McClure ACF5 Feeder, with power pack, £11/11; Mighty Gem Midget battery, portable, £6/6.—A.C.S. Radio, 46, Widmore Rd., Bromley. [8970

TO Clear, Cost of Customs Only.—New "Korting" equipment, 4-stage high fidelity amplifier, 25 watts, £8; 75 watts, £15/10; radial diffuser loud speakers, 9 watts 70/-, 25 watts £10/15; P.M. chassis speaker, 25 watts, £5/10; microphone pre-amplifiers, 38/6; crystal microphone with transformer, 90/-; crystal microphone, with screened lead, 95/-.—W. A. Bryce and Co., Ltd., Shenley Rd., Boreham Wood, Herts. Elstree 1875. [8951

COMMUNICATION RECEIVERS

IMMEDIATE Delivery Sky Champion S20R, £18/2/6; Defiant, £26/10; Skyrider SX23, with speaker, £37/10; R.M.E.69, £38; Howard 440, £31/12/6.—A.C.S. Radio, 46, Widmore Rd., Bromley. [8971

ARMSTRONG

WE APPRECIATE APPRECIATION

In our monthly talks we have told you of our products, of our war-time difficulties, and of our determination to maintain Armstrong pre-war Quality. During the eight years we have advertised our Chassis, letters of appreciation have been received from many hundreds of readers but we have never previously published or referred to them.

In case some readers may think that war conditions may adversely affect Armstrong Chassis, we would like you to read just one recent appreciation of a Model SS10 built during the seventh month of the war. Here it is !

Ideal Buildings,
Mill Street, Kidderminster.
31.3.40.

Dear Sirs,—

I acknowledge with thanks safe receipt of chassis SS10.

May I be allowed to congratulate you upon this model ; the results are certainly excellent, tonal quality is very good indeed and the selectivity could not be bettered. Altogether a chassis to satisfy the most exacting requirements, giving equally satisfactory results on long, medium and short waves in selectivity, tone and volume.

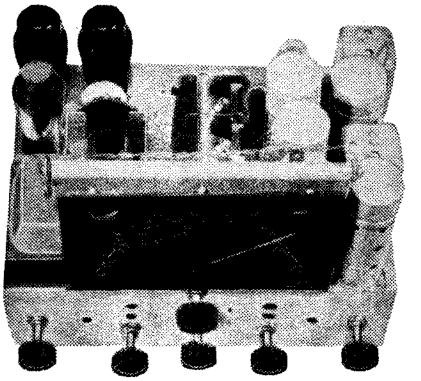
You may make use of this testimonial, as you wish, as a good article cannot be too extensively praised.

It is as well, however, to state at this juncture that a high quality L. speaker must be used, capable of handling the output this chassis can give, and to ensure faultless reproduction.

Yours faithfully,
F. H. HARVEY.

MODEL SS10 — 10-V SUPERHET-STRAIGHT ALL-WAVE HIGH-FIDELITY R-G CHASSIS

incorporating Two Independent Circuits, Superheterodyne and Straight, having R.F. Pre-amplifier and R.C. Coupled Push-Pull Triode Output capable of handling 8 watts.



The circuit of the SS10 is unique. When used as a STRAIGHT receiver two H.F. stages are in operation with A.V.C. Diode Detector is used for distortionless detection together with Triode Push-Pull output. A turn of only one knob is necessary to switch from "Superhet" to "Straight." The Gramophone Amplifier has been specially studied and records can be reproduced with *excellent* quality. **12 gns.** Plus 5%

MODEL AW125PP—12-V 5-BAND ALL-WAVE R-G CHASSIS(12-550 continuous, 1000-2000 m)

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

Readers need no introduction to this most popular model, so favourably reviewed by *The Wireless World* on Jan. 5th, 1939. .... **17 gns** Plus 5%

7DAYS' APPROVAL—12MONTHS' GUARANTEE.

If you haven't seen our Illustrated Art Catalogue describing our full range, drop us a card and we will send one along.

ARMSTRONG MANUFACTURING CO.
WARLTERS ROAD, HOLLOWAY, LONDON, N.7
(Adjoining Holloway Arcade.) 'Phone: NORth 3213.

Letters addressed to Box Nos. are simply forwarded to the advertiser. No responsibility is accepted in connection with these advertisements.

DEPOSIT SYSTEM. Readers may deal with advertisers in safety through our Deposit System. Purchase money payable to Iliffe & Sons Ltd. should be deposited with "The Wireless World," when both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For transactions up to £10 a deposit fee of 1/- is charged ; over £10 and under £50, 2/6 ; over £50 and under £75, 5/- ; over £75 and under £100, 7/6 ; over £100 one-half per cent. All correspondence must be sent to Dorset House, Stamford Street, London, S.E.1.

Cheques and Postal Orders sent in payment for deposits or advertisements should be made payable to Iliffe & Sons Ltd., and crossed. Notes cannot be traced if lost in transit. They must therefore be regarded as being despatched at sender's risk. Alternatively, they may be sent per registered post.

USED SETS FOR SALE

SCOTT

SCOTT Imperial, in Console, 23 valves, perfect; £45.—A.C.S., 46, Widmore Rd., Bromley. [8972

TROPHY

TROPHY 3 A.C., new March, perfect condition, under guarantee; £6/6.—Wishart, 9, Tankerville Tee, Newcastle-on-Tyne, 2. [8976

Wanted

RADIOGRAM, non-commercial quality set.—Write "L. W.," 389, Southborough Lane, Bickley, Kent. [8939

WANTED, Philips 362 Receiver, Everizone or similar tuner; must be cheap.—Box 2150, c/o *The Wireless World.* [8967

H.M.V.650 G.E.C.4010, or other British all-wave multivalve set.—Particulars to Harvey, 92, Romsey Rd., Winchester. [8962

WANTED, McMurdo Silver Super Silver Communication receiver, double regeneration.—Eastment, Horsington, Templecombe, Somerset. [8961

HAYNES Tuner R2, 14-watt amplifier, model V (chassis or in cabinet), with separate speaker (Haynes, Goodman or similar); year, serial numbers, full particulars, and cash price, to: Box 2129, c/o *The Wireless World.* [8956

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment.

