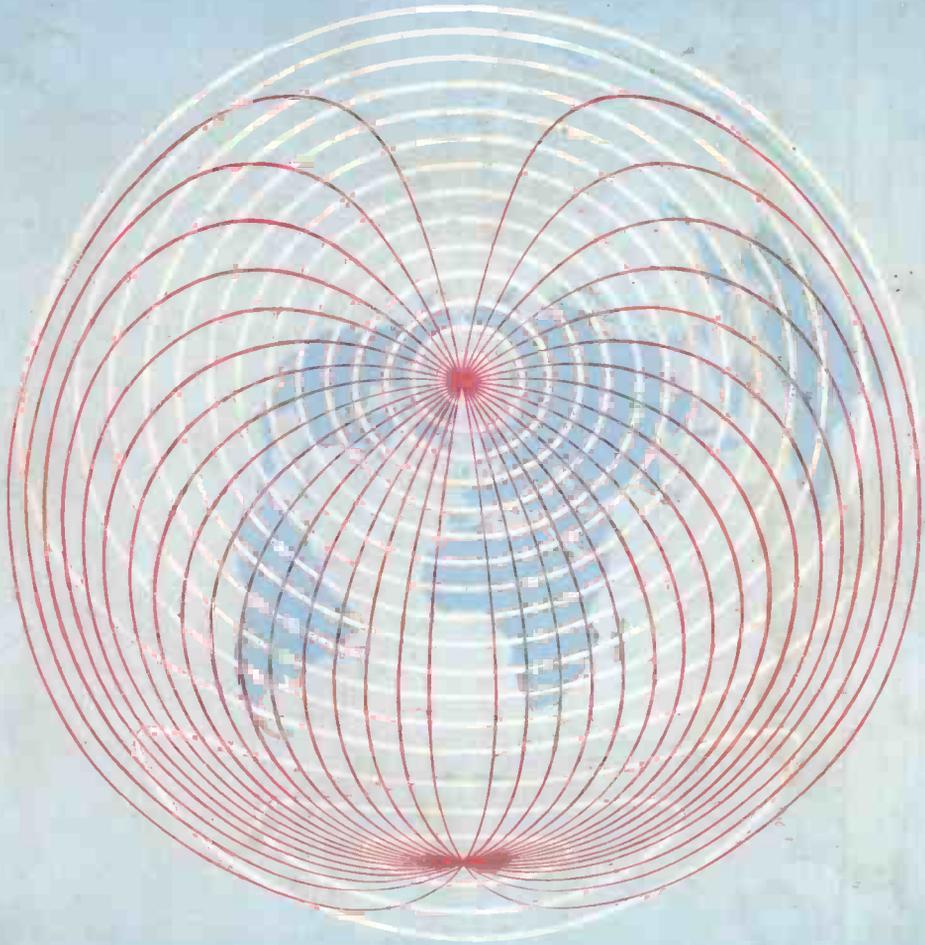


Wireless World

FEBRUARY 1954

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Wireless World

RADIO, TELEVISION
AND ELECTRONICS

43rd YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.

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FEBRUARY 1954

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VALVES, TUBES & CIRCUITS

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CHOICE OF RESERVOIR AND SMOOTHING CAPACITORS. When designing an amplifier it is desirable to know the amount of a.c. ripple which may be superimposed on the direct voltage supplied to the valves. For a particular input voltage and output current the values of ripple and direct voltages depend upon the reservoir capacitance and upon the type of smoothing network. Generally the power supply includes a reservoir capacitor (C1), either an inductance (L) having a resistance (R) or a resistance (R) alone, and a smoothing capacitor (C2). The following table shows typical values of ripple and direct voltages across C1 and across C2 for several standard values of components. The input voltage is 2 x 250V r.m.s. and total output currents of 90 and 60 mA are considered.

In general, the value of the ripple voltage across C2 is inversely proportional to the values of both C2 and C1 whereas the ripple across C1 is only inversely proportional to the value of C1 and not dependant upon L, R or C2. To ensure a low ripple voltage at C2 it is necessary to make both C1 and C2 as large as possible. If further smoothing is desired, as with the supplies to a pre-amplifier stage, it is usual to incorporate this in a form of decoupling in order to isolate this stage.

If large values of capacitance are used it is possible to economise in the design of the amplifier by replacing the smoothing choke by a resistor with little change in ripple voltage. The output voltage from C2 will then be reduced by an amount depending upon the load current and the value of the resistor. In this case the voltages required for the anodes of the output valves may be taken from C1. With a single valve output stage, the ripple across C1 must then be as low as possible. In push-pull stages, if the two output valves are reasonably similar, quite large amounts of ripple can be tolerated as they will be balanced out.

From the table it is seen that the conventional network of C1 = 8μF, L = 10H, C2 = 16μF may be replaced by C1 = 50μF, R = 500 Ω, C2 = 50μF with only a slight increase in ripple across C2 from 210 mV to 225 mV and a reduction in the ripple across C1 from 21V to 3.5V. The output voltage across C2 is reduced from 251V to 220V but the anodes of the output stage may be connected to C1, across which is a voltage of 265V.

V_a (r.m.s.) = 2 x 250V, I_{out} = 90mA.

C1 (μF)	C2 (μF)	L (H)	R (Ω)	Ripple Voltage across		Direct Voltage across	
				C1 (V _{r.m.s.})	C2 (mV _{r.m.s.})	C1 (V)	C2 (V)
8	8	10	100	21	450	260	251
8	16	10	100	21	210	260	251
16	16	10	100	10.5	110	263	254
50	50	0	500	3.5	225	265	220
50	50	0	1000	3.5	110	265	175

V_a (r.m.s.) = 2 x 250V, I_{out} = 60mA.

C1 (μF)	C2 (μF)	L (H)	R (Ω)	Ripple Voltage across		Direct Voltage across	
				C1 (V _{r.m.s.})	C2 (mV _{r.m.s.})	C1 (V)	C2 (V)
8	8	10	100	15	315	283	277
8	16	10	100	15	145	283	277
16	16	10	100	7.5	75	285	279
50	50	0	500	2.5	160	287	257
50	50	0	1000	2.5	80	287	227

VALVE DATA

HEATER	V_h	6.3	V
	I_h	0.6	A

LIMITING VALUES	V_a (r.m.s.) max.	2 x 350	V
	I_{out} max.	90	mA
	C max.	50	μF
	$V_{h-k(pk)}$ max.	500	V

BASE
B9A

DIMENSIONS	Max. seated height	61	mm.
	Max. overall length	67	mm.
	Max. bulb diameter	22.2	mm.

TYPICAL OPERATING CONDITIONS

V_a (r.m.s.)	2 x 250	2 x 275	2 x 300	2 x 350	V
C	50	50	50	50	μF
* R_{lim} min.	125	175	215	300	Ω
I_{out}	90	90	90	90	mA
V_{out}	265	285	310	360	V

*Per anode.



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MVM 260

Wireless World

FEBRUARY 1954

VOL. 60 No. 2

V.H.F. Very Much at Sea

THE world as a whole seems to have got itself into an almost inextricable tangle over international marine radio-telephone communication on v.h.f. The trouble started with the Atlantic City conference in 1947, where, we can now see clearly, insufficient thought was given to the framing of regulations for this branch of communications. As a result, frequency modulation is used in the Americas while almost everywhere else amplitude modulation has been adopted.

So far as purely local marine services are concerned, the lack of universally accepted standards is not necessarily a serious handicap. But it is a different matter when we come to ocean-going ships, which, to derive the fullest benefit from v.h.f. equipment, should be able to communicate freely with coastal stations, as well as with tugs and possibly other ships, in all parts of the world. For these vessels, universally agreed standards are clearly desirable.

America, as the principal champion of frequency modulation, has suggested that Great Britain should change over to that system, and it has been implied in reply to questions in Parliament that this change has been considered. The Post Office, however, in a memorandum issued as long ago as 1949, showed itself very much in favour of amplitude modulation. Whatever may be the advantages of f.m. for broadcasting and for some other services, it certainly has not been proved that these hold good for marine communication. A strong argument advanced against f.m. for marine applications is that it would prevent intercommunication between ships and a.m.-equipped aircraft in case of accidents.

All these matters are discussed at length in a statement, summarized on another page, recently issued by Rees Mace Marine. For an ultimate solution of the various problems, the company, appreciating the necessity for a completely new international agreement, pleads for the setting up of a truly representative marine international body. For such a highly specialized branch of communications, a body of this kind would appear to be essential, but, inevitably, the framing of new international regulations and their universal acceptance would take years. As a matter of short-term policy, Rees Mace face the inevitable.

and suggest that ships sailing to those countries which have adopted f.m. should be fitted with equipment for dual modulation as soon as the other factors involved can be agreed internationally. This proposal does at least provide a realistic solution of an awkward problem.

Safety in the Air

IF we wireless people had our way, ships and aircraft would become merely floating or flying platforms for the carrying of radio equipment. So runs an oft-repeated gibe and, in our more dispassionate moments, we must admit there is a grain of truth in it. We must always bear clearly in mind the fact that the primary function of craft navigating sea or air is to carry passengers and freight as economically as possible. There is, particularly in the air, a distinct upper limit to the amount of space and weight that can be allocated to wireless gear. Then there are the associated problems of operation and maintenance; both of these are mainly economic.

These thoughts are provoked by recent correspondence originating in *The Times*, where it was suggested that passenger aircraft could be made a good deal safer if more extensive use were made of airborne radar for preventing collisions with mountain peaks, other aircraft and dangerous clouds.

All this raises problems that cannot be summarily disposed of, one way or the other. Elsewhere in this issue a contributor who cannot be accused of undue partiality in either direction examines dispassionately some of the problems inherent in the use of airborne radar for civil aviation. Very roughly, his conclusions are that the installation of cloud warning radar may be justified on certain routes at certain times of year, but the practicability of its general application is extremely doubtful.

No doubt, however, there will be considerable technical development in this field. A device combining the functions of radio-altimeter and cloud-warning indicator, with sequential scanning in different planes and simultaneous but independent presentation of the two kinds of information, should not be beyond the bounds of technical practicability.

“Chameleon” Oscillator

Versatile Modified Hartley Circuit Giving High Frequency Stability

By THOMAS RODDAM

ALTHOUGH you might not think so, if you took these columns as a statistical guide, oscillators are our bread and butter: or perhaps our bread, with modulators playing the role of butter. Without these two essential devices the whole of the radio field would be non-existent. It is rather surprising, therefore, how rare it is to see any description of a newish oscillator circuit, while every variant of a variant of an amplifier circuit is described in detail. One reason is that oscillators are fairly easy to build, and, apart from the traditional reversal of the feedback winding, they usually work after a fashion as soon as they are connected. When the oscillator is to work over a frequency range the requirements for stability are normally fairly lax, and any of the textbook circuits will do.

For more advanced work there is always the crystal oscillator, the Meacham bridge circuit,¹ the Gouriet circuit² or the Tillman circuit.³ But these are complicated, or difficult to design, or use a lot of components, or give rather a small output, or don't give a sinusoidal output. There appears to be room for a good middle-class oscillator giving a fairly large sinusoidal output and good stability, and not using too many components.

The oscillator described in this article appears to me to offer all these advantages. The stability against variations in valves and supplies is high, so that the frequency can be trusted to a few parts in 10⁴ without supply stabilization, or better than 1 part in 10⁴ if the anode supply is stabilized. It uses relatively few components in its basic form, produces all the output the valve can give, and has a very low distortion content. To date it has been tested at frequencies from 500 c/s to 10 Mc/s, using exactly the same design method, and has worked according to plan every time. This last feature, designability, is one which is often ignored in oscillator circuits: my own view is that if you can't design it you can't trust it.

The title I have chosen for this article reveals one difficulty: there are several different ways of approaching the circuit, all equally valid and all stressing different aspects of the operation. Rather than prejudice the issue, I evade it.

The basic circuit of the oscillator is shown in Fig. 1. Apart from the resistance R, it is just a cathode-coupled Hartley circuit, and the addition of R might be regarded as a bit of whimsy intended to make things more complicated. This is not so, however, because the introduction of R ties the whole circuit down to an optimum design. It also enables us to transform the circuit in several different ways: we shall come back to this point later.

Fig. 2 shows the equivalent circuit, with the valve regarded as a cathode follower and the grid connection dotted. The valve becomes a generator $\frac{\mu}{\mu + 1} e_g$ with

internal impedance $1/g_m$, acting in series with R: the losses in the tuned circuit are represented by the resistance R_2 , which is the dynamic impedance of the circuit at anti-resonance.

The design problem is obviously to determine where the tap A should be on the coil, and what value of R should be used. Clearly a large value of R will be advantageous, because R and $1/g_m$ are in series, so that the bigger we make R, the more we swamp $1/g_m$ and the less effect this term will have on the behaviour of the circuit. A high value of R will help to keep the valve out of the circuit.

The coil acts as an auto-transformer, with a ratio 1 : n, so that at anti-resonance we shall see across AB a resistance of R_2/n^2 . The voltage at AB is thus

$$\frac{\mu}{\mu + 1} \cdot e_g \left(\frac{R_2}{n^2} \right) / \left(\frac{R_2}{n^2} + R + \frac{1}{g_m} \right)$$

and as the auto-transformer has a step-up of n times, the voltage across BC is

$$n \cdot \frac{\mu}{\mu + 1} \cdot e_g \left(\frac{R_2}{n^2} \right) / \left(\frac{R_2}{n^2} + R + \frac{1}{g_m} \right)$$

This, of course, is just e_g , so that we must have

$$\frac{n\mu}{\mu + 1} \cdot \frac{R_2}{(R_2 + n^2R + n^2/g_m)} = 1$$

For any practical valve, μ is large enough for $\mu/(\mu + 1)$ to be taken as unity, within a few per cent.

Fig. 1. Skeleton of the modified Hartley circuit: the lettering is carried over to Fig 2.

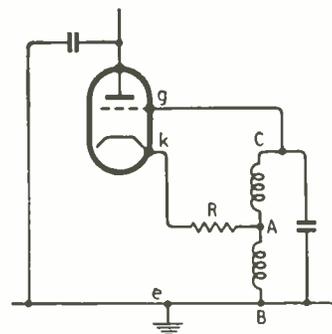
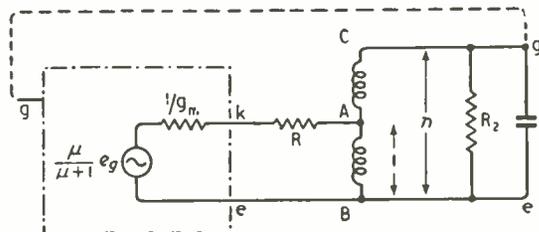


Fig. 2. (below): Equivalent circuit, for calculation purposes. R_2 is the loss in the coil.



¹ Bell System Technical Journal, Oct. 1938.

² Wireless Engineer, April 1950.

³ Wireless Engineer, Dec. 1947.

We intend to have R very much greater than $1/g_m$, to decouple $1/g_m$ from the circuit. A fairly good approximation, therefore, is that

$$\frac{nR_2}{R_2 + n^2R} = 1 \text{ or } R = \frac{n-1}{n^2} R_2$$

In this equation R_2 is fixed, because it is a property of the coil. The maximum value of R is then obtained if $n = 2$, when $R = R_2/4$. You can check by plotting the graph of $(n-1)/n^2$ that the maximum is a fairly flat one, so that the result is not particularly disturbed by the approximations we have made, and subject to these approximations we find that the centre-tapped coil is the *best* solution.