IMITATED, but unequalled.

WE Invite You to a Demonstration.

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

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

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

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

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up, with tone control, complete with valve and plugs; £17/10.

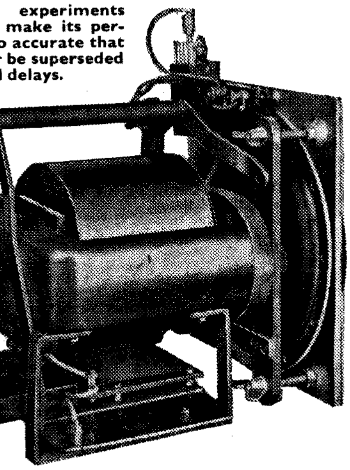
COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer; £22/10.

(This advertisement continued on next page.)

Our Apologies

to those friends interested in our MOVING COIL PICK-UP.

Additional experiments intended to make its performance so accurate that it will never be superseded have caused delays.



A large choice of Valves is given in this issue *but the only choice for a LOUDSPEAKER is*

VOIGT!

- **D.C. Twin Diaphragm VOIGT LOUDSPEAKER units cost from £15** (*ex works*).
- **Simple horns for these can be home made.**

Write for full details to:

VOIGT PATENTS LTD.
The Courts, Silverdale, London, S.E.26.
Telephone: SYDenham 6666.
Regd. Office: 22, Castle Street, London, E.C.1

WARD

WE MANUFACTURE:
ROTARY CONVERTERS DC/AC for operating P.A. amplifiers, Radio Receivers, etc.
DC/DC ROTARY TRANSFORMERS, SMALL ALTERNATORS, SMALL DC MOTORS, H.T. GENERATORS. MAINS TRANSFORMERS up to 10 k.v.a. **PETROL ELECTRIC** generator sets up to 50 k.v.a.
BATTERY CHARGERS for private and industrial use.
We can also handle general small engineering work.
Full details of any of the above upon request

CHAS. F. WARD
46, FARRINGDON ST., LONDON, E.C.4
Telephone: Holborn 9703.
Works: Bow, E.

We carry good stocks of

RAYTHEON - NATIONAL UNION - PHILCO and TUNGSRAM

American Valves—as well as

TUNGSRAM-HIVAC and TRIOTRON

British Specifications.

Our business is wholesale only; our service covers the country. Speedy clearance of traders' want lists by C.O.D. post is our speciality.

Send your trade card for lists to-day—to

LEONARD HEYS, Faraday House, 36, Henry Street, BLACKPOOL, Lancs.

PUBLIC ADDRESS

(This advertisement continued from previous page.)

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

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

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

6- or 12-volt Car Battery Charger, 30/-; complete in gauze case, 35/-.

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

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

SEE Our Display Advertisement on Edit. page 271.

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

NEW MAINS EQUIPMENT

V

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not you?

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 2814. [8242

ALL-POWER TRANSFORMERS, Ltd.—Transformers and chokes to specification, rewinds; write for quotation.—8a, Gladstone Rd., Wimbledon, S.W.19. Liberty 3303. [8913

SHORT-WAVE EQUIPMENT

DENCO.—Ultra low loss S.W. components, receivers, polystyrene insulation; send 2d. for catalogue.—Warwick Rd., Clacton, Essex. [8960

G5NI fo Short Wave Equipment; largest stocks in the country; communication receivers; National agents; American and British Valves, etc. See advertisement on page 4—44, Holloway Head, Birmingham. [0531

"H.A.C." One-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Rd., S.W.8. [8881

NEW LOUD-SPEAKERS

BRAND New Speakers.

SAVE Pounds. 1½d. stamp for list of British and American P.A. speakers. Example: P.A. speaker with transformer, weight 21lb., incorporating curved cone; 52/-.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, London, W.2. Paddington 6492. [8789

BAKERS Brand New Surplus Speaker Bargains. Every music lover interested in realistic reproduction should write for descriptive leaflet now.

£8 ONLY, usual price £16.—Brand new Corner Horn speaker, frequency range 30-12,000 cycles.

£3/15, usual price £9.—Brand new Infinite baffle speaker, complete with cabinet, 19in×19in.×18in., exceptional transient response.

£3/17/6, usual price £9.—Brand new super quality triple cone electro magnet speaker.

£2/7/6, usual price £5.—Brand new super quality triple cone permanent magnet speaker; exceptional value.

SECURE One of These Exceptional Bargains Now.

BAKERS SELHURST RADIO, 75, Sussex Rd., South Croydon. [8978

TRIPLE CONE CONVERSIONS

BAKERS Triple Cone Conversions Will Immensely Improve Reproduction of Your Present Speaker. The following is typical of many unsolicited testimonials:—"Enstone," Lincoln Grove, Newcastle-u-Lyme, Staffs. My speaker arrived safely on Saturday and has now been put into commission. The results are truly amazing, the bass register is reproduced faithfully whilst the upper frequency response is brilliant. For a few shillings you have converted a speaker scheduled for the scrap heap into one worth pounds. I am indeed very satisfied.—W. E. Darby (Grad. I.E.E.).