We are still rather in the air, however, because the design simply says "take one coil." Can we find out anything more? We have seen that across AB we now have a resistance of $R_2/4$, and at the cathode of the valve we shall see $R + \frac{R_2}{4}$ or $R_2/2$. We know

that a high μ will help to make $\mu/(\mu+1)$ more independent of μ , and a high g_m will keep $1/g_m$ small, so that we can choose a valve. The CV455 (ECC81, 12AT7) has a g_m of 5 mA/volt and a μ of about 50 (each section), so that $\mu/(\mu+1)$ is 0.98 and $1/g_m$ is 200 ohms. A good load for this valve is about 25,000 ohms, which gives a compromise between gain and power output. We must therefore take $R_2 = 50,000$ ohms, so that $R = 12,500$ ohms. Of this, 200 ohms is in the term $1/g_m$, leaving 12,300 ohms. Even so, we haven't taken account of the $\mu/(\mu+1)$ term, which would reduce the 12,500 ohms to 12,250 ohms, giving $R = 12,000$ ohms as a pretty close approximation.

That final dubious piece of arithmetic, with 50 ohms disappearing up my sleeve, is justified by the fact that the coil is yet to be calculated. We know that we want R_2 to be 50,000 ohms. The next step is to choose a coil type, knowing the order of Q to be expected, and from this value of Q and the value of R_2 just determined calculate the inductance. Since $Q = R_2/2\pi fL$ we have

$$L = R_2/2\pi fQ \quad \text{and} \quad C = 1/(2\pi f)^2L$$

Having calculated the coil and constructed it, with its centre-tap, the actual value of Q can be determined, and from this the true values of R_2 and R . That is why the calculation of R above was scamped—the data lacked precision, anyway.

It is, unfortunately, necessary to add some more components, because with 10 k Ω odd in the cathode the valve current will be so small that the mutual conductance will be much lower than we have assumed. The necessary modifications are shown in Fig. 3, and as you can see, they are just a conventional cathode bias resistor R_k , which forms part of the total R , and a grid capacitor and leak resistor. The bias resistor should be the ordinary Class A amplifier bias resistor, chosen to ensure that the valve will cut off rather than run into grid current. The grid circuit should be generously proportioned, with $2\pi f C_g R_g \gg 1$ to avoid any phase shift which might alter the operating frequency. And there is the oscillator circuit, all worked out.

A particular design, operating at 1,600 c/s, made use of a dust-iron cored coil with a Q in the region of 50. For this case, assuming still that we want $R_2 = 50,000$ ohms, we have $L = R_2/2\pi fQ = 50,000/10,000 \times 50 = 100$ mH.

When tested, the coil was found to have a Q of 60, making $R_2 = 60,000$ ohms and the approximate value

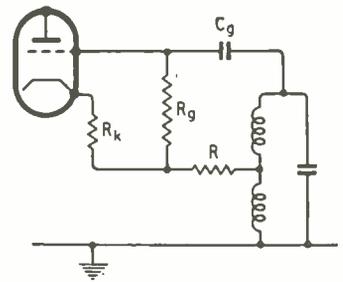


Fig. 3. Adding R_k , R_g and C_g to get the valve biased to the best point.

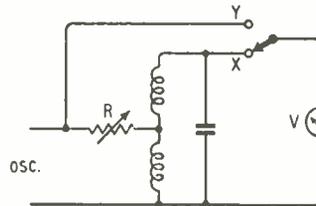


Fig. 4. No Q-meter! You can use this circuit to find the value of R needed in the oscillator. V must be a high-impedance valve voltmeter.

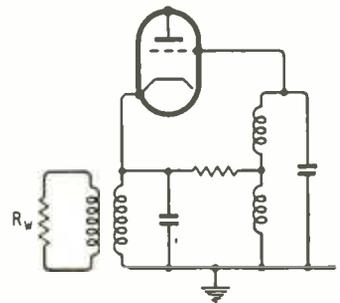


Fig. 5. A transformer in the cathode makes it possible to get the full voltage across the valve: more out, more stable.

of $R = 15,000$ ohms. No attempt was made to calculate the exact value, but a normal-tolerance 15 k Ω resistor was used and the appropriate value obtained by adding in parallel a resistance box covering the range up to 1 M Ω . A final test showed that 330 k Ω could be used for this position.

Measuring "Q"

The next stage in refinement gives further advantages, but before continuing with this it is worth noticing that a Q-meter is not needed in the design of this circuit. It can perfectly well act as its own Q-meter and, indeed, for some types of core material it is necessary to use this technique. The only apparatus needed is an oscillator, a high-impedance valve voltmeter, and a variable resistance unit. The circuit is shown in Fig. 4. The valve voltmeter is first connected to X, and the oscillator, or the circuit tuning, adjusted until a maximum reading is obtained. The switch is then moved to the position Y, and a convenient deflection obtained on the valve voltmeter. Then switching between X and Y the value of R is adjusted to obtain the same reading at both points. By the mathematics already given, $R = R_2/4$, so that Q can easily be calculated. This circuit is also very useful for studying core materials in which the loss varies with the level, because the value of R_2 for any voltage across the coil is easily, and directly, measured.

The ordinary Q-meter is only useful if the Q does not depend on the signal level.

A disadvantage of the oscillator circuit as it appears in Fig. 3, is that a lot of supply power is wasted in R, and that there is nowhere to connect a load. The other half of the CV455 can be used as a buffer amplifier, of course, but it would be advantageous to find some way of keeping the d.c. out of R, for economy, to avoid changes in R caused by heating and to keep g_m high by passing more current through the valve. With the values discussed above only about one-third of the supply voltage is available between anode and cathode, which is a severe limitation. The circuit shown in Fig. 5 was evolved to deal with this question. The transformer primary is chosen to have a resistance equal to the required bias resistance in low frequency designs, and has an added series resistor, which is not shown, in high frequency designs. A tuning capacitor is provided, but the tuning is extremely coarse, since the valve presents a very low impedance in shunt across the circuit. Power can be taken off in a secondary load R_w , thus avoiding the need for a buffer amplifier.

It was found that even though now loaded directly, the performance of the oscillator was not degraded, owing to the fact that the full supply voltage now appeared across the valve. The problem was then to calculate the cathode transformer. As before,

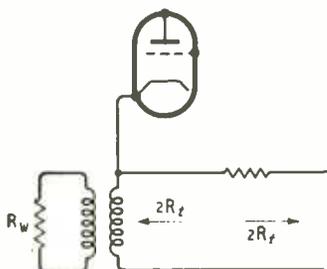


Fig. 6. The bottom of Fig. 5 looks like this as we calculate the cathode transformer.

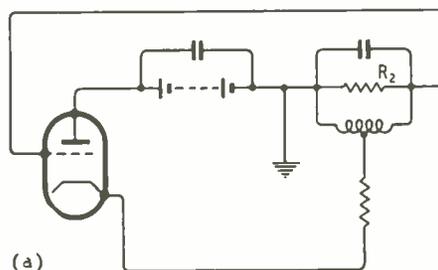
Right: Fig. 7. Drawn as in (a) the circuit shows the bridged-T form. After the T- π transformation (b), and a further rearrangement (c), the circuit assumes a bridge form.

we must choose the load which is to be presented to the valve, and we will usually be free to take some compromise between maximum gain and maximum power, leaning now towards the conditions for maximum power. Let us call this optimum load R_l . If all the power goes into the load, and none into the oscillatory circuit, the oscillator will not be stable: if all the power goes into the oscillatory circuit and none into the load it will not be very useful. As a compromise, let us split the power equally between the load and the oscillator itself. This gives us the conditions indicated in Fig. 6, so that if we know R_w , the actual load, the output transformer must have a ratio of $\sqrt{2R_l/R_w}$. The oscillator circuit must be recalculated, with R now equal to R_l and $R_2 = 4R_l$. This does not make so very much difference, because R_l will be lower than the optimum load for gain alone. In a particular design, the one for which the numerical example above was actually used, the value of R_l for a CV455 was taken as 25,000 ohms, and in the embodiment of this design it was found that a change

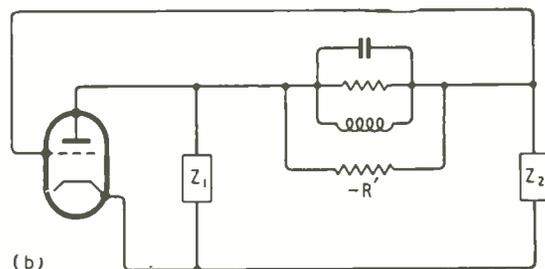
of supply voltage from 150 V to 300 V produced only about 1 part in 1,000 change in frequency. Small changes of anode voltage had very little effect on the frequency, and quite elaborate equipment was needed to measure the changes.

All the best oscillator designers incorporate a.g.c. in their designs: none is used in this oscillator. The reason why it is not needed here is in the vital inequality $R \gg 1/g_m$. Viewed at the point A in Fig. 1, the negative feedback is very large, and the valve is either operating in the linear region, or it is cut off. Even when the valve is not cut off, the impedance at the grid is very high, because of the cathode-follower action: when the valve is cut off, the impedance is, of course, even higher. As a result, the tank circuit is free to swing for a fraction of a cycle, and driven through a high resistance over the rest of the cycle. There isn't really very much which can upset the frequency.

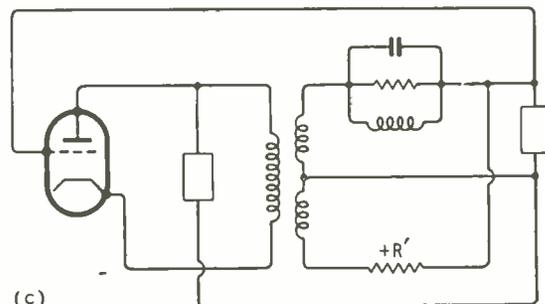
Having decided that this circuit, which doesn't seem to have been analysed anywhere else, though it is mentioned in "Waveforms" (B. Chance *et alia*, M.I.T. Series, McGraw Hill), is a good one, there remains the problem of why it is quite so good. After staring at the circuit for quite a time it became clear that it can be drawn in the form shown in Fig. 7(a). I do not propose to go through the analysis of what



(a)



(b)



(c)

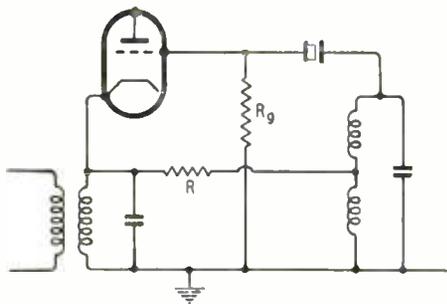


Fig. 8. You want to add a crystal? Just plug it in, and add a grid leak. The value of R needs to be reduced by a few per cent.

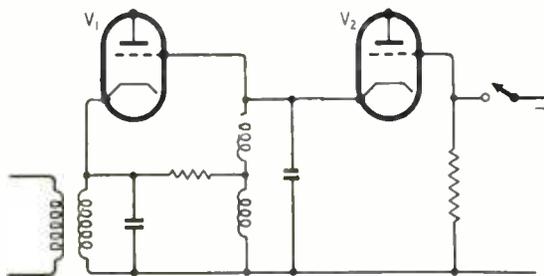


Fig. 9. The triode V_2 can be used to key the oscillator and provide the same starting phase to each pulse.

happens next, but by means of T-- π transformation the network can be converted into the form of Fig. 7(b), with the shunt arm R transforming to a negative resistance $-R'$ this is the method used to obtain an infinite-Q rejection circuit, and it was described in *Wireless World* some years back¹. A further operation gives us the equivalent circuit shown in Fig. 7(c), with a transformer providing a phase reversal on one side so that a positive R' can be used.

Now we can see what is happening. The resistance R' produces positive feedback from anode to grid, but this is offset by the negative feedback through the LCR circuit, except at the anti-resonant frequency of the LCR circuit. At this frequency the negative feedback through R_2 is not quite enough to prevent oscillation: at harmonic frequencies, of course, there is a lot of negative feedback, so that harmonics, and hum, too, are suppressed. Drawn in this way the circuit is obviously a bridge and has all the advantages of a bridge circuit. The reader may wonder why the oscillator does not include a thermistor for amplitude control, thus ensuring completely Class A operation. The answer is simple: thermistors with a suitable characteristic are hard to come by. For the example we have discussed the thermistor, which would replace the resistor R, would need to be about 12,000 ohms with an applied voltage of about 10 volts—a dissipation of the order of 10 mW. Furthermore, the resistance must rise with applied level. If this B-type characteristic were readily available it might be worth reconsidering the design to see if we could apply thermistors.

An interesting extension of the oscillator is to crystal control. It is not, I suppose, one of the very best

crystal circuits, but it has a feature of extremely great value: the crystal current is predetermined quite accurately, so that there is no reason why the crystal should be overloaded. The necessary modification for crystal control is shown in Fig. 8. The circuit without the crystal is designed in the way already described, and is set up to give oscillations at the required frequency. The amplitude of oscillation is adjusted by trimming R. Suppose that this amplitude is 20 V, and that the recommended maximum crystal current is $25 \mu\text{A}$. By choosing $R_g = 1 \text{ M}\Omega$, the crystal current cannot exceed $20 \mu\text{A}$, because the grid swing, which is equal to the cathode swing, can only drive this current through the crystal and R_g in series. When the crystal is inserted, of course, the oscillator will probably not oscillate, because R will be just too high. A very small reduction of R will be needed to make up for the loss in the series resistance of the crystal. In this circuit the crystal is operating in its series mode, and I can see no reason why it should not be worked on an overtone, although I have not yet tried this.

One final variant is shown in Fig. 9. This is actually better known than the oscillator itself. It is a method of keying this oscillator to produce a very clean square wave-train which always starts with the same phase. When the key is down, V_2 is completely backed off, and the oscillator functions quite normally. When the key is up, the grid of V_2 goes to earth, V_2 conducts and damps the tank circuit so heavily that the oscillations just stop. Each time the key is operated, therefore, the cathode of V_2 drops sharply, brings the grid of V_1 down with it, and the circuit is all set at a peak of the sinusoid, free to oscillate. This form is described in "Waveforms," referred to above.

The modified Hartley oscillator described in this article is an extremely simple and good circuit. As we have seen, it can be described as a bridge circuit; and it might also be well described as an over-balanced rejector circuit oscillator.

Measuring Interference

DIFFICULTIES have for some time been experienced both in Germany and in this country in correlating the data on the measurement of interference from motor vehicles obtained in each country. Tests were, therefore, arranged through the Electrical Research Association and the Fernmeldetechnisches Zentralamt, with the co-operation of Joseph Lucas, Ltd. and the Bosch Co., in order to compare the behaviour of the British and German measuring equipment under identical conditions.

A comparison of the two types of equipment, as a result of tests which were carried out in January last year at the F.T.Z. at Darmstadt, is given in a report published by the E.R.A. This report (M/T123) entitled "Radio Interference from Motor Vehicles," by A. H. Ball and S. F. Pearce, shows that the British interference measuring equipment (Post Office measuring set R12) will give indications of field strength from an ignition system approximately 20 db lower than that obtainable with the German set.

The results of the tests show why more elaborate suppression was required in Germany to meet the proposed limit of $120 \mu\text{V/m}$ than has usually been found necessary to conform to the British limit of $50 \mu\text{V/m}$. Experience in Germany would be comparable with that in Great Britain if the proposed German limit were increased to $500 \mu\text{V/m}$.

The report is obtainable from the British Electrical and Allied Industries Research Association, Thorncroft Manor, Dorking Road, Leatherhead, Surrey, price 10s 9d by post.

¹ June 1950, p. 223

The Transistor in

By S. KELLY*

DURING the five years since the introduction of transistors, considerable effort has been expended not only in the development of the transistors themselves but also in circuit techniques and associated components. The prime advantages of the transistor are the ability to work at very low power levels with high efficiency, small size and light weight. The disadvantages of currently available transistors are higher noise level than equivalent vacuum valves, rather bad temperature coefficient, and greater variability of characteristics than vacuum valves. So far as can be seen at present, the first and last of these criticisms are a question of manufacturing techniques and will be overcome as quantity mass production of transistors becomes fact. The question of temperature coefficient appears to be bound up in the nature of the beast and, for the time being at any rate, must be suffered. Variations in transistor characteristics and temperature coefficient can be compensated by circuit design, but are usually wasteful of gain, and with the present high cost of transistors cannot usually be justified on economic grounds for commercial applications.

It is important to appreciate that the transistor behaves almost as the dual of the familiar vacuum valve.¹ Additionally, there is considerable reaction

between the input and output circuits coupled to the transistor, which is almost entirely absent in vacuum valve circuits at low frequencies, thus requiring an entirely different approach to circuit design. Unfortunately, junction transistors have not so far been generally available in this country, with the consequence that practical experience, which alone can give familiarity with any technological process, has been denied to the majority of designers.

Apart from specialist uses, such as for military requirements, computers, and the telephone industry, the main outlet for transistors in the domestic field in the next few years would appear to be in hearing aids and miniature "personal" radio receivers, where the high initial cost of the transistor is more than outweighed by the considerable saving in running costs. So far as can be seen, the transistors will all be of the junction type.

An output power of 2.5mW at 10 per cent distortion can be obtained from available junction transistors for a current consumption of 2mA at 3V, or an efficiency of 42 per cent. A modern hearing aid sub-miniature output pentode gives 0.95mW output at 10 per cent distortion for a total battery power consumption of 15.25mW with an efficiency of only 6 per cent. The significance of the transistor will be appreciated by those who have not already had experience of maintaining small battery-operated

devices, when it is realized that the cost of "high-tension" power from batteries may cost as much as £5 per kilowatt hour as compared with, say, 1d from the national electricity supply grid.

Because of the low voltages and currents involved, the design of really sub-miniature components becomes a practical proposition, and the reader is referred to the article "Components for Transistors," by G. W. A. Dummer (*Wireless World*, May, 1953). These components, however, have been developed for the Services, and are not yet generally available.

Transistors can be used in various ways: (a) earthed base, (b) earthed emitter, and (c) earthed collector. Fig. 1 shows their approximate equivalent vacuum valve circuits.

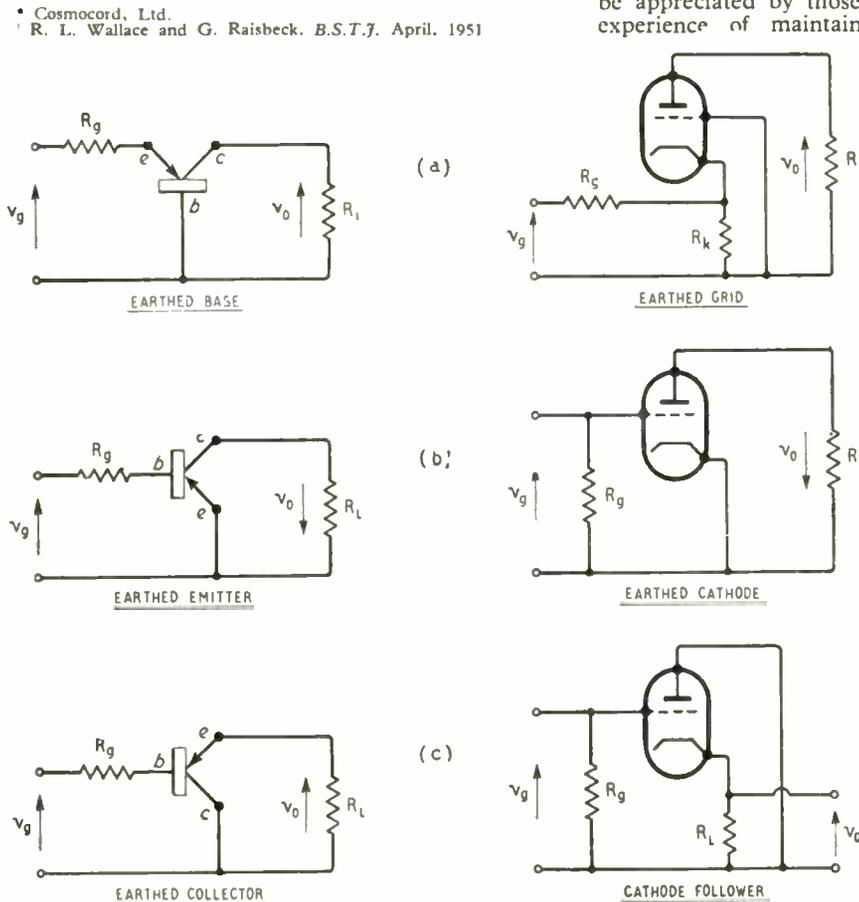


Fig. 1. Transistor circuits and their approximate valve duals.

* Cosmocord, Ltd.
R. L. Wallace and G. Raisbeck. *B.S.T.J.* April, 1951

Hearing Aids

Its Impact on the Design of Components



It is emphasized that these are approximate only, but they are a good practical working guide. Application of feedback to the equivalent circuits can give an exact correlation,² but it is not justified in this dissertation.

When used as an earthed base amplifier, the input resistance lies between 40 and 100 Ω and the output resistance between 100k Ω and 300k Ω ; the power gain will vary from 10 to 20db for a variation in load impedance of 1,000 to 10,000 Ω . As shown in Fig. 1 (a), this form of connection behaves very much the same as an earthed grid triode.

The earthed emitter gives the same general effect as a normally connected triode with the cathode at earth potential. The input resistance is 500 to 1,200 Ω , the output 20k Ω to 100k Ω ; the power gain is 20 to 30db for a source resistance of 800 to 1,200 Ω , and a load resistance of 15k Ω to 25k Ω (Fig. 1 (b)).

When used as an earthed collector, Fig. 1 (c), the cathode follower configuration is approximated. The input resistance will vary from 10k Ω to 200k Ω when the load resistance is varied from 500 to 10,000 Ω , the power gain being almost constant at about 10db for a variation in load resistance of 300 to 10,000 Ω .

Circuit Design

From the above it is seen that there is considerable interaction between the input and output circuits, and the determination of the operating point, particularly when using a single power source (which is dictated by the ease of battery replacements, servicing, etc.), becomes a complicated affair. However, for the majority of audio-frequency applications, the earthed emitter configuration is used and the circuit designed backwards (i.e., decide power output, determine the best load resistance, then work towards the front end).

As we have seen, the input resistance of the average transistor working as an earthed emitter is of the order of 1,000 Ω as against, say, 0.5 to 5M Ω for the grid resistance of a vacuum valve. The output impedance of the transistor will usually be of the order of 20,000 Ω , and for maximum power gain the load resistance should approximate this value. In cascade circuits, some form of impedance transformer will therefore be required to couple the stages. Were transistors not so costly, it would be possible to use an earthed collector transistor as the impedance-transforming device between the earthed emitter units. Under present conditions it is more economic to use a transformer.

The transformer shown third from the left in the

² R. F. Shea, "Transistor Circuits" Chapter 15.

Some typical transistor hearing aid components. (Left to right) 6 μ F electrolytic coupling capacitor, junction transistor, coupling transformer, bias cell, on-off switch and low-resistance logarithmic volume control.

photograph measures 0.375in \times 0.375in \times 0.25in. The stack of 0.008in thick Mumetal laminations has a core cross-sectional area of 0.096in \times 0.096in and the bobbin is 0.25in cube. The primary is wound with 3,500 turns of 49 s.w.g. and the secondary with 800 turns of the same gauge of wire. The insertion loss of the transformer at 3,000c/s is 2.7db under working conditions, the primary inductance being 6 henrys when measured with 0.1 volt a.c. across it.

The coupling condenser, which is of the electrolytic type, has a value of 5 to 10 μ F, in order to maintain the bass response with the low value of the load resistance. Compared with the remainder of the components, the electrolytic condenser is somewhat large, and some Continental manufacturers have replaced it with a modified form of bias cell (fourth from left in the photograph). This requires the circuit constants to be slightly rearranged so that a maximum potential difference of 1.2 volt across the cell terminals is not exceeded. Under these circumstances, the bias cell behaves as a capacitance of 30 μ F at 3,000c/s, the impedance being approximately constant with frequency and the leakage current negligible.

One of the severest headaches encountered to date has been the provision of sub-miniature volume controls with a low resistance value of 5,000 Ω and a logarithmic track. These are now available in production quantities and when used between the first and second stages of the amplifier, the noise level is considerably less than that due to associated circuits.

Choice of Microphone

Valve-operated hearing aids almost invariably use piezo-electric microphones, the input resistance of the amplifier is usually of the order of 10 to 30 M Ω , and the design of the microphones is directed to obtain the highest practical open circuit voltage sensitivity. To this end, small crystals using series elements are used, resulting in an output of approximately 3 millivolts with a source capacity of 300 to 500pF. But the transistor has a low input impedance and must be thought of as a power-operated rather than a voltage-operated device.

Crystal microphones can be used successfully with transistors by using an appropriate matching trans-

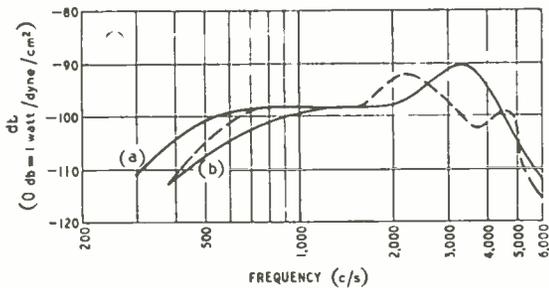


Fig. 2. Response of parallel-connected crystal with transformer working into 1,000-ohm load. Microphone capacitance (a) 4,000pF, (b) 2,000pF. A typical magnetic microphone response is shown dotted.

former. If a normal type of hearing aid microphone is used, the primary inductance of the transformer would need to be between 100 and 200H for adequate bass response. This high value of primary inductance can be reduced to approximately 20H or even less if certain elementary modifications are made to the crystal assembly. It can be shown that if a parallel combination of crystal elements instead of the usual series arrangement is used, the voltage is reduced by half, and the capacitance increased by four times—which, in terms of available power, is exactly the same as the first case. If the crystal is further subdivided, into a total of four elements, the capacitance is increased 16 times and the voltage output reduced to a quarter. (These two latter combinations giving between 2,000 and 4,000pF and 10,000 and 20,000pF respectively.)

Coupling Transformers

It thus becomes a practical proposition to design a sub-miniature matching transformer to couple the microphone to the transistor. In the case of the four-element crystal, the transformer previously described functions quite satisfactorily, but the crystal element is a rather costly proposition. The two-element parallel crystal can be used successfully if the primary inductance of the coupling transformer is approximately 20H. The absolute value is arranged to resonate with the microphone crystal capacitance at the low-frequency end of the spectrum (the -3db point). This has been taken as 750c/s for hearing aids, and without any secondary loading there will be a resonant rise in current at this frequency. The turns ratio is adjusted to give the maximum power transfer at 1,000c/s, resulting in a virtually aperiodic system, and

a fall of 6db per octave below 750c/s. The actual transformer winding consists of 6,000 turns of 50 s.w.g tapped at 600 turns, and is used as an auto-transformer to conserve space.

The sensitivity of the microphone plus transformer is -100db referred to 1 watt per dyne per cm² at 1,000c/s and can be maintained easily to 6kc/s (Fig. 2). It should be noted that the high-frequency performance of these miniature transformers is extremely good, considering their simple construction, some units being only -1db at 20kc/s referred to the 1-kc/s level.

Magnetic-type microphones, which can be manufactured quite economically for low-impedance working, are quite a practical proposition, the coil being wound to give the correct source impedance for matching the input impedance of the transistor. The majority of present-day magnetic microphones are very similar in construction to the magnetic telephone receiver with the addition of an auxiliary diaphragm. The power sensitivity of these units is the same as the crystal microphone, being approximately -100db referred to 1 watt per dyne per cm². With one or two notable exceptions, the high-frequency response is not good, there being a rapid cut-off above the main resonant frequency, which is usually about 2,500c/s.

The modern insert magnetic telephone receiver is characterized by high power sensitivity, good low-frequency response, and low distortion; but the high-frequency response could, with advantage, be improved. In most units the peak sensitivity is at about 2kc/s with a very rapid fall-off in sensitivity beyond 2.5 to 3kc/s. They can be wound to any required impedance between about 25 and 10,000Ω and can therefore be connected directly in the transistor collector feed circuit without an isolating transformer. Excellent impedance match can be obtained and they will give an output in excess of +120db referred to 0.0002 dyne per cm² (threshold level) for 2 milliwatts input power. This is usually adequate for most hearing aid and miniature receiver requirements.

Fig. 3 shows a complete hearing aid amplifier circuit which has performed satisfactorily with both American and British junction transistors.

Maximum power output, whilst keeping within the limiting values imposed by the transistor manufacturers, requires rather critical control of the base bias resistor, and it has usually been necessary to vary this resistance for optimum conditions, the value usually lying between 5kΩ and 30kΩ. Once the optimum value has been determined, it can be considered fixed for the life of the transistor, provided that the unit has not

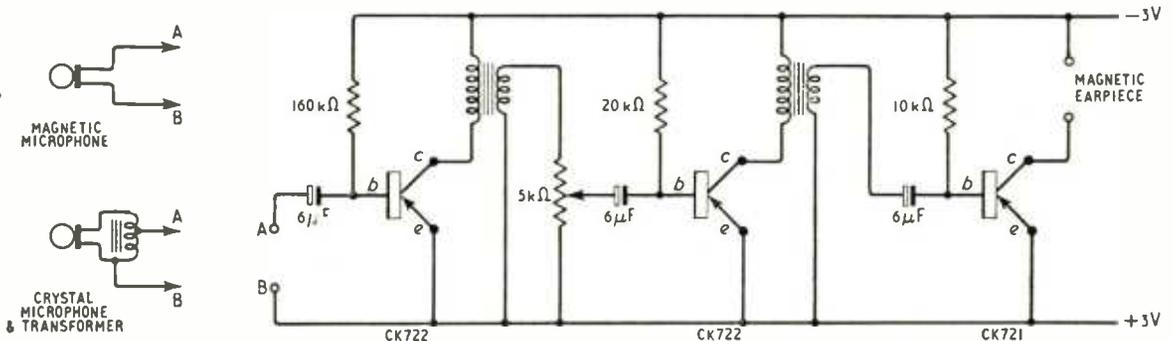


Fig. 3. Hearing aid circuit which gives good results with many makes of junction transistor.