FREE Descriptive Leaflet from Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [8979

ROTARY CONVERTOR

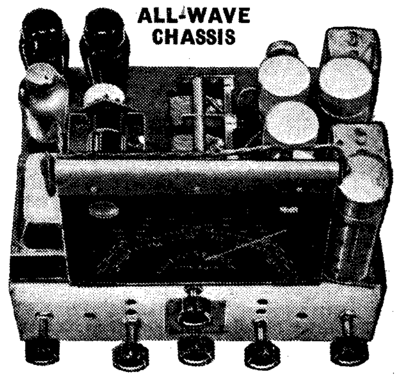
Wanted

SECOND-HAND Rotary Convertor for Radio, input 50v. D.C., output 230v. A.C.—Robinson, Holford House, Lostock Gralam, Northwich. [8982

L·R·S EASY TERMS

The modern method of acquiring the most modern radio at a modest monthly outlay

ARMSTRONG Model SS10
10-VALVE SUPERHET—STRAIGHT



Fully described in Armstrong advert., p. 34
Cash or C.O.D. **£13 . 4 . 0**
Or **45/-** with order and 10 monthly payments of **23/-**.

MODEL AW125PP—12-v 5-Band R-G Chassis (12-550 continuous, 1,000-2,000 m.)
Cash or C.O.D. **£18 . 15 . 0**
Or **76/-** with order and 8 monthly payments of **40/-**.

MODEL AW38—8-v All-Wave Superhet
Cash or C.O.D. **£8 . 16 . 6**
Or **45/6** with order and 7 monthly payments of **20/-**.

WRITE for full specification, Price Lists and Terms for complete Armstrong range.

In addition we shall be glad to quote for all other high-grade equipment, such as **Ambassador Chassis and Receivers, Sound Sales Amplifiers, Voigt Speakers, Haynes Radio, Avo-Meters,** and **PORTABLE A.R.P. RECEIVERS.**

● JOHN McCLURE ●
FEEDER and TUNING UNITS
on convenient terms—

These excellent Feeder Units so favourably reviewed and recommended by "The Wireless World" in March are now available from us on our usual terms. For example:

TYPES ACF4 & UF4. Cash or C.O.D. **£8 . 18 . 6**
Or **£1.8.6** with order and 8 monthly payments of **20/-**.
Full details of other Units on request.

●DRY SHAVERS on 14 DAYS' APPROVAL●

against cash or on first instalment of **10/-**. Should the shaver be returned, **7/6** will be refunded.

VICEROY Non-electric - - £2 . 10 . 0
Or **10/-** with order and 6 monthly payments of **7/2**.

SHAVEMASTER Electric - - £4 . 4 . 0
Or **10/-** with order and 8 monthly payments of **10/-**.

● ELECTRICAL APPLIANCES ●

Fires, Vacuum Cleaners, Clocks, Irons, Fans are all available on our convenient terms.
Write TO-DAY for illustrated details.

The *Evacuation address:* **Est. 1925**
LONDON RADIO SUPPLY COMPANY
"Winden," Ardingly Road, Balcombe, Sussex

CABINETS

A CABINET for Every Radio Purpose.

SURPLUS Cabinets from Noted Makers Under Cost of Manufacture.

UNDRILLED Table, console and loudspeaker cabinets; from 4/6.

RADIOGRAM Cabinets; from 30/-.

INSPECTION Invited.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2 Tel.: Pad. 5891. [0485

CHALLENGER RADIO CORPORATION for the finest obtainable cabinets, table, Console and radiogram; also record-changers at £5/11; send 1½d. stamp for list "illustrated."—Challenger Radio Corporation, 31, Craven Terrace, London, W.2. Paddington 6492. [8790

RECORDING EQUIPMENT

PRESTO Junior Recorder, shop soiled, £45; 10in. D.S. Acetate discs, 2/-; 12in., 3/-; polished cutting needles, 1/3 each.—A.C.S. Radio, 46, Widmore Road, Bromley. [8973

DYNAMOS, MOTORS, ETC.

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

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

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

Wanted

PHILIPS Tubular Vibrator Converter, price and condition.—King, 66, Harcourt Ave., London, E.12. [8871

VALVES

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

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring, American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

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

METROPOLITAN RADIO SERVICE.—American valves, in all types, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

TEST EQUIPMENT

KITS.—A.C./D.C. multimeters, circuit analysers, valve voltmeters, bridges, etc., and associated components.

SIGNAL Generator Kit Available Shortly, 6 to 3,000 metres; stamp for lists.—L. A. MacLachlan and Co., Strathyre. [8987

METERS, ETC.

THERMAL Ammeters, super quality, Ferranti, 0-1a., 2in. dial, H.F., A.C., or D.C.; also M. coil vms., 0-40v. and ammeters, etc., all new; 12/6 each.—Rose, 25, Bower Av., Norbury, Hazel Grove, Stockport. [8969

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS.

PREMIER RADIO.

PLEASE See Our Displayed Advertisement on page 5. [0488

SOUTHERN RADIO'S Bargains.

ALL Guaranteed; postage extra.

5/- Parcel of Useful Components, comprising condensers, resistances, volume controls, wire, circuits, etc., value 25/-; 5/- per parcel.

15/-.—Service man's component kit; electrolytic condensers, volume controls, resistances, tubular, mica, paper condensers, valve holders, etc., 120 articles, contained in strong carrying case, 9in. × 7in.×7in.; 15/- the kit.

5/-.—100 wire end resistances, assorted capacities, ½ and 1 watt; 5/- per 100.