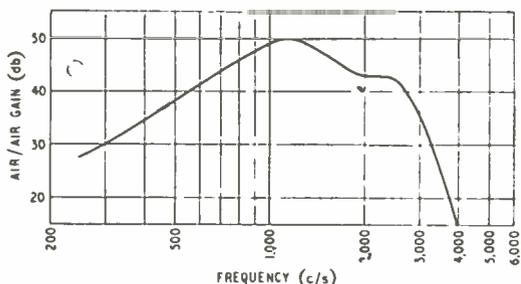


Fig. 4. "Air-to-air" overall gain of the hearing aid whose circuit is given in Fig. 3.

been exposed to temperatures in excess of about 60 deg C. It has been found easier to adjust the resistance until the collector current is of the order of 2 to 2.2mA, although for greater power output it can be adjusted for a maximum of about 4mA. This results in a reduction of the input impedance of the transistor and the coupling transformer turns ratio must be adjusted accordingly.

The second stage is not critical, but the adjustment of the base resistor can vary the overall gain quite considerably. Here, however 20k Ω has proved more satisfactory.

Noise Reduction

Either magnetic or crystal-cum-transformer microphones may be used, and the circuit is generally self-explanatory. There are, however, one or two points which need amplification. Usually the first transistor has to be carefully selected for noise and it has been found expedient to vary the base bias resistor for optimum results—about 160k Ω results in the best compromise between maximum gain and maximum signal-to-noise ratio.

The coupling transformers are the units previously described, and the maximum working gain is of the order of 80 to 85db. It is flat from about 500c/s to 15,000c/s. With care, the noise level can be dropped within 20db of Johnson noise. Transistor noise differs from other common types such as thermal and shot noise in that transistor noise per unit bandwidth varies approximately inversely with frequency,³ (i.e., each octave of the frequency range contains the same noise power). The representative value of the collector open circuit noise voltage is 5 to 15 microvolts; the emitter open circuit voltage is usually 30 or 40db below this value. The total noise is, however, very dependent upon the operating point. The emitter noise is almost independent of the collector voltage whilst the collector noise depends strongly on it. In addition to this dependence on operating conditions, noise is also very dependent upon operating temperature, and, generally, the increase in noise is such as to detract considerably from the use of transistors in fairly low level circuits for use in temperatures in excess of 40 deg C. Additionally, the transistor parameters vary very considerably with temperature. For example, the collector resistance under a given set of conditions can vary from 100k Ω to 50k Ω over a temperature range of 20 deg to 70 deg C. The latter is considerably above normal ambient temperatures and will

not usually be reached with transistors working under low power conditions, but this temperature can certainly be obtained if the transistor is called upon to deliver more than a few milliwatts of power.

Fig. 4 shows the air-to-air response of the complete hearing aid receiver, and before the high-fidelity enthusiasts raise their hands in pious horror, a word of explanation may be offered. The amplifier portion is quite flat in the high-frequency region, and the very rapid fall off with frequencies above the peak is due almost entirely to the insert telephone receiver. The low-frequency cut-off is deliberately engineered in the microphone circuit in order to provide the most desirable frequency response of +12db per octave which, according to the Medical Research Council Report No. 261, results in optimum articulation efficiency for deaf people. The overall performance is by no means ideal, but is comparable with the average two-valve and some of the three-valve hearing aid units being offered to the public today. The high-frequency response could be materially improved with a better high-frequency performance on the part of the telephone receiver. It may be thought possible to compensate for this lack of high-frequency response by altering the frequency characteristic of the amplifier or microphone, and this would be satisfactory if the unit were not required to run at peak power over the whole frequency band. Obviously, if the output transistor is delivering peak output at 1,000c/s and a rise in frequency characteristic is built into the pre-amplifier, it will be grossly overloaded at these higher frequencies although, at lower levels, the measured frequency response may appear superior.

Much remains to be done in component development for use with transistors and, in this country at least, it can be said that generally transistor development is ahead of associated components. But, to revert to the introductory remarks, it is a pity that more transistors were not generally available earlier, because they are delightful little beasts and tend to grow upon one.

PRODUCTION CONTROL

IN the report of the specialist team* on production planning and control which visited the United States in 1951, the use of radio as an aid to production control—in some quarters erroneously called radio control—is strongly recommended to British industry.

One of the first engineering concerns to employ radio communication to co-ordinate the movement of goods in its factories was Davey, Paxman and Company, of Colchester, Essex. Their installation, which includes five mobile units and a control station, was initially installed by Pye two years ago. Operating on 172.2 and 182.2 Mc/s, which are shared with (among others) a London taxi organization, the fixed station can readily be received at Harwich Quay, over 25 miles away. Its main use, however, is for the co-ordination of movement of heavy cranes and fork lifts within the main works and the conveyance of goods between the two factories which are about a mile-and-a-half apart.

With the proposed clearing of Band 3 to make room for an alternative television service, the position of such users is threatened and the recently formed Mobile Radio Users' Association is strongly contesting the users' case.

*Among the 12 members of the team were representatives of Plessey, B.T.H., E.M.I. and Automatic Telephone & Electric Co.

³ H. C. Montgomery. *Bell Lab. Record* Sept., 1949.

Measuring Non-Linearity

By D. C. PRESSEY, B.Sc. (Lond.)*

DISTORTION arises as a result of non-linearity in the input versus output characteristic of apparatus, and has been the subject of two recent articles in *Wireless World*^{1,2}. This article has been written with the object of supplementing them with a method of measuring non-linearity that is simple, and has found numerous applications.

When the input is sinusoidal the output contains harmonics of the input frequency as well as the fundamental, and to measure or examine the distortion the fundamental must be somehow removed.

For the purpose of diagnosis, Wigan¹ has described a rather elaborate method for subtracting the fundamental; it requires both filters and phase-shifters. Tyler² uses a fairly simple valve filter to remove the fundamental.

The disadvantages of filters are that they may shift the phase of harmonics, and that they restrict the test frequency to that for which the filters were designed.

In the following method the subtraction is carried out by a frequency-insensitive element, so that tests may be carried out from zero-frequency upwards and without the need, in general, of pure sine-wave test signals.

The basic principle is simply that if the apparatus is linear, and of gain A , the output may be cancelled by adding to it a voltage A times the input voltage, but in

* Southern Instruments Ltd., Camberley, Surrey.

Fig. 1. Illustrative input/output characteristic.

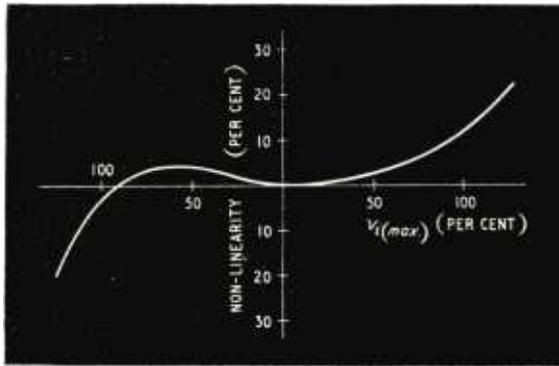
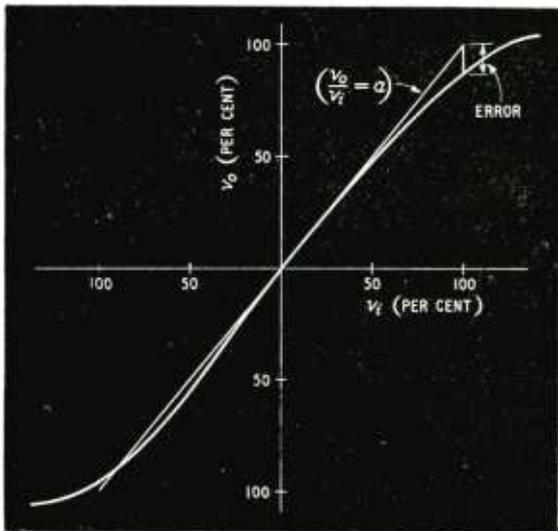


Fig. 2. Here, the non-linearity of the characteristic of Fig. 1 is plotted as a percentage of the nominal maximum output $av_{i(max)}$ against the input v_i . These two figures incidentally illustrate the difficulty of observing non-linearities of below 3% on c.r.t. displays corresponding to Fig. 1.

anti-phase to the output. If the apparatus is non-linear incomplete cancellation results, the difference being exactly equal to the amount of the non-linearity for every value of the input voltage.

This method was developed particularly to measure the non-linearity of d.c. computing amplifiers and other units having non-linearities of the order of 1% or less, but it is entirely suitable for less rigorous tests.

The process can be formulated mathematically as follows. The relationship between output and input can be written:—

$$v_o = av_i + bv_i^2 + cv_i^3 + \dots \dots \dots (1)$$

where the coefficient a defines the gain, and b, c , etc., are the coefficients of the non-linear terms. This relationship is depicted in Fig. 1, showing also that a is the slope of the tangent to the curve at the origin. If the apparatus were linear the output would be av_i , and adding $-av_i$ to equation (1) gives:

$$v_o - av_i = v_e = bv_i^2 + cv_i^3 + \dots \dots \dots (2)$$

Strictly, the percentage non-linearity is given by:

$$N = (v_e/av_i) \times 100\% \dots \dots \dots (3)$$

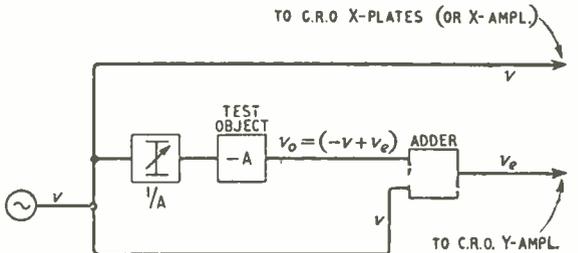


Fig. 3. Suitable experimental arrangement.

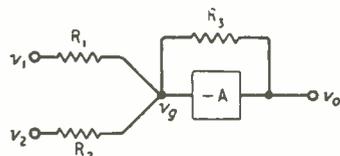


Fig. 4. Amplifier connections to provide an output proportional to the sum of two inputs. Typically $R_1 = R_2 = R_3 = 1M\Omega$.

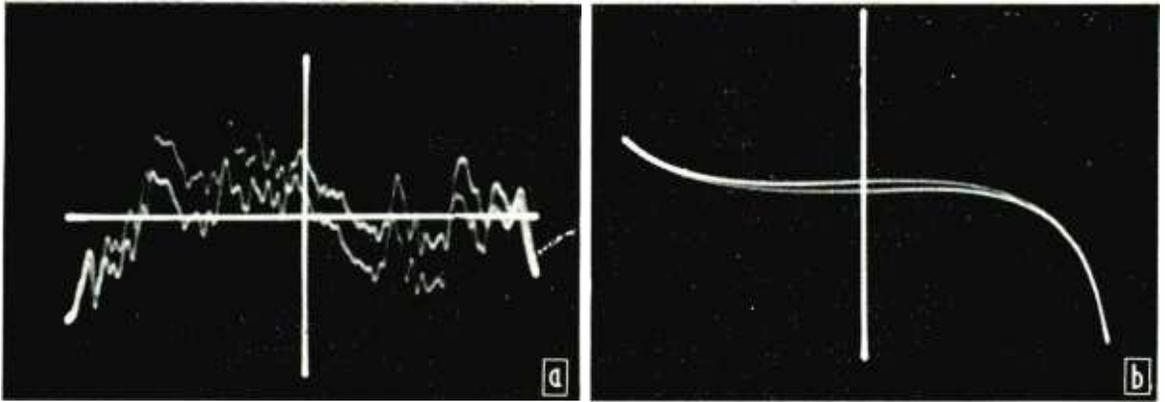


Fig. 5. The trace (a) shows the error in the output of an analogue multiplier. The irregularities are due to a scanned edge, and the separation of the traces is due to hum. The gain has been taken as the value which gives minimum peak-peak value to the error voltage. The amplitude of the calibration line is $\pm 0.5\%$. In (b) is shown the error of a paraphase amplifier adapted from the circuit of Fig. 6(a) by applying the input to R_1 and omitting R_2 . In this case the error curve is horizontal at the origin. The amplitude of the calibration line is $\pm 1\%$.

but it is more convenient, and more usual, to calculate the non-linearity as a percentage of the nominal maximum output; i.e., $av_{i(max)}$ is used in place of the term av_i in equation (3). The non-linearity of the curve in Fig. 1, is plotted on this basis in Fig. 2.

This way of defining the gain leads to the simplest mathematics, and is correct for audio amplifiers and many others. For other applications (e.g., oscilloscope amplifiers) it is more convenient to define the gain as the slope of the best straight line, which, in this case, is that straight line drawn through the origin which gives minimum errors at all points throughout the working range.

In d.c. amplifiers for analogue computers the quantity v_e is frequently called the "error" due to the amplifier, leading to the name "error curve" for the curve of Fig. 2. As it shows the departure from true linearity of the apparatus this term is thought to be more descriptive than "difference diagram," as used by Wigan. Furthermore, the error of a meter is expressed in this way, $av_{i(max)}$ corresponding to full-scale deflection.

Experimental Arrangement. The simplest and most accurate arrangement for testing a phase-

reversing amplifier by this method is shown in Fig. 3. If the attenuator is adjusted till the error curve is horizontal at the origin, or till the errors are minimal, depending on the application of the unit, the attenuation is then equal to $1/A$, A being the gain of the test object. The value of N is found by calibrating the Y-amplifier by means of a suitable fraction of v . The adding unit is of the type used in analogue computers. For d.c. tests the oscilloscope X and Y amplifiers can be replaced by meters.

Fig. 5 shows some of the results obtained.

The adding unit is a negative-feedback amplifier connected as in Fig. 4. For $R_1 = R_2 = R_3$ and a sufficiently high gain the output approximates to the sum of the inputs, i.e.,

$$v_o \approx (v_1 + v_2) \dots \dots \dots (4)$$

For example, for $A = 150$, $v_o \approx 0.98 (v_1 + v_2)$, which is sufficiently accurate for many purposes. If required, perfect addition may be obtained by making

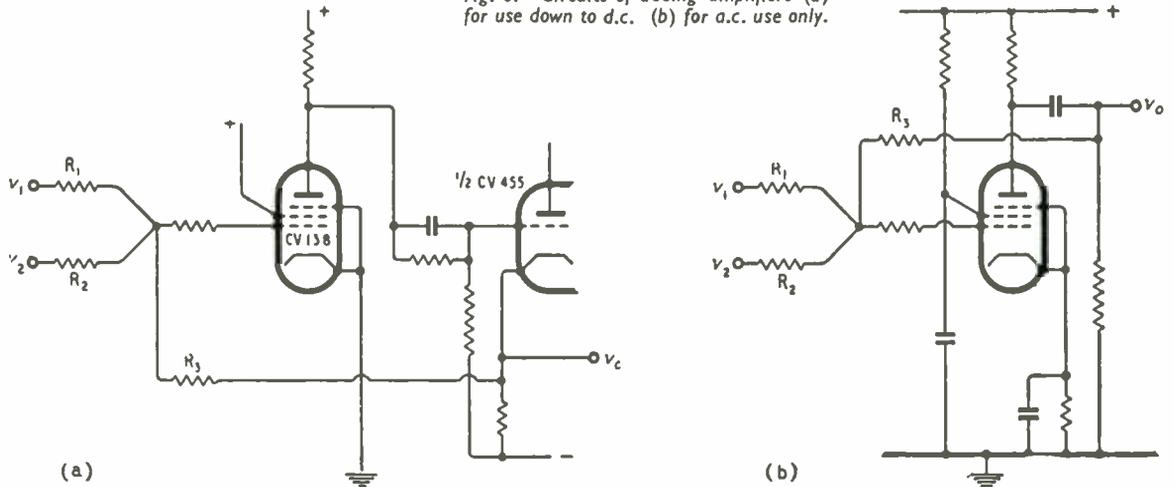
$$R_3 = R(A - 1)/(A + 2) \dots \dots \dots (5)$$

where $R_1 = R_2 = R$

These formulæ are derived in Appendix 1.

A suitable circuit is shown in Fig. 6 (a). For a.c. use only, the simpler circuit of Fig. 6 (b) can be used.

Fig. 6. Circuits of adding amplifiers (a) for use down to d.c. (b) for a.c. use only.



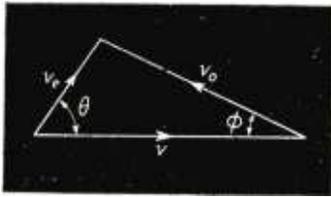


Fig. 7. Vector diagram for the equation $v_e = v + v_o$. The amplitudes and phase angles are shown. If v is taken as the reference phase, then conventionally, both v_e and ϕ are negative for the case shown.

In the computer field such arrangements are known as "adders," or "adding amplifiers."

For the a.c. tests of non-phase-reversing units the problem of phase-reversal is simply solved by the use of a centre-tapped transformer to supply test signals to the adder and the test object in antiphase. For d.c. tests a paraphase amplifier must be inserted between the attenuator and the unit under test, except when this has a gain of less than unity, when it is best to insert it in the lead to the adder, as it then has to handle smaller signals. The non-linearity of this unit has to be added to the measured error; its non-linearity being simply measured by first omitting the test object and attenuator.

The attenuator may be dispensed with when the gain of the unit under test does not differ greatly from unity by adjusting the ratio of (R_1/R_2) .

Requirements of Test Apparatus and Precautions.—It is essential for the adder and Y-amplifier (and X-amplifier and attenuator if used) to be free from phase shift at the test frequency. At 50 c/s, or even 1,000 c/s, this presents little difficulty. When testing at mains frequency, it is advisable to observe the c.r.o. trace before applying the test signal to the adder and the test object in order to note any hum. If the test object introduces any phase-shift the error curve will take the form of a loop.

A saw-tooth test signal may be used (e.g., a c.r.o. time-base) providing that the frequency response of all units, including the one under test, is flat over the range of frequencies contained in the saw-tooth. This is quite a stringent requirement as harmonics up to twenty times that of the recurrence frequency will normally be present.

Accuracy.—The method is inherently very accurate provided that the adder is carefully adjusted to give no output for equal and opposite inputs. Subsequent errors in measurement of the error voltage are of secondary importance. Thus if a paraphase amplifier giving a nominal 50 volts out has a measured error voltage of 50 millivolts then the non-linearity is 0.1%, but if there is, say, a 10% high error in the measurement of the error voltage the true figure for the non-linearity is 0.09%. If the output had been measured directly, however, and the measuring instrument had given a 10% high figure (i.e., 55.05 volts) the figure for the non-linearity would have appeared to be 10.1% instead of 0.1%.

Measurement of Phase-Shift.—Phase-shift is usually accompanied by a change in the output level. To measure these it is necessary to use a pure sine-wave input and to decrease the input level until the test object is substantially linear. The c.r.o. display will then be elliptical if the phase shift is present. The amplitude and phase angle of the error voltage are then determined^{3,4}. If these are v_e and θ then the amplitude error is given by $(v - v_o)$, which may be expressed as a percentage or as a number of decibels in the usual way, where v_o is given by:

$$v_o = \sqrt{(v^2 + v_e^2 - 2vv_e \cos \theta)} \dots (6)$$

and the phase angle is given by:

$$\phi = \cot^{-1}[(v/v_e) \operatorname{cosec} \theta - \cot \theta] \dots (7)$$

The formulæ are derived in Appendix 2.

Further Applications.—It is possible to apply this technique of error measurement to the testing of servo-mechanisms providing that the input and output are, or can be converted into, voltages. It is thought that it may be possible to carry out what have been referred to as two-terminal tests¹ by the provision of a reference signal.

Acknowledgements.—The author wishes to record his indebtedness to his colleagues and to Mr. J. A. Colls for helpful discussions.

APPENDIX 1

The analysis of the circuit of Fig. 4 is as follows.

Denoting the gain of the amplifier by $-A$, we have

$$(v_o + v_e) R_3 = (v_1 - v_e) R_1 + (v_2 - v_e) R_2 \quad (1)$$

and $v_e = -Av_o$ (2)

From (1), putting $R_1 = R_2 = R$

$$v_o = \{(v_1 + v_2)R_3 / R\} - v_e(1 + 2R_3 / R) \dots (3)$$

From (2) and (3)

$$v_o = (v_1 + v_2)(1 - 1/A - 2R_3 / AR) \dots (4)$$

showing that the output is equal to the sum of the inputs multiplied by a constant factor. For $R_3 = R$, this reduces to

$$v_o = (v_1 + v_2)(1 - 3/A) \dots (5)$$

which approaches unity as A approaches infinity. If required, perfect addition is obtained by making the factor exactly unity, and the condition for this is

$$R_3 = R(A - 1)(A + 2) \dots (6)$$

APPENDIX 2

Relationships between error voltage and output voltage.

Fig. 7 shows the vector relationship of the voltages involved. For the case shown, if v is taken as positive, then v_e and ϕ are negative, ϕ being a phase lag.

Clearly, for v_o we have

$$v_o = \sqrt{(v^2 + v_e^2 - 2vv_e \cos \theta)} \dots (1)$$

Also $v = v_e \cos \theta + v_o \cos \phi$ (2)

and $v_o \sin \theta = v_e \sin \phi$ (3)

therefore $v_o = v_e \sin \theta / \sin \phi$ (4)

whence $v = v_e \cos \theta + v_e \sin \theta \cot \phi$ (5)

$\therefore \cot \phi = (v - v_e \cos \theta) / v_e \sin \theta$ (6)

or $\phi = \cot^{-1}[(v/v_e) \operatorname{cosec} \theta - \cot \theta]$ (7)

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Centimetre-wave Oscillograph

FREQUENCIES of the order of 9,500 Mc/s can be displayed on an experimental c.r. oscillograph which has recently been built at Manchester. Described in a letter to *Nature* (5th December, 1953) by B. Jackson, D. R. Hardy and R. Feinberg, it uses a special 6-in aluminized c.r. tube with a highly actinic blue phosphor screen. The vertical electrostatic deflection system is formed by a twin-wire transmission line passing through the tube at right angles to its axis. This reduces the transit time of the electron beam in the deflection field and permits correct matching to the signal source. The deflection sensitivity of the tube is about 0.006mm per volt. A single-sweep time base of 1.3 milli-microseconds duration is used, giving a sweep width of about 4cm, and with this the writing speed amounts to approximately 5×10^{10} cm per second. The tube is magnetically focused and its trace is about half a millimetre wide.

The D.C. Component in Television

Video-Stage to C.R. Tube Coupling

By W. T. COCKING, M.I.E.E.

IN a recent paper¹ D. C. Birkinshaw has stressed the importance of the d.c. component of the television signal to the correct reproduction of pictures and he illustrated his theme by a most convincing series of photographs. He pointed out that although considerable attention is paid to the maintenance of the proper level of the d.c. component in the B.B.C. transmissions it is considerably attenuated in many commercial receivers.

Out of 26 sets tested, only seven reproduced the d.c. component fully. Eight reproduced it with from 15% to 40% attenuation, six with 50%, three with 62% to 70% and two with 100%.

The d.c. component is, of course, the part of the picture signal which governs the mean brightness of the picture. Its absence or appreciable reduction means that the brightness control of the receiver will require re-adjustment whenever the mean brightness of the transmitted scene changes. If such re-adjustment is not carried out some pictures will be too dark, with a lack of detail in their darker parts, and others will not be dark enough and will have washy blacks and visible frame-flyback lines.

In view of this, it seems surprising that deliberate attenuation is often introduced in commercial receivers. As Birkinshaw states, however, it is often done with the aim of reducing aircraft flutter. It is, however, not essential to attenuate the d.c. component to do this; it is possible to reduce flutter in other ways,² the use of a.g.c. being probably the best method. In his paper, Birkinshaw did not consider how the d.c. component should be retained; he confined himself to showing the bad effect of attenuating it and he did this most convincingly. However, he did make one statement about circuit performance which is actually incorrect. He is hardly to be blamed for this, because most designers believe the circuit in question to be a satisfactory one and, until quite recently, the writer did also.

The reference is to the common circuit (Fig. 1) in which the cathode of the c.r. tube is fed from the anode of the video stage through a voltage divider. This is done to keep the heater-cathode voltage of the tube within its rating and it inevitably reduces the d.c. component of the signal below the value existing at the anode of the video valve. To overcome this, the d.c. component is equally over-amplified at the anode of the video valve, usually by a correct choice of value for the anode decoupling resistor.

What has been overlooked in the past, and what makes it impossible to obtain the correct level for the d.c. component with this circuit, is the fact that a c.r. tube which is fed at the cathode has a fairly low input resistance. Moreover, it has an input resistance which varies greatly with the signal voltage.

The circuit in question is the well-known one of Fig. 1. In an a.c./d.c. set, the heater of the tube must usually be at chassis potential and the maximum allowable difference of potential between heater and cathode is usually 150 V; in some of the older tubes it was

considerably less. The anode potential of the valve may well be 150–200 V and the voltage divider brings the cathode potential to $R_4(R_3 + R_4)$ of this figure.

At all frequencies within the picture signal, the capacitors are large enough to be short-circuits. The load on the valve is then R_1 in parallel with R_4 and, since R_4 is large compared with R_1 , it is virtually R_1 alone. At d.c. the capacitors form open-circuits and the load on the valve is $R_1 + R_2$. The amplification at d.c. is $1 + R_2/R_1$ times as great as at higher frequencies, but only $1/(1 + R_3/R_4)$ of it is passed on to the tube. The d.c. component is fully retained if $R_2/R_1 = R_3/R_4$. In addition, if C_1 and C_2 are related in a certain way the overall amplification is constant at all frequencies. However, by a proper choice of their values, the amplification can be made to fall off at very low frequencies near to d.c. and the circuit can then give proper representation to the d.c. component while also reducing aircraft flutter.

All this is in accordance with the usual circuit theory and supposes that the c.r. tube has an input resistance which is very large compared with R_3 .

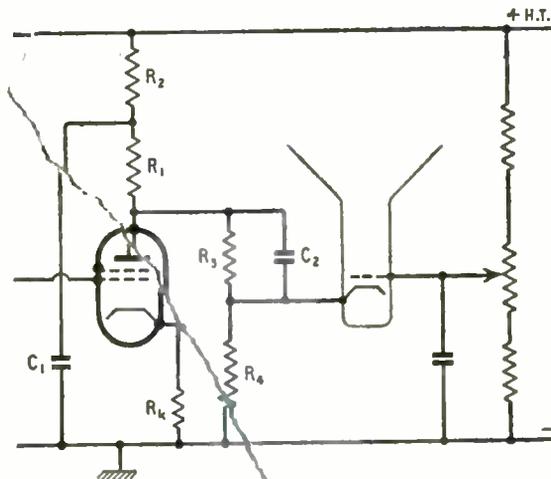


Fig. 1. A commonly-used video-stage to tube coupling. If the tube resistance is very high, the coupling is compensated and gives equal gain at all frequencies. The compensation is spoilt in practice by the input resistance of the tube.

¹"The Importance of the D.C. Component," *J. Televis. Soc.*, July-September 1953, Vol. 7, No. 3, p. 105.

²See "Television Interference by Aircraft," by A. H. Cooper, *B.S.C. Wireless World*, April 1949, Vol. 55, p. 142, for a discussion of the subject. Because of the input impedance of the c.r. tube the particular circuit and component values given in this article are unlikely to permit full retention of the d.c. component.

and R_4 in parallel. Quite normal circuit values would be $R_1 = R_2 = 3.5 \text{ k}\Omega$ and $R_3 = R_4 = 100 \text{ k}\Omega$.

Tube Input Impedance

Now a cathode-ray tube is exactly analogous to an ordinary valve as far as its electrical characteristics are concerned. Although figures for them are not usually quoted, it has a mutual conductance g_m and an anode a.c. resistance. It is well known that when a valve is used in a cathode input (earthed-grid) circuit it has a low input resistance of the order of $1/g_m$; it is commonly 100–500 Ω . A cathode-ray tube also has an input resistance of $1/g_m$ but, because the mutual conductance is small compared with that of a valve, the input resistance is correspondingly high. It is not often less than 50 $\text{k}\Omega$.

The mechanism by which this comes about is quite simple. If the cathode voltage is changed by some small amount in a direction to increase the anode current (that is, cathode voltage changing negatively) this same voltage is operative between grid and cathode where it also acts to increase the anode current, but by μ times as much. The change of current is thus

$$i_a = \frac{e_k}{r_a} (1 + \mu)$$

where r_a and μ are the anode a.c. resistance and amplification factor of the tube. This current flows from the circuit which feeds the tube. An equivalent resistance R_{in} for the tube is one which, if connected to the driving circuit in place of the tube, would draw from it the same current. Therefore

$$R_{in} = \frac{e_k}{i_a} = \frac{r_a}{1 + \mu} \approx \frac{1}{g_m}$$

It is possible to obtain figures for g_m from the ordinary tube maker's grid-volts-anode-current characteristics. At an operating voltage corresponding to peak white, the mutual conductance is usually about 0.02 mA/V, which makes $R_{in} = 50 \text{ k}\Omega$.

Like those of a valve, the tube characteristics are curved and the mutual conductance falls as the tube is biased back for reduced brightness, consequently the input resistance rises as the brightness decreases. Unlike a valve, however, a cathode-ray tube cannot be operated only over the straight part of its characteristic, for the beam current must be nearly, if not quite, cut off for picture black. As the signal varies the brightness between white and black, therefore, the input resistance must change from a minimum of the order of 50 $\text{k}\Omega$ to a high value approaching infinity.

In the circuit of Fig. 1, this tube resistance appears in shunt with R_1 . At high frequencies, where the capacitors are short circuits, the load on the valve is R_1 , R_2 and R_{in} all in parallel. If R_1 is 3.5 $\text{k}\Omega$ and R_2 is 100 $\text{k}\Omega$, the load is $3.5 \times 100/103.5 = 3.38 \text{ k}\Omega$ in the dark parts of the picture where R_{in} is very large. At peak white, if R_{in} is 50 $\text{k}\Omega$ the load falls to $3.38 \times 50/53.38 = 3.17 \text{ k}\Omega$. The gain near white is about 94% of that near black. The effect on the tone graduation of the picture is that changes near white are not quite as great as they should be.

The magnitude of this effect is very small, however, and is both smaller and in the opposite sense to that brought about by curvature of the tube characteristics. It is therefore negligible.