ORMOND Loud Speaker Units, 2/6; Westectors, type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d.

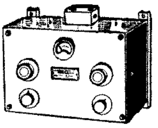
2/-.—Tool or instrument carrying cases, ex Government stock; wood, 9in.×7in.×7in.; 2/-.

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653 [8904

COULPHONE RADIO, Grimshaw Lane, Ormskirk.—Collaro induction gramophone motors, 12in. turntable, 27/6; radiogram units, 45/-; Rola G12 energised speakers, with transformers, 52/6; G12 P.M., 65/-; American valves, guaranteed, standard types, 4/6; Octal, 5/6; crystal pick-ups, 22/6; battery A.C./D.C. portables, 5-valve superhet, £6/5; Plessey 8+8 tubulars, 525 volt, 2/9; get our quotation for R.G.D., Ferguson, G.E.C., Decca, K.B.; stamp for list. [8963

ELECTRADIX

A.C. MAINS CHARGERS. "LESDIX" TUNGAR CHARGERS. Two models of these famous sets. One for 70 volts 6 amps. with meters and controls, etc., will handle 100 cells a day, **£7/17/6.** Another fine Tungar for two 5 amp. circuits with meters and variable volt controls, 70 volts 10 amps., for 200 cells, bargain, **£12/15.**



WESTINGHOUSE METAL RECTIFIERS. 200/250 v. A.C./D.C. Single circuit, wall type, 9in. × 10in. × 11in. 230 v. A.C. for D.C. 100 v. at 500 m/a. Sale, **£5/10.** Wall type "R" steel case, 12in. × 19in., A.C. mains to D.C. 40 volts 3 amps., for 40 radio cells, guaranteed, **£7/7/6.** Similar one for car battery charging, 15 volts 6 amps., D.C. output, **£6/17/6.** Fine model also for A.C. mains with D.C. output of 280 volts 250 m/a., **£7/2/6.** Two 50-volt circuits each of 750 m/a., D.C. from A.C. mains, is another bargain at **£6/10.**

RECTIFIER UNITS ONLY. Westinghouse Metal Rectifier Units, 110 volts .75 amps., **35/-.** 55 volts 1.5 amp., **37/6.** 20 volts 3 amps., **40/-.** 9 volts 2 amps., **26/-.**

DAVENSET A.S.C.4. 4-circuit charger for up to 80 cells. List Price, **£32.** Four sets of Auto-charge regulators and indications on panel with switch volt control. Four circuits of ½ amp., 1 amp., 2 amps., and 2 amps. or three of 1 amp., 2 amps. and 2½ amps., or one of 50 volts 6 amps. Fine steel clad set complete in details that will quickly earn its cost, **£14/10**

A.C./D.C. DAVENSET, Type G.C. House, Garage Wall Type Charger, 3 circuits, output D.C. 25 volts 6 amps. Trans. tapped for 15 volt, 20 volt, 25 volt. Two independent circuits, max. cell capacity 40 radio cells, **£6/5.**

PHILLIPS Model 1087, with valve for 24 volts 10 amps. Steel case, **£7/10.**

PHILIPS "Three in One" for 36 cells, with valve, 3 circuits, **£6/10.**

D.C. CHARGING OFF D.C. MAINS. £14. Davenset DC2 steel-cased 200/250 volt charger, large meters, wheel controls. 2 circuits, 1 amp. and 3 amps., as new. Sale Price. **£5/10.** Charging resistances, all sizes in stock. State load required.

230/230 volts MAINS CONVERSION UNITS. For operating D.C. from A.C. mains screened and filtered, 120 watts output, **£2/10.**

D.C. ROTARY CHARGERS. 3 h.p. 220 volt D.C. motor, 6 volt 250 amp. dynamo, **£16.** 200 volt motor, 25 volts 8 amps. dynamo, **£4.** Motor 220 volts, 8 volts, 50 amps. dynamo, **£6/10.** And others up to 6 kW.

A.C. ROTARY CHARGERS. 3-phase motor, 200 volt to D.C. Dynamo 8 volts 15 amps., **£4/17/6.** R.C.A. 3-ph. motor, 220 volts, coupled to D.C. dynamo, 500 volts 200 m/a., **£5/10.** Single-phase to D.C., Higgs 230 volt A.C. motor coupled to D.C. dynamo, 8 volts 16 amps., **£5/10.** B.T.H., ditto, 1½ h.p. motor, with starter on bed with 15 volt 30 amp. dynamo, **£7/10.**

300-CELL A.C. CRYPTO MOTOR-GEN. SET. For 220 volt A.C. mains, for radio cell circuits and ten 12 volt 10 amp. car batteries D.C. output, **£32.**

Ask for List "C.W." of Charging Dynamos, hundreds in stock.

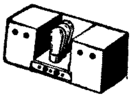
LUCAS FIELD SIGNAL LAMPS **£3/10**

ALDIS TRIGGER TYPE.................. **£3/10**

HIGH RESISTANCE AND RADIO PHONES. The finest always is the adjustable Browns A Reed Phone aluminium swivel headband, 4,000 ohms, **35/6.** 1,500 ohms, **21/6.** 120 ohms, **17/6.** Cords, **1/6. Various Makes.** Second-hand Headphones, in good order, 2,000 ohms and 4,000 ohms, **5/-, 6/6** and **7/6,** with cords. Western Electric, 2,000 ohms, **4/6.**

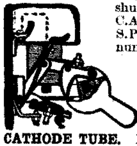
L.R. SOLO PHONES. The extra receiver you want on your phone line. For use with buzzer morse. A circuit tester with a pocket cell. Single Earpiece, 40 ohms, metal hook loop, with cord, **1/3.** Ditto, D.3 60 ohms, with cord, **1/6.** W.E. 1,000 ohms, with cord, **2/-.** 2,000 ohms Earpiece, with cord, **2/6.**

L.R. DOUBLE HEADPHONES. Pilot Signallers, 120 ohm Phones. All leather headbands with slide adjustment chin strap and 4ft. cord. Comfortable, **3/6.** Sullivan 120 ohms, aluminium headbands, **3/9.** Cords, **1/6** extra.