At d.c., however, matters are quite different, for the tube is fed from R_3 and R_4 which have values of

the same order of magnitude as R_{in} . Near black level R_{in} is large and will have comparatively little effect upon the circuit so that the d.c. component will be present at the tube cathode at very nearly its proper level. At peak white, however, matters are very different. Suppose $R_1 = R_2 = 3.5 \text{ k}\Omega$, $R_3 = R_4 = 100 \text{ k}\Omega$ and $R_{in} = 50 \text{ k}\Omega$. Then R_1 and R_2 in shunt come to 33.33 $\text{k}\Omega$, and the loading of the voltage divider on $R_1 + R_2$ (7 $\text{k}\Omega$) is 133.33 $\text{k}\Omega$. The load on the valve is $7 \times 133.33/140.33 = 6.65 \text{ k}\Omega$. At high frequencies the load is 3.17 $\text{k}\Omega$, so the gain to the valve anode is at d.c. $6.65/3.17 = 2.1$ times the gain at high frequencies. The reduction factor to the tube cathode is $33.33/133.33 = 0.25$ and so the d.c. component is $2.1 \times 0.25 = 0.525$ of its proper level.

The result of using this circuit in practice is that if the brightness control is initially adjusted correctly on a rather dark picture, then when a picture of greater mean brightness comes along the brightness does not increase proportionately. The dark parts of the picture are too dark and the detail in them is lost. The brightness control has to be turned up for proper reproduction. Conversely, if the brightness control is initially adjusted on a bright picture then when a dark one is transmitted it will be reproduced too brightly; black will not be black, but dark grey, and the frame flyback lines will show. These effects are quite noticeable in practice.

It will now be clear that with the circuit of Fig. 1 a reduction of the d.c. component to 50% of its proper value is quite likely even when the designer has the intention of retaining it fully. Because of the variable nature of R_{in} it is not possible to compensate for it by any practicable change in the values of the components. Because the resistance is variable, its effect can be made negligible only by feeding the tube from a circuit having a resistance low compared with the lowest value of R_{in} . This is a condition which exists in Fig. 1 only at high frequencies and it is one which must be made to exist at d.c. also.

In the circuit of Fig. 1 this could be done if it were practicable to reduce R_3 and R_4 to about 10 $\text{k}\Omega$ only. They would then shunt R_1 and R_2 so much that these two resistors would have to be increased in value. The reduction of R_3 and R_4 , coupled with the increase of R_1 and R_2 , would require an increase of h.t. supply voltage to maintain proper operation of the valve. In an a.c./d.c. set this is usually impossible.

In commercial practice circuits of the form of Fig. 1 are often used but with values deliberately chosen to reduce the d.c. component. Quite often, for instance, R_2 is omitted. Even without the effect of the input resistance of the tube the d.c. component may then be reduced to 50% of its proper value; when the tube resistance is taken into account the reduction may be to 25% of the correct level. As already stated, this reduction is often deliberate and is introduced to alleviate aircraft flutter.

We are not concerned here with the question as to whether or not it is desirable to do this. There is no doubt that where aircraft flutter is not experienced it is desirable to retain the d.c. component fully. There is also very little doubt that it is desirable to remedy aircraft flutter, not by reducing the d.c. component, but by employing a.g.c. Whether or not it is commercially practicable to do so this is quite another matter.

For the present, therefore, we shall consider only how best to retain the d.c. component. It is clear that the use of the circuit of Fig. 1 is inadmissible. Two alternatives present themselves. The first is to utilize the circuit of Fig. 1 but to include a cathode follower between R_3, R_4 and the tube. The second is to omit R_3, R_4 and to join the cathode of the tube directly to the anode of the valve, adopting some other means of keeping the heater-cathode potential within bounds. The cathode follower is used in at least one commercial set, but mainly for other reasons. The second alternative is used in a good many sets and is applicable wherever it is possible to use a separate winding on a transformer to supply the heater of the tube. It is only in the case of the a.c./d.c. set, where the heater must be at chassis potential, that difficulty may arise with it.

Practical Cathode-Input Circuit

We shall not discuss here the cathode-follower circuit, because the design of the complete video stage plus cathode follower is quite an intricate matter. We shall deal only with the second circuit in detail. Before doing so, however, it may be as well to remark that if the video signal is fed to the grid of the tube instead of to the cathode all these difficulties disappear. A capacitance coupling with a d.c.-restoring diode can be used. Because the video signal must then be of opposite polarity, however, difficulties arise in the sync separator and an extra valve in this circuit would probably be needed to obtain a normal performance. The use of d.c. restoration with cathode input to the tube does not seem practicable because of the low input resistance of the tube. The use of capacitance coupling to the tube cathode with a pulse-operated black-level clamp might, however, be practicable but has not been investigated.

The form of circuit which we shall now consider in detail is shown in Fig. 2. At all but the lowest frequencies and d.c., that is, at what we shall for convenience term high frequencies, the capacitors are all short-circuits and the video stage gives an amplification of

$$A = \frac{g_m R_1}{1 + F_k} \dots \dots \dots (1)$$

where g_m and g_T are respectively the mutual conductance of the valve connected as a pentode and as a triode and $F_k = g_T R_k$. At d.c. the internal resistance of the h.t. supply, shown as R_2 , plays a part, for it is common to both screen and anode circuits. The

voltage developed across it appears on the cathode of the tube and a fraction $R_3/(R_1 + R_3)$ of it is also applied to the grid (via the brightness control) where it acts in opposition; only the fraction $R_1/(R_1 + R_3)$ of the voltage across R_2 is, therefore, effective in operating the tube.

The voltage across R_2 and R_k , and also any across R_3 , acts on the screen grid where it produces negative feedback tending to reduce the gain. On balance, R_2 tends to increase gain and R_3 to reduce it. It is possible, therefore, by a proper choice of R_3 to make the gain at d.c. the same as at higher frequencies.

It is not difficult to work out the d.c. gain. Between the grid of the valve and the cathode-grid circuit of the tube it is

$$A_{DC} = \frac{g_m R_1 \alpha}{1 + F_s + F_a + F_k} \dots \dots \dots (2)$$

where

$$\alpha = \frac{R_1}{R_1 + R_3}$$

$$F_k = 1 + g_T R_k$$

$$F_s = (g_T(R_2 + R_3 + R_k) - g_m R_3) / \mu_{12}$$

$$F_a = (R_2 + R_k) g_T g_m + R_1 r_a$$

r_a = anode a.c. resistance of the valve as a pentode.

μ_{12} = amplification factor of the valve between control and screen grids.

The gain at d.c. relative to that at high frequencies is

$$\frac{A_{dc}}{A} = \frac{1 + \frac{g_T R_2 \alpha}{g_m R_1}}{1 + \frac{F_s + F_a}{1 + F_k}} \dots \dots \dots (3)$$

In a pentode r_a is normally very large and the term F_a can usually be neglected. If the gains at a.c. and d.c. are to be equal equation (3) must be unity. Neglecting F_a , the condition for this is

$$R_3 = \frac{g_T R_2 \mu_{12} \alpha (1 + g_T R_k) - g_T (R_2 + R_k)}{g_T - g_m} \dots \dots (4)$$

As an example, suppose $R_1 = 3.5 \text{ k}\Omega$, $R_k = 220 \Omega$, $R_2 = 500 \Omega$, $\alpha = 0.6$, $g_m = 6.5 \text{ mA/V}$, $g_T = 8.5 \text{ mA/V}$, and $\mu_{12} = 75$. Inserting values, we get $R_3 = 9 \text{ k}\Omega$.

It may or may not be possible to use this value for R_3 . It depends on the h.t. voltage and the required screen voltage. If R_3 is zero, the relative gain works

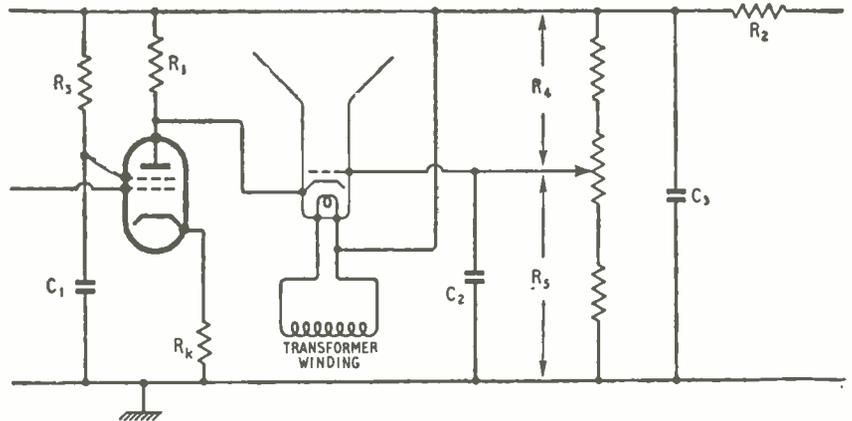


Fig. 2. This circuit can give nearly perfect reproduction of the d.c. component if R_3 is correctly chosen. It is, however, very good even without R_3 . The resistance R_2 represents the resistance of the h.t. supply. Care must be taken over the tube-heater supply if the heater-cathode rating is not to be exceeded.

out at 1.08 to slide-rule accuracy. Without any attempt at compensation by choosing a particular value of R_3 , therefore, the excess of d.c. component is only about 8%.

The basic tendency with this circuit is for the d.c. component to be slightly over-amplified. The excess, however, is not critically dependent on the values of components or the valve characteristics as long as the two right-hand terms in numerator and denominator of equation (3) are a good deal smaller than unity. Consequently, it is not necessary to employ close-tolerance components. In the circuit of Fig. 1, however, close tolerances, or at least closely matched components are necessary; with normal components errors of 40% in the d.c. component level are possible.

Taking into account both performance and cost, the circuit of Fig. 2 seems to be unquestionably the best one. Generally speaking, it seems to be an unnecessary refinement to choose R_3 in accordance with equation (4) and it is sufficient to choose it only to suit the screen voltage required by the valve. Often this will be the full voltage of the h.t. line and then both C_1 and R_3 can be omitted.

It must be emphasized that the practicability of the circuit of Fig. 2 is often restricted to receivers in which it is possible to supply the heater of the tube from its own private winding on a transformer. The heater can then be joined to any required point on the h.t. supply to minimize the heater-cathode potential difference. As shown in Fig. 2, this will often be positive h.t.

In an a.c./d.c. set, however, the tube heater must usually be at chassis potential. It is safe to use the circuit in such sets, therefore, only when the h.t. supply is of lower voltage than the heater-cathode rating of the tube.

In neither Fig. 1 nor Fig. 2 have the high-frequency compensating components been shown. They are irrelevant to the present discussion but, in practice, R_1 will usually have an inductance in series with it, or there may be one in series with the cathode lead of the tube; sometimes both are used. Then R_2 quite often has a small capacitance in shunt with it. All these things have no effect at all at d.c. or at the lower picture frequencies; they play their part at frequencies over 2 Mc/s.

Ionosphere Review: 1953

Short-wave Propagation Changes : Approaching the Sunspot Minimum

By T. W. BENNINGTON*

IT is now nearly ten years since the last sunspot minimum—ten years during which the solar activity has passed through nearly all its changes and is now approaching a minimum again. It was in April, 1944, that the last sunspot minimum values were recorded, after which the activity rapidly increased to a maximum of almost unprecedented intensity in May, 1947. Almost unprecedented, that is, when compared with the intensities of the previous maxima shown in the records available, records which exist on a continuous basis for just over 200 years. In that time 19 sunspot maxima have been recorded, and only one of these was of greater intensity than that of 1947—a fact which may or may not be of significance. Who can say, for what is 200 years in the life of the sun?

Since 1947 the average sunspot activity has been declining towards another minimum and it might be thought, observing that the mean duration of the cycles is about 11.1 years, that the coming minimum is a year away. But there is no certainty about this; the length of the sunspot cycles varies very considerably, ranging for the 17 cycles for which we have complete records from about 9.1 to about 13.6 years. Thus the time of the occurrence of an approaching minimum cannot be foretold on the mere basis of the lapse of time since the preceding

minimum, or indeed of that since the last maximum. It is, in fact, impossible to forecast its occurrence with accuracy on any known basis, though, as we shall see later, indications of some value on this point may be obtained from a study of the past cycles. There are also some of greater value directly provided by the sun itself.

Fig. 1 shows the twelve-month running average of the sunspot number for each monthly epoch from Jan./Feb., 1947, to June/July, 1953; the twelve-month running average of the noon critical frequency of the ionospheric F_2 layer and the twelve-month running average of the midnight critical frequency of the layer, for the same periods. The sunspot number is obtained from the observations made at a number of astronomical observatories (or, in the case of the last 12 values, at the Royal Greenwich Observatory alone) and is a measure of the sunspot activity on the sun's visible disc. The critical frequency of the F_2 layer is the highest frequency returned from the layer (which is the principal transmission medium in short-wave communication) when the measuring waves are sent vertically upwards. The two curves are compiled from the measurements made at the Slough station of the D.S.I.R. The

* British Broadcasting Corporation.

object of presenting the curves in the form of twelve-month running averages is that by smoothing out the month-by-month variations in sunspot number and the regular seasonal variations in critical frequency enables the long-period changes in both sunspot number and critical frequency to be more clearly seen. The last available number given by this method is, of course, that for a period six months back from the time of the last observation; *i.e.*, in the present case six months back from December, 1953, to the epoch June/July, 1953. The dotted portion of the curve which carries it forward into 1954 will be referred to later.

It is seen that since the sunspot maximum in 1947 the sunspot number has fallen from about 150 to one of somewhat less than 20, though during the last twelve months it fell only by about 15. During all this time the critical frequency curves have followed the decreasing sunspot activity in a very faithful fashion, decreasing, in the case of the noon curve, from about 10.4 Mc/s to about 5.5 Mc/s and in the case of the midnight curve from about 5.7 Mc/s to about 3.1 Mc/s. It was pointed out, at the end of 1952, that the critical frequency had already attained "quasi minimum" values, and indications were that the noon critical frequency would fall by about 1 Mc/s only between then and the sunspot minimum. As can be seen, during the past year the fall in noon critical frequency is of the order of 0.5 Mc/s only, whilst that in the midnight value was correspondingly smaller. It appears, therefore, that the critical frequencies are likely to undergo only a very small further decrease between now and sunspot minimum.

All of which means, of course, that there is not likely to be much change, due to the sunspot cycle, in the frequencies at present of use for short-wave

communication until after the coming minimum. These have decreased very considerably since the 1947 sunspot maximum, and, whilst the actual decrease varies widely for different circuits, with the seasons and with time of day, some idea of the order of things can be obtained from the figures given here. The decrease in noon critical frequency implies that the mean noon m.u.f. for transmission over the longest possible one-hop trajectory, with the ionosphere over Slough as its apex, has decreased since sunspot maximum by about 15 Mc/s, whilst the midnight figures indicate that the mean midnight m.u.f. has fallen by about 8 Mc/s. These large decreases have necessitated drastic alterations in the conduct of all kinds of long-distance services, which are now generally confined to the lowest short-wave frequencies, having regard to season and time of day. But, as has been said, no further appreciable reduction in their working frequencies is likely to be necessary.