PORTABLE "LESDIX" THREE-VALVE AMPLIFIER, for mike or pick-up, operated from A.C. or D.C. 200/250 volt mains. Undistorted output. 3 watt. **£8/10.** Complete with Dance Band Mike, Transformer, Vol. Control and Valves, **£11/10.** Size 9½×7×5½in. 200/250 v. A.C. or D.C. mains. N.E. 10, WATT in steel case with valves as illus., **£10.** A few soiled and portable other amplifiers cheap. Portable Midget Deaf Aid Amplifiers, with Mike and Earphones, **£9.**

RELAYS. Ultra-sensitive moving coil Relay, 1,000 ohms, coil closes circuit on 50 micro-amps., **60/-.** 2,000 ohms, 5 m/a. lightweight magnetic Relay, **10/6.**

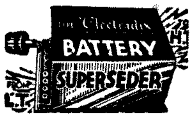


CIRCUIT BREAKER RELAYS, from **10/-.** Charging relays wound shunt and series, Lucas 12 volt 6 amps., **10/6.** C.A.V., ditto, with voltage regulator, **15/-.** D80 S.P. relays for automatic remote control. And a number of other types. See Relay Leaflet.

PHOTO CELLS. R.C.A. Caesium Vacuum, £5 list, for **25/-. Electro-Photonic** photo-cells generate E.M.F. under light, 1½in. by ⅞in., **22/6.** **Disc Selenium Cells,** light to dark resistance, ratio mounted in bakelite case, **8/6.** In brass housing, superior model, **10/6.**

CATHODE TUBE. New, 8in. screen, Ediswan, **£3/10.**

ELECTRIC GOVERNORS, centrifugal control, 1,500 r.p.m., contacts, brushes, slip rings for auto. speed regulation, **7/6.**



H.T. BATTERY SUPERSEDERS. 85 v. at 6 m/a. for H.T. from your 2-volt battery, no H.T. batteries. 7in.×4½in.×3in. Bakelite finish, Vibrator and Metal Rectifier, by S. G. Brown. Sale, **37/6.** Full guarantee. Type S, for larger sets. Can be supplied for either 2-volt, 4-volt or 6-volt battery. Model 10, output D.C. 120 volt, 10 m/a., 2 taps, **65/-.** Model 20, output D.C. 135 volt, 20 m/a., 3 taps, **70/-.** VIBRATORS, 6/12 volt car type, 4-pin, **10/-.**

Free. Our Latest Bargain List "W."

ELECTRADIX RADIOS

218, UPPER THAMES STREET, LONDON, E.C.4.

Telephone: Central 4611

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

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

ELLIPTICAL Speakers, Celestion, suitable Ekco replacements, 750 ohms, less transformers, speech 25 ohms, new, handle 8 watts, carry up to 120 m.a.; 3/9 each, to clear.

FERRANTI Air Core Type Tuning Coils, transformer wound, can be used as band pass, tuned grid with reaction, chassis type; three for 2/6, with coil connections.

T.M.C. 0.5 mf. Paper Tubular Condensers, N.I., 400v., D.C working, 3 for 1/3; Erie 60 ohm ½-watt resistances, 1/3 dozen; Erie 1,500 2-watt resistances, 4 for 1/3; 600 ohm wire wound, 3 watt, 4 for 1/3.

THIMBLE Top Caps, 24 for 1/3; Cornel Dubilier mica 0.001, 0.002, 0.003, 1/3 dozen; 9-pin plugs, with cap and socket, 2 for 1/6; Octal top caps, with hood and screened lead, 4 for 1/3; Octal wafer, V.H., 3 1/3.

SATOR 5,000 ohm Pots, with switch, 1/3; Sator 10,000 ohm broad base, without switch, 1/3; Centralab 11,000 ohm short spindle, less switch, 2 for 1/3; Epicyclic (reduction) drives, 2 for 1/3.

ELECTROLYTICS.—Plessey or T.C.C. 30×8×2 at 300v. working, 1/6 each, 12/- doz.; 25 mf.×25v., 2 for 1/6; T.C.C. 8 mf. wet type 802 upright cans, 440v. working, 460v. surge, 1/9 each, 15/9 dozen.

VOLUME Controls.—½ meg., with switch, Morganite Stackpole, ex K.B., 1/9 each; Murphy type ½ meg., with D P. switch, 1/9; Sator ½ meg., D.P. switch, 1/6.

MAGNAVOX 2,000 ohm 8in. speakers with pentode transformer, 7/-; R. & A. 2,500 ohm 8in. speakers, pentode trans., 7/-; Plessey 6,500 ohm speakers, Pentode trans., 6/6.

SPEAKERS.—Pairs elliptical cone M.C. speakers, Plessey and R. & A., ex Philco, push-pull pentode transformer, fields 325 ohm for smoother, 8,600 ohm as bleeder, handle 10-15 watt, 10/9 pair.

GOLDTONE Mains H.F. Chokes, 120 watt, 2 for 1/6; Plessey midget semi screened twin gangs, 2/9; Plessey twin gangs, screened, with trimmers, 2/6.

AMERICAN Type 2v. Valves (1A4, 1B4 2101), in sets three, VM/HF/Pen., HF/Pen., and ½ watt output pentode, with valve base circuit and details, 4- and 5-pin, with top grids, 5/9 set three; valve holders, chassis, to suit, three for ninepence.

AMPLIFIER Kit Parts for 12-watt output, single 6L6 output, V.H., etc., mounted on chassis, 10×7, complete with four valves, pair Celestion elliptical speakers, resistances, condensers, tone and volume controls, and comprehensive circuit, 3 stage high gain, fully tested, for A.C. 200-250 volts; 45/6, carriage paid.

BEST Known Make, 1 watt, colour coded carbon resistances, 20 sizes, as ordered; 2/6 dozen; ½ watt type, 2/- dozen.

SATOR 1,500v. Test Tubular Condensers, assorted, equal numbers, 0.0002-3-5, 0.001, 0.03, 0.05, 0.002-3, mica; all at 50 for 2/6.

ASSORTED Resistances, 50 for 2/6; 1 watt carbon, U.S.A. make, reasonable assortment given, sizes approx. 450-12,000-17-60-70-90-120 thousand ohms.

PAKOLIN Strip for Group Boards, etc. 2⅛in. wide, 3ft. for 1/3; Centralab ¼-meg. and 50,000 ohm pots, with switch, long spindles, 2/6.

ULTRA Type Brown Knobs, octangle, plain arrow, L.S., 1/9 dozen, 8/6 gross assorted, 10/6 gross plain or arrow.

SMALL Iron Core Coils, made by Varley, aerial and oscillator, 465 k/c, 2/6 pair, with coil connections for straight type gang.

FERRANTI Wire Wound 2½ watt Resistances, with metal end caps, tubular, sizes 3,000, 4,000, 6,000, 8,000, 35,000; four for 1/3.

CLIX Valve Holders 4- and 5- and 7-pin, square and oblong, 1/3 dozen; chassis types, 4- and 5- and 7-pin, round type, with cover, 2/6 dozen.

REX Type Switches, 4B, 2P, 4w., with shorting plates on 5 switches, 2/6; 4B, 2P, 3w., 1/6; 3B, 4P, 3w., 1/3; screens, 3¾×3⅝, 5 for 1/3.

PLESSEY 3-gang Fully Screened Straight Type Condensers, with top trimmers, 2/9; Plessey 3-gang straight type, all wave, ceramic insulators with SM cord drive, antimicro feet, 2/9. [8953

MAINS RADIO DEVELOPMENT COMPANY'S Super Service; immediate delivery; carriage paid or c.o.d.—Telephone Tudor 4046. Stamp for list 235.

ERIE Unused Resistors, 1 watt, all sizes, 4d. each, 3/6 dozen; 2-watt, 7d.

T.C.C. Card Case Electrolytics, 600v. surge, 8×8 mfd., 3/6; B.I.C. metal can dry, 8 mfd., 550v., 2/9; 50 mfd., 50v., tubular, 1/9.

TUBULAR Condensers, unused, wire ends, best make, 400v. working, 0.0001 mfd. to 0.1 mfd., 5d.; 0.25, 0.5 mfd., 8d.

N.S.F., unused, marked and colour-coded resistors, ½ and 1 watt, ten useful sizes in each parcel of 20 resistors; for 1/- only.

CLIX Unused Chassis Valve-holders, 5-pin, 4d.; all American sizes, 6d.; Polar midget three-gang superhet, 2/-.

CENTRALAB Unused Latest Potentiometers, long standard spindle, all sizes, 2/3; with switch, 2/6.

DUBILIER Unused Mica Condensers, midget tags, 0.00005 to 0.0005 mfd., 3d. each, 2/6 dozen.

MAINS RADIO DEVELOPMENT Co., 52a, Church Crescent, Muswell Hill, London, N.10. Tudor 4046. [8968

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

R.

RADIO CLEARANCE, Ltd.,

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

COMPLETE Kit of Parts to Build Lissen Hi Q Battery Shortwave Receiver, 5-91 metres switched; brand new goods, boxed, with circuit and instructions, listed £4/15; our price, £1/19/11, less valves.

ALL-WAVE Superhet Chassis, 5-valve A.C.; latest Mullard valves, T.H.4B., V.P.4B., T.D.D.4, Pen. A.4, I.W., 4-350v.; ranges, short wave, 16-48 metres; med. wave, 200-560 metres; long wave, 800-2,200 metres; size of chassis, 14½in. long, 7½in. deep, height overall 8½in., controls, tuning at side, volume on-off at side, wave change, provision for pick-up; complete with valves and knobs, £4/17/6; special speaker, 1,500 ohms field, 10/6 each.

L.F. Transformer, Lissen Hi Q., ratio 3-1, high grade, boxed, list 6/-; our price 2/3 each.

H.F. Choke, Lissen Hi Q, compact disc type, with feet, boxed, list 2/6; our price 6d. each.

ULTRA Short and Short Wave Choke, Lissen Hi. Q., inductance 100 microhenries, boxed, list 2/-; our price 1/- each.

ULTRA Short and Short Wave Double Wound Low Resistance Choke, Lissen Hi Q., resistance less than 0.05 ohms, boxed, list 2/6; our price 1/3 each.

LOW Loss Ceramic Valve Holders, Lissen Hi Q. baseboard and chassis, 5- and 7-pin; 10d. and 1/- each.

DECIMAL Dial and Slow Motion Drive, Lissen Hi Q., finest short wave dial made, hour and minute hand type, divided into 1,000 divisions, list 12/6; our price 5/11 each.