For those who may be interested in more details of the changes which have occurred over the past few years the curves of Fig. 2 are given. These show the monthly means of the sunspot number and of the

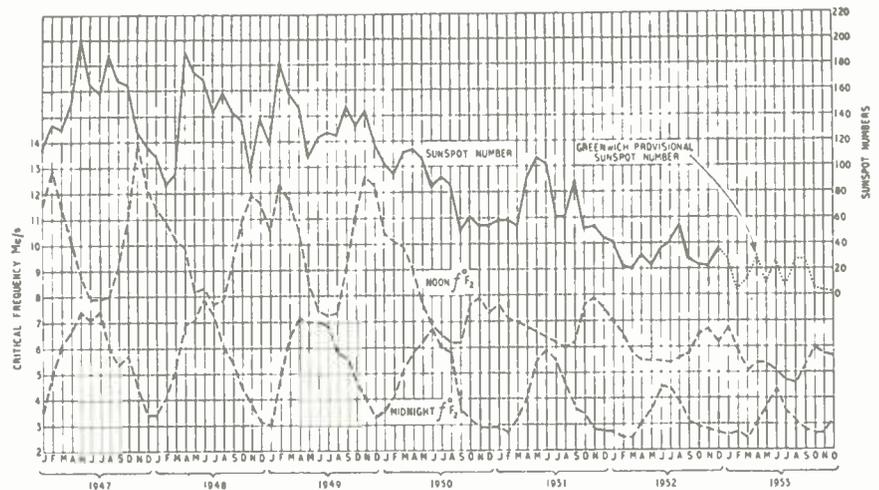


Fig. 1. Twelve-month running averages of sunspot numbers and noon and midnight F_2 critical frequencies since the last sunspot maximum, with possible future values of sunspot number (dotted extension).

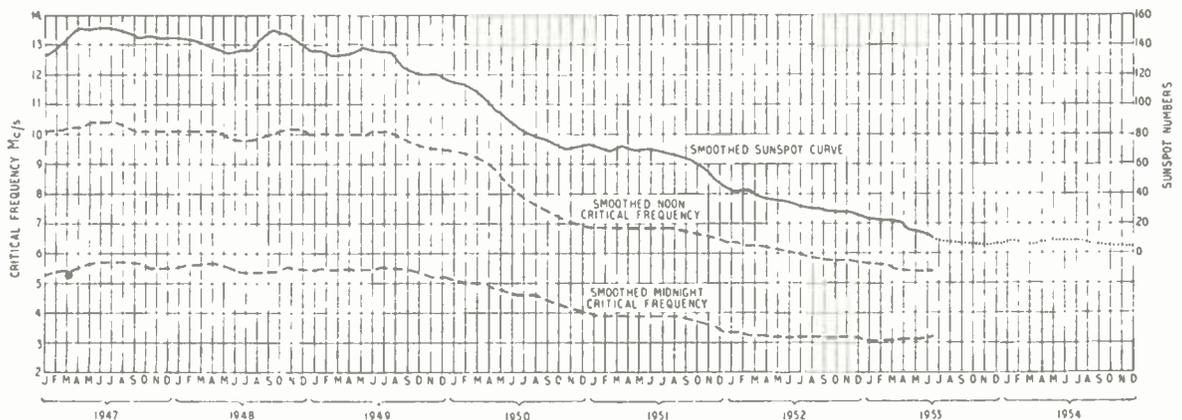


Fig 2. Monthly mean sunspot numbers and noon and midnight F_2 critical frequencies since the last sunspot maximum.

F_2 critical frequencies as measured at Slough. Some of the variations in the latter are rather interesting. For instance the noon critical frequency, which reaches its lowest values during the summer months, and its highest about mid-winter, is seen to have decreased by a very much greater amount since the sunspot maximum during the winter than during the summer. In fact it has decreased by about 8 Mc/s for winter and by about 3 Mc/s for the summer. On the other hand the midnight critical frequency decreased by about 1 Mc/s for the winter and by about 3 Mc/s for the summer. These differences may be ascribed to the differing effects of the sun upon the layer, either in kind or degree, at different times of the day and the year, but the net result on the usable short-wave frequencies is clear. They must vary over the sunspot cycle to the greatest extent during the winter day, to a lesser extent during the summer day and night, and least of all during the winter night. Of course these variations are much modified by the behaviour of the ionosphere in different terrestrial regions, and by the varying conditions over a long transmission path. But broadly speaking the variations in usable frequencies over the sunspot cycle are of the kind described.

Transferring our attention to Fig. 1 again and remembering our conclusion that it is unlikely there will be much further variation in critical frequencies or maximum usable frequencies until after the coming sunspot minimum, we are naturally concerned to know when that event will occur. But, as has already been stated, there is no way of telling this with any real accuracy. However, a classification of the sunspot cycles of which we have record would appear to indicate that the present one belongs to the class with high maximum and medium long duration. By matching it to a "representative" cycle of this class—which is the mean of all previous cycles of the same class—one can extrapolate it towards the minimum, and the result of this is shown in the dotted extension of the curve. This indicates possible future values of the 12-month running average sunspot number and places the sunspot minimum at November/December, 1954. The curve should, of course, be accepted with reserve.

Signs of the New Cycle

However, some additional and stronger evidence that sunspot minimum may occur within a year or so has now been obtained from observations of the sun itself. Towards the end of a sunspot cycle the sunspots belonging to that cycle all appear in positions relatively near to the solar equator, but when the new cycle commences the spots appear in relatively high solar latitudes. Furthermore the spots of the new cycle have opposite magnetic polarity to those of the old one. These high latitude sunspots (belonging to a new sunspot cycle) usually begin to appear some considerable time before those of the old cycle have ceased, and, in fact, about a year before the sunspot minimum is reached.

According to a report from America† there was observed on August 13th, 1953, a very small sunspot in solar latitude 52° N by members of the staff of the McNath-Hulbert Observatory, Michigan, which it would seem may have been the first spot of the new cycle. It is also reported that magnetic observations

of the sun made in Pasadena increase the probability that this sunspot belongs to the new cycle. If this is so the observations would indicate that, on the basis of similar observations made towards the end of past cycles, the sunspot minimum might be expected between about March, 1954, and April, 1955. Therefore, whilst it still is not possible to be precise about the time of the minimum, the implications of the observations do not appear to conflict very much with the dotted part of the curve of Fig. 1.

The frequencies at present of most use for communication over various circuits—such as 17, 15 and 11 Mc/s for daytime broadcasting, 9 Mc/s for summer night-time and 7 and 6 Mc/s for winter night-time use—are thus likely to remain so during 1954. And even after sunspot minimum does occur it would seem unlikely that the sunspot activity will begin rapidly to increase for several months, or perhaps for a year. So it looks as if the present "rock bottom" conditions are likely to remain for a considerable time yet and perhaps, to hazard a guess, till towards the end of 1955.

Transistor and Valve Circuitry

BECAUSE there is a good deal of functional similarity between the transistor and the thermionic valve, people have been tending to think of the process of "transistorization" as little more than pulling out valves and inserting transistors in their place, after making very slight circuit modifications. This impression has been greatly strengthened by various theories about the duality between valves and transistors and how it can be utilized in the design of transistor circuitry. Engineers are now beginning to realize, however, that this duality idea is not a good thing to follow slavishly, as it tends to restrict what can be done with the transistor. The valve automatically becomes the yardstick, and by comparison the transistor sometimes appears as rather a poor substitute. It would be more profitable to take the transistor for what it is, and build an entirely new type of circuit technique around it. For example, it has been suggested that since the transistor operates very efficiently in pulse and trigger circuits we should attempt to transform our existing linear circuits into this type of operation—rather as we can use a.c. techniques for amplifying d.c. fluctuations after making the d.c. discontinuous.

This new outlook was implicit, if not stated in so many words, in a recent I.E.E. discussion meeting "Will Transistors Oust Receiving Valves?" opened by E. H. Cooke Yarborough. One example which was mentioned of a departure from established valve-circuit technique was a new transistor digital computer at Manchester University. As a result of the new approach there were actually fewer transistors in this computer than there would be valves in an equivalent "thermionic" computer doing the same job. It was also pointed out by several speakers that greater flexibility should be possible in transistor circuits because of the reversible functions of the collector and emitter—a feature not possessed by the equivalent electrodes of thermionic valves.

At the same time, of course, the transistor must emulate the valve in some respects and be able to bear comparison with it. The limit on operating frequency is one problem here (resulting from the lower electron transit time in semiconductor materials) and to get comparable results the electrode spacing has to be very much smaller. However, one speaker at the meeting mentioned that an experimental transistor had been made to operate at 80 Mc/s, and there were hints from others that the limit could be pushed to well over 100 Mc/s. The restriction on power output was another difficulty, although it was mentioned that transistors dissipating as much as 20 W were being produced in the U.S.A.

† *Publications of the Astronomical Society of the Pacific*, Oct., 1953, Vol. 65, No. 386, p. 256.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Ignition Interference in U.S.A.

HAVING read the letter from Mr. Morse on ignition interference with TV in this country (your October issue) and your subsequent editorial comments, coupled with those of my friend "Diallist," I feel driven to enter the controversy, if only to keep the record straight.

As an English immigrant to the U.S.A. of less than two years standing, I can claim to have seen TV on both sides of the ocean, and, quite impersonally, would like to make these comments.

There is no doubt that interference does exist in fringe areas, but it is a growing problem to find a fringe area, as new transmitters going into service are a frequent occurrence on the u.h.f. band. Mr. Morse probably speaks as he finds things. In nearly two years of TV, I have yet to see visual interference on my screen derived from auto ignition. Up to two months ago, I lived on an eight-lane super highway, with autos passing four abreast in each direction at the usual thirty-foot intervals, and never had reason to complain of interference. My experience when visiting with friends or in various cities across this country has been the same; no visual signs of ignition interference. As several million TV sets are in constant use, I feel sure, knowing the Americans, that if auto interference was a problem something would be done about it, and we would know.

My feeling is that it must be standard practice for all interference-forming machines to be adequately suppressed by the maker before sale. My car, a cheap one, was suppressed as delivered from the factory. So was my vacuum-cleaner, my washing machine, the clothes drier, the dish-washer, the refrigerator and all the small kitchen power tools. I have heard auto interference myself, particularly when following a pre-war car along open highways, showing as a superimposed crackle on the car radio. However, this has never been heard when following post-war automobiles.

I am not prepared to argue American v. British design, as I have a foot in both camps, but I will back Mr. Morse fully when he says he has never seen auto TV interference, I never have either, nor have any of my friends. So shall we put the matter to bed by saying electrical appliance makers suppress their products adequately before sale, here in the U.S.A.?

Ferguson, Mo., U.S.A.

R. LINCOLN OSTER.

Skin Effect

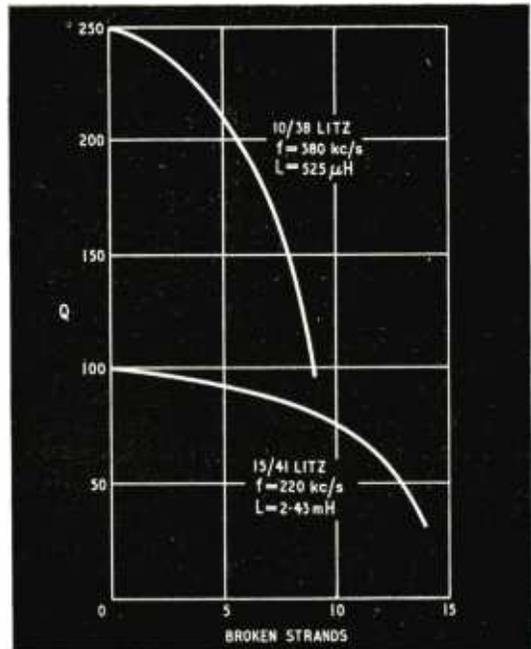
IN the final paragraph of his article "Skin Effect" (*Wireless World*, November, 1953), "Cathode Ray" observes that the effective resistance of litz wire rises appreciably when some of the strands are broken. While actual values are not stated, the reader is given the impression the resistance will increase in proportion to, or even exceed, the increase in d.c. resistance.

This popular misconception seems to appear periodically in the literature. Theory, however, does not substantiate this argument: in fact, there is ample evidence which disproves it.^{1, 2}

The accompanying curves show the effect of broken strands in a universal type coil wound with 10/38 litz, and in a single-layer solenoid wound with 15/41 litz. The frequency in each case was sufficiently low to ensure efficient use of the litz wire.

¹Hund and De Groot, *Bur. Stds. Tech. Paper 298*, Vol. 19, p. 651, 1925.

²Morecroft, J. H., "Principles of Radio Communication," 3rd Ed., p.195.



Curves showing effect of broken strands of litz wire in two different types of coil.

From the curves it is evident that the broken strands are not completely divorced from the circuit. Some current remains in the broken strands owing to the tight coupling between strands.

It is interesting to note the curves are somewhat similar when compared on a percentage basis.

Fairlawn, N.J., U.S.A.

R. E. LAFFERTY.

["Cathode Ray" writes: I am much obliged to Mr. Lafferty for correcting me in the matter of the rise in resistance when strands of "litz" wire are broken. It would be interesting to know what was the basis for the common belief that a few broken strands cause a disproportionate increase in r.f. resistance. I have been unable to trace it.—ED.]

Why No Prices?

WHY are so many of your advertisers so cagey about the prices of the goods they are trying to sell? One can, perhaps, understand it where a maker of resistors or condensers offers hundreds of different sizes, types and capacitances and is only interested in attracting makers of radio or electronic equipment; but there are many makers of other types of gear—testing sets, amplifiers, loudspeakers, recording tape, new types of valves and so on, who omit from their advertisements any suggestion of the price. Even the women's magazines now give one an idea of the prices of the creations advertised, "This dinky little model chapeau in *fer blanc*, about nine-and-a-half-guineas," but there isn't even that suggestion in many of your advertisements.

Surely the AVO people, Vortexion, Marconi Instruments and Trix don't expect to sell their products whole-

sale by the gross—or do they? Even if they did, an indication that the retail price is so-and-so would be of interest to many readers, and would still not debar the large user from negotiating other terms.

Cambridge. G. W. IRWIN.

Crystal-Transistor Link?

IT is difficult to disagree with anything that Dr. Armstrong, the distinguished pioneer of regeneration, super-regeneration and the superheterodyne principle, says in his letter published in your January issue. "Major" Armstrong (as he will always be to me) helps to get the perspective right. The valve made little impact on the radio art until the introduction of regeneration, which turned it into a receiving device of hitherto undreamed-of sensitivity. The regenerative triode detector was the heart of the radio receiver for many years, and was not finally displaced until the short-lived neutralized triode (which quickly gave way to the screened-grid tetrode) provided us with effective r.f. amplification.

But is Dr. Armstrong right in implying (his penultimate paragraph) that the originators of the transistor obtained no inspiration from the crystal detector? I am inclined to submit that if they did not, there was little excuse for their failure. The oscillating zincite crystal, which aroused some interest in the early 1920s (I cannot con-

firm the date*) surely served, or should have served, as a fairly obvious connecting link between the humble crystal detector and the transistor.

"RADIOPHARE."

* Editorial footnote.—Several articles on oscillating crystals, including one from the Russian originator Lossev, appeared in *Wireless World* during 1924.

Historical Relic

MAY I correct "Free Grid's" dates? The German-made coherer unit which he illustrates on his page in your January issue was certainly on sale in either 1911 or 1912. I became the proud owner of one, with its accompanying spark-coil transmitter, about two years before the outbreak of the first World War. These sets were sold, I believe, by more than one shop dealing in electrical novelties for schoolboys.