MANSBRIDGE Type Condensers, Lissen Hi Q., 250 D.C. working, moulded case with feet, 0.1 mfd. and 1 mfd.; 6d. each.

ROTARY Coil Unit, Lissen Hi Q., four band, from 4.8-91 metres, can be selected by a turn of the knob, with circuit, boxed, list 15/6; our price 6/11.

LOW Loss Short Wave Variable Condensers, Ceramic insulation brass vanes, Lissen Hi Q., minimum capacity 5 micro-micro farads, two types, boxed, with knobs; 160 m.mfd., list 7/6, our price 3/6 each; 20 m.mfd., list 5/6, our price 2/11 each.

MICA Condensers, Lissen, new, boxed, all useful sizes, our selection; 1/3 per dozen.

SPEAKER Cabinets, finished black rexine, circular face, metal grille, size 8½in.×9½in.×4½in.; 4/6 each.

SCREENED 3-way Flexible, 4 yards for 1/6.

MEDIUM and Long Wave Coil Units, with valve holders and sundry resistances; 9d. each (no circuit).

MIXED Tubulars, wire ends, our selection; 2/6 per dozen.

4-PIN Baseboard Valveholders, Lissen; 2 for 3d.

4-1 L.F. Transformers, Lissen, boxed; 2/6 each

CONE Speaker Unit, Lissen, complete with reed and chuck, boxed; 1/- each.

SPAGHETTE Resistances, Lissen, many useful sizes, our selection; 1/3 dozen.

4-PIN Valve Adaptors, Lissen; 6d. each.

PUSH-PULL Switches, Lissen; 2-point, 4d. each; 3-point, 6d. each.

RICE-KELLOGG Senior, 12in. moving coil speakers, 20 watts, field 1,000 ohms, 11 ohms speech coil, without speech transformer, 32/6 each; with transformer tapped, 3,000 ohms and 7,000 ohms, 35/- each.

10IN., 10-watt, 2,500 ohms energised speakers, Grampion, heavy cast frame, 15/- each; with heavy duty Pentode speech transformer, 17/6 each.

HEAVY Duty Speech Transformers, Pentode matching, 2/11 each; 2-gang straight condensers, Plessey, 1/6 each; ditto 3-gang, 2/- each.

ROLA P.M. Speakers, latest type 7½in. cone with Pentode transformer, boxed; 14/6 each.

CLOCK-FACED Dials, 5in.×3½in., with printed 3-wave scale, ox-copper escutcheons and glass, 3/6 each; ditto, less escutcheon, 2/6 each.

HORIZONTAL Dials, with plain scale, 7½in.×3¼in. and pointer; 1/- each.

MAINS Transformer, Plessey, 350-0-350v., 90 m.a., 4v., 2.5 amps., 4v. 6 amps.; 8/6 each.

FILAMENT Transformers, input 200-250 volts, output 4v. 4 amps., 4v. 6 amps.; 4/11 each.

MAINS Transformers, G.E.C. American windings, 350-0-350v., 65 m.a., 5 volts 2 amps, 6.3 volts 2.5 amps., suitable for replacements in G.E.C. models; 5/6 each.

MAINS Transformers, Wearite; Type R.C.1, 250-0-250v., 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each; Type R.C.2, 350-0-350v., 120 m.a., 4v. 2.5 amps, 4v. 4 amps., 12/6 each; Type R.C.3, 350-0-350v., 150 m.a., 4v. 2.5 amps, 4v. 2 amps, 4v. 5 amps., 15/- each; Type R.C.4, 500-0-500v., 150 m.a., 4v. 2 amps, 4v. 2 amps., 4v. 2.5 amps, 4v. 5.6 amps, 21/- each.

(This advt. continued in 3rd column.)

GALPINS

ELECTRICAL STORES

75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13

Telephone: LEE GREEN 5240

Terms: Cash with Order

ALL GOODS SENT ON THREE DAYS' APPROVAL AGAINST CASH

EPOCH SUPER CINEMA MOVING COIL SPEAKERS, 18 inch cone, 6 volt field, 15 ohm speech coil, **35/-** each, C/F.

PHILIPS MAINS TRANSFORMERS, input 200/240 volts, output 4,000 volts 200 m/a., centre tapped, also 2-lt windings, **35/-** each, C/F.

MULTI-CONTACT RELAYS, EX-G.P.O., as used in automatic exchange, condition as new, small size, suitable for automatic tuning for press-button control, heavy platinoid contacts, **2/6,** post 3d.; 2 for **4/-,** post 6d.; 3 for **6/-,** post 6d.

VOLTAGE CHANGING TRANSFORMERS (Auto. wound), 12 months' guarantee, 100/110 to 200/240 volts or vice versa, 250 watts, **21/-**; 500 watts, **26/-**; 750 watts, **32/6**; 1,000 watts, **37/6**; 1,500 watts, **50/-**; 2,000 watts, **62/6.**

HIGH VOLTAGE TRANSFORMERS for Television, Neon, etc., 200/240 v. 50 cy. 1-ph. primary 5,000 and 7,000 volts secondary, enclosed in petroleum jelly. Size: 5⅜in. × 4½in.×4½in., **7/6** each, post 1/-. Ditto, skeleton type, **5/6,** post 9d. All brand new.

PAUL & GAMBRELL WHETSTONE 1 to 10,000 OHM RESISTANCE BOXES, in good condition, **£5** each.

EVERETT EDGCUMBE ELECTROSTATIC VOLTMETER, 8in. dial. 0 to 6,000 volts, in good condition, **55/-,** post 2/-.

MORSE TRANSMITTERS, perforator type, motor driven, complete with motor, 100/200 volts D.C., in very good condition, **70/-** each.

X-RAY TRANSFORMERS. All in good condition, fully guaranteed 120 volts, 50 cy. 1-ph. input, 64,000 volts 2 kVA. output, with winding for Coolidge Tube, **£11 10s.** Another, same input, 80,000 volts 3 kVA. output, **£14 10s.** Another, 200/240-volt input, 4,000 volts 12 m/a. output, **£6.** All Carriage Forward.

TRUVOX PUBLIC ADDRESS HORN SPEAKER UNITS, 15 ohm Speech Coil, 6 volt field, **15/-** each, post 1/6.

DYNAMOS, for charging or lighting, etc., all shunt wound and fully guaranteed. 100-volt 10 amp., 4-pole, 1,500 r.p.m., **90/-**; 50/75-volt 15 amp., 1,750 r.p.m., 4-pole, **90/-**; 30-volt 10 amp., ball bearings, 1,500 r.p.m., 4-pole, **70/-**; 25-volt 8 amp., 1,750 r.p.m., 2-pole, ball-bearing, **37/6**; 50/75-volt, 25 amp., 4-pole, 1,500 r.p.m., **110/-.**

ELECTRIC LIGHT CHECK METERS, for sub-lettings, garages, etc. 200/250 volts, 50 cy. 1-ph., supply 5, 10 or 20 amps., **6/-** each, post 1/-.

SAVAGE MAINS TRANSFORMERS, input 200/250 volts, output 50 volts at 6/8 amps., usful for arc lamps, etc., **15/-** each, post 1/-.

STUART TURNER 2¾ h.p. **PORTABLE ENGINE,** petrol, flat twin, air cooled, complete with all accessories, in good condition, **£7 10s.,** C/F.

EVERSHED RECORDING AMPMETERS, 20 amps. D.C., in good condition, **55/-,** C/F.

PORTABLE LIGHTING ENGINES, 2¾ twin Douglas, special, air cooling, complete with all fittings, including petrol tanks, etc., fully protected, condition as new, **£10,** C/F.

SILVERTOWN HORIZONTAL GALVANOMETERS, jewelled movements, **5/-** each, post 6d.

EX-G.P.O. GLASS TOP RELAYS, Type B. Useful as Keying Relays, **5/-** each, post 6d.

T.C.C. 2,000 MF. ELECTROLYTIC CONDENSERS, 50-volt working (brand new). **5/-** each, post 6d.

STANDARD TELEPHONE BELL WIRE, all brand new, 150-yd. coils, twin 22 gauge, **4/-,** post 9d.; 250-yd. coils, single 18 gauge, **4/-,** post 1/-; 300-yd. coils, single 22 gauge, **3/-,** post 6d.

MOVING COIL MOVEMENTS, complete in case with pointer, very low m/a., full deflections, 2½in. dia., **5/-,** post 6d.; 4in. dia., **6/-,** post 9d.; and 6in. scale, **7/-** each, post 9d.

MAINS TRANSFORMERS, 200/250 volts input, 12 and 24 volts at 4/6 amps. output, suitable for model trains, etc., **15/-** each, post 1/-.

MAINS POWER PACK, consisting of 2×20 Hy chokes and 2×2 mf. condensers, **3/-,** P/F.

D.C. to D.C. ROTARY CONVERTORS, 200/240 volts input, 14 volts 12 amps. output, useful to garages for accumulator charging, **35/-** each, C/F.

D.C. MOTORS, ¾ h.p., 4,000 r.p.m., double ended shaft, useful for polishing, grinding, etc., in good condition, **35/-,** C/F.

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

(This advt. continued from 1st column.)

ALL the Above C/T Windings.

TYPE R.C.5, 100-watt Auto transformer, 100-110v.-200-250v., reversible, 12/6 each; type R.C.B., 350-0-350v., 80 m.a., 5v. 2 amps, 6.3v. 5 amps., 6/11 each.

ALL Transformers 200-250v., tapped primaries.

CHASSIS Mounting Valve Holders, American, 4-, 5-, 6- and 7-pin, 4d. each; Octals, 6d. each; Loctals, 10d. each; 7-pin English type, 3d. each.

POLAR N.S.F. 1-watt Resistances, 4d. each, 3/9 dozen; all sizes up to 2 meg.

WEARITE 110 k/c I.F. Transformers; 1/- each.

VOLUME Controls, American C.T.S., finest made, divided spindles, length 2½in., with switch; 2,000, 5,000, 10,000, 25,000, 100,000, 250,000, 500,000 and 1 meg., 2/6 each; wire wound, 5-watt (less switch) 2,000, 5,000, 10,000, 20,000, and 25,000 ohms; 2/- each.

24 MFD. Can Type Electrolytics 450 volt working; 1/- each.

B.I. Wire-end Type Bias Electrolytics; 50 mfd., 12 volts, 1/6 each; 50 mfd., 50 volts, 2/- each.

TUBULAR Wire-end Non-inductive Paper Condensers, all sizes up to 0.1; 5d. each, 4/9 dozen.

ENERGISED Speakers, Plessey 6in. cone, 1,500 ohms field; 5/11 each.

BATTERY Output Pentode Valves, well-known make; 3/11 each.

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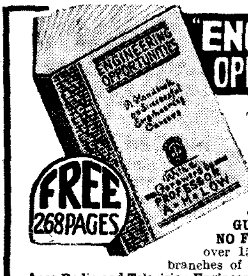

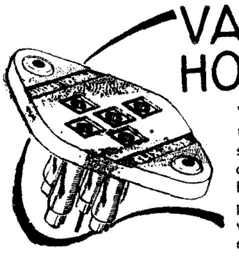

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