The relay fitted to the receiver unit was for actuating the de-coherer, which at the same time rang a bell and so gave a clearly audible signal. I think "Free Grid" is wrong about the morse inker, which was not used with my set.

With careful adjustment of relay and de-coherer, a range of 20 or 30 yards was obtainable.

Manchester.

A. M. FISHER.

INTERNATIONAL MARINE V.H.F.

AT the Atlantic City Conference of the International Telecommunication Union in 1947, frequency modulation was made compulsory for marine v.h.f. communication on certain frequencies in Region 2 (the Americas), but not in Regions 1 (Europe) and 3 (Far East). Subsequently, in 1949, it was announced by the Post Office that it had been decided to specify amplitude modulation for all v.h.f. maritime services of the United Kingdom using the international simplex channels (156.8 and 156.6 and 156.3 Mc/s), or the proposed international two-frequency public correspondence channel (157.4 Mc/s mobile and 161.9 Mc/s fixed) and associated national two-frequency public correspondence channels (157.5, 157.6, 157.7 and 157.8 Mc/s mobile and 161.5, 161.6, 161.7 and 161.8 Mc/s fixed), or the group of two-frequency channels reserved in this country for the use of harbour docking and pilotage authorities (158.6 to 159.4 Mc/s mobile and 163.6 to 164.4 Mc/s fixed).

Not only was a.m. adopted by this country, but it was widely recommended by the U.K. to other countries in Regions 1 and 3.

According to facts given in a report issued by Rees Mace Marine these opposing decisions have resulted in a position where some 40 base stations and 330 mobile stations in North America (mostly on the Great Lakes) have been equipped with f.m. gear while over three times as many stations in the rest of the world have been fitted with a.m. equipment.

The Assistant Postmaster-General recently stated in the House, in reply to a question, that "The shipping industry and the radio industry (with the exception of one manufacturer) have agreed that it would be in the national interests to resume discussions internationally with a proposal in favour of standardization on frequency modulation, and there is at last some prospect of reaching agreement and of removing the uncertainty."

The Rees Mace report summarizes the present position and formulates a plan for the solution of the impasse. A truly international decision on a unified system of modulation cannot be arrived at until the next meeting of the I.T.U. which, at the earliest, will not be held until 1957. The view is, therefore, expressed that it would be wrong

for changes to be introduced in the interim as these would not be internationally binding; on the other hand, it is pointed out that it would be quite unthinkable to stop fitting v.h.f. gear during this period. There must, therefore, be some co-ordinated interim plan, but, as pointed out by the General Council of British Shipping, such a plan must not only permit the continued growth of the use of v.h.f. but must ensure that any eventual change can be made with a minimum of inconvenience. It is, therefore, suggested that the problem can be solved by the production of dual-modulation equipment. During the interim period it will be necessary for only a small proportion of British ships to install dual-purpose equipment, in fact only those sailing to Region 2.

The report lists some of the problems which have to be solved before international standardization can possibly be achieved. They include (a) frequency allocation (at present only three channels have been internationally allocated); (b) simplex or duplex working; (c) a standardized selective calling system, and (d) transmitter and receiver specifications. Rees Mace consider that it would cause less disruption to British manufacturers to market dual equipment for a.m. and f.m. than it would to adopt American standards. "It is, therefore, at least as important to find out American views on international standards as it is to find out their views on modulation."

It is claimed that the Admiralty will support any plan which will permit British merchant ships to continue fitting v.h.f. and will facilitate v.h.f. inter-communication with ships throughout the world. The plan formulated in the report also leaves the door open for the integration of v.h.f. services for air/sea rescue purposes.

PUBLICATION DATE

In future *Wireless World* will be published on the last Monday (instead of the last Tuesday) of the month preceding that for which it is dated.

RUSSIAN TELEVISION

Some Notes from the U.S.S.R. on Equipment

LITTLE has been published in this country on the development of Soviet television, and it was, therefore, refreshing to find a delegate to this country during the recent British-Soviet Friendship Month who was able to give some factual information.

It is, of course, general knowledge that the U.S.S.R. is employing the "European" standard of 625 lines, 50 frames per second and f.m. sound, but using a bandwidth of 8 Mc/s. Transmissions are horizontally polarized.

It would appear that while there are a considerable number of communal receivers installed in the service areas of each of the four stations (Moscow [2], Leningrad and Kiev) there is a growing demand for domestic receivers. The large majority of sets are for direct viewing, but some projection models are available and both forward and back projection is employed.

In addition to the two transmitting stations, Moscow now has a television theatre which regularly shows the transmitted programmes on a big screen.

Each of the present stations originates its own programmes, but can be linked with other transmitters by radio and cable. Undoubtedly one of the biggest and most important problems for the Soviet broadcasting authorities is the relaying of television programmes in such a vast country. The shortest distance between any two of the present three centres is 500 miles. The same applies to the new stations being constructed in Stalingrad and Sverdlovsk.

Russian television sets give a certain impression of the earlier American practice. The screens are fairly small—9in being about the average size—and are often made to look even smaller by the large loud-speaker grilles which appear alongside them on the fronts of the cabinets. There are usually four, five or six controls brought out for the viewer to adjust, and apart from the usual brightness, focus and sound volume these often include such things as contrast, frame-hold, wave-change and tone control. Modern

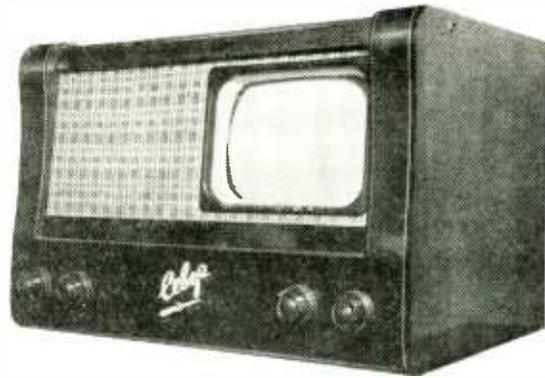
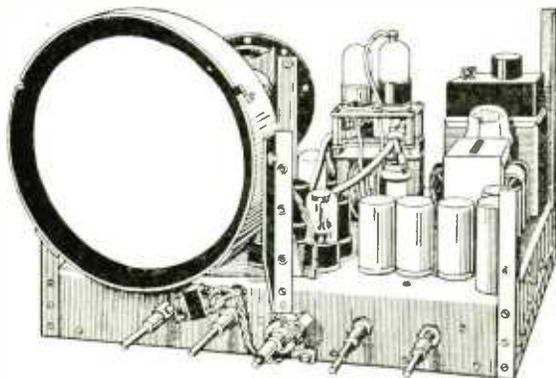
sets are still being built with mains transformers and there is no evidence of the a.c./d.c. transformerless technique.

While most of the receivers are superhets, a good many straight sets are still being made for short-range reception. These usually have about ten valves to the superhets' 20. Some models have provision for receiving a.m. and f.m. sound broadcasts as well as the f.m. television sound transmissions. Few, if any, extra valves are needed for this, as some of the sound-channel stages are used for double purposes. One recent prize-winning design, for example, has a valve which acts as a limiter on the f.m. signals and as a diode detector for the a.m. sound broadcasts.

Blocking oscillators are popular for both frame and line time-bases and scanning coils are often directly fed from the anodes of their appropriate output valves. An unusual feature of one fairly typical receiver is the use of an efficiency diode to recover energy, not for the scanning system, but to energize the focus coil. It seems there is no difficulty in getting enough scanning power for the deflector coils since the cathode ray tubes are fairly small with narrow deflection angles.

American-type metal valves with octal bases are widely used in receivers and the 6.3-V heater appears to be standard. Some of the valves have well-known American type numbers and equally familiar characteristics, while others have numbers which are not recognizable but are obviously based on the same system. There are no signs of any miniature valves. Components generally have much the same appearance as ours.

With horizontally polarized transmissions the receiving aerials are naturally T-shaped, as in America. A good many people, however, make use of indoor aerials which are disguised to look something like electric bowl fires. The bowl reflectors are actually used to give a directional effect, so that the aerials can be adjusted to find the best angle for



On the left is a sketch of a recent prize-winning Russian receiver, reproduced from the Soviet journal "Radio," and on the right is a fairly typical table model in its cabinet.

reception. Naturally the directivity is not very great because the reflectors are relatively small compared with the wavelength. In blocks of flats communal aerial systems are used, as the authorities have the same objections to forests of dipoles on the roofs as they have in this country.

Colour television will be starting up soon, apparently on the frame-sequential system, and adaptors with rotating colour filters are being made for use with existing black-and-white receivers.

One type of interference which is not experienced by town dwellers in the U.S.S.R. is flutter caused by aircraft; flying is prohibited over built-up areas.

Gregory Alexandrov, our informant, who was leader of the delegation from the U.S.S.R., is a professor at the Central Film Institute, Moscow, and has directed a large number of Soviet films. He told us, incidentally, that they have experimented with the use of electronics in the production of films, but have abandoned the project.

Television Society's Exhibition

New Circuitry and Devices

HELD in London on 7th-9th January, the annual exhibition of The Television Society included 39 exhibitors. As in previous years, it was noteworthy for the number of demonstrations of an experimental and educational nature.

One of particular interest to sufferers from ignition interference was the "grey spotter" circuit of G.E.C. The circuit is shown in Fig. 1; V_1 is the video stage coupled in the usual way to the cathode of the c.r. tube. The signal from V_1 is also applied to the cathode of V_2 , and appears at the anode in the same phase, whence it is passed to the grid of the tube. If the complete signal were passed it would, of course, cancel the cathode signal, but the limiting action of V_2 and V_1 makes the grid signal one of interference only. V_2 is biased to be non-conductive during the video signal proper and to conduct only during noise pulses of amplitude greater than peak white. It then conducts and amplifies and if it were not for the diode V_1 , it would be a "black spotter" for, because of the amplification in V_2 , the noise pulse applied to the grid of the tube would be greater than that applied to the cathode. V_1 , however, is biased to act as a second limiter, this time of the noise pulse amplitude applied to the grid. The result is that the effective level of noise on the tube is held at a level corresponding to grey in the picture and as this is the average level of illumination the contrast between the noise and the picture brightness is reduced. In a demonstration the circuit appeared very effective.

A circuit which enables a direct visual comparison to be made between two aerials was demonstrated by Belling & Lee. It enables the top half of a normal television picture to be reproduced from a signal received on one aerial while the bottom half is provided by a signal received on a second aerial. It has the great merit of

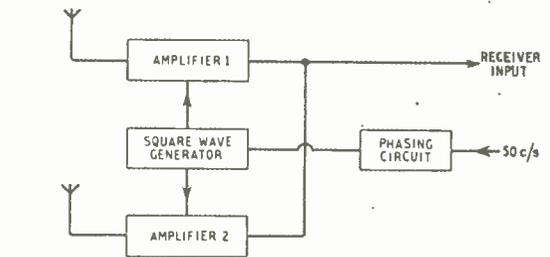


Fig. 2 Belling-Lee electronic switch for aerial comparison.

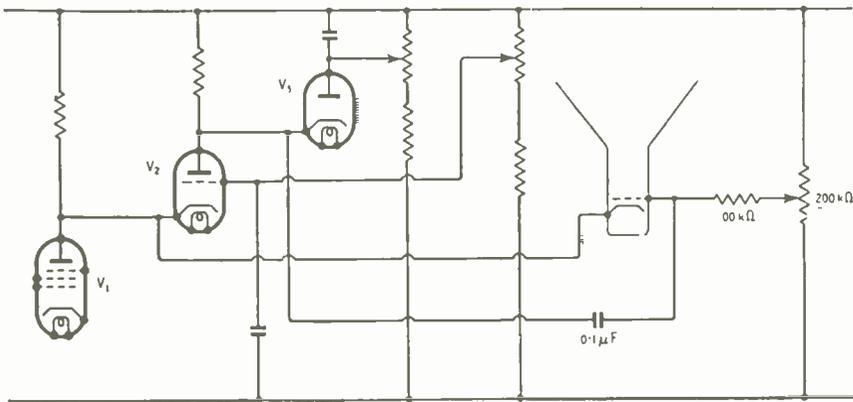
enabling a direct comparison of two aerials, particularly as to their susceptibility to interference, to be made under proper viewing conditions.

The arrangement is sketched in Fig. 2. Each aerial feeds an r.f. amplifier the outputs of which are commoned and taken to the input of any television receiver. The two amplifiers are rendered alternatively inoperative by a biasing pulse. A 50-c/s square-wave generator is used for this and is locked at 50 c/s through a phasing circuit which enables the change-over to be adjusted to the required point. One change-over occurs during the frame fly-back, the other half-way through the picture. In the demonstration an artificial source of interference was impressed on the input signal to one amplifier, the input to the other being free of interference. This gave a good idea of the capabilities of the method, which

appears to be a valuable one for assessing the practical value of television aerials whenever it is possible to have the two to be compared erected simultaneously.

Apart from ignition interference, aircraft flutter is probably a major cause of interference, especially in certain districts. A circuit to reduce its effect on the picture was demonstrated by G.E.C. Under the somewhat artificial conditions of the demonstration, where the signal fluctuations were provided by an input attenuator which was varied regularly at a

Fig. 1 Circuit of G.E.C. "grey spotter"



slow rate, the circuit made an enormous improvement to the picture, although it did not completely eliminate the effects of the flutter,

The circuit is shown in Fig. 3 and is extremely simple. The video signal is fed back through an RC network comprising a cascade of integrator and differentiator type circuits which form a frequency-selective circuit. Neither picture-frequency signals nor d.c. is passed. Slow variations of the signal in the region of 10 c/s are passed, however, and vary the bias, and hence the gain of the i.f. amplifier, so that as the output increases the gain decreases and vice versa. It is a form of a.g.c.

The care that is needed in television receiver production is brought home by the elaborate apparatus shown by Bush for r.f. amplitude and phase characteristic tests. A combination of step and pulse methods is used. This same firm also showed an experimental recording wobulator which enables a permanent record of the response curve of a television receiver to be made by means of a pen recorder. A variable-frequency oscillator is used to produce the signal and there are several crystal-controlled marker frequencies.

Bush showed a receiver using a direct-drive line-scanning circuit to show the simplicity resulting from this arrangement and G.E.C. demonstrated a set using an experimental 12-in. c.r. tube with a 90° deflection angle. Small external magnets are used to correct for pincushion distortion.

The possible advent of new television stations in Band 3 was reflected at the show by a 12-channel tuner (Cyldon) covering the frequency range 50-220 Mc/s, and two new Mullard valves specifically designed for use in such circuits. These valves were the PCC84 double triode and the PCF80 triode-pentode, both on the B9A base. The PCC84 is intended for use as a cascode low-noise r.f. amplifier with an h.t. voltage of 180V. In the cascode circuit the two triodes are connected in series across the h.t. supply so they get only 90V each, but in spite of this low operating voltage each triode has a slope of 6mA/V and an amplification factor of 24, permitting a gain of about 12 db from the circuit. A difficulty of the cascode circuit is that a high voltage is placed across the heater-cathode insulation of the top earthed-grid valve. This has been catered for in the PCC84, which has a heater-cathode voltage rating of -250V and +90V.

The PCF80 triode-pentode is intended for use as a frequency changer following the PCC84, and in a typical circuit it is claimed to give a conversion gain of 20 db working with an input frequency of 200 Mc/s. The triode and pentode sections are placed side by side instead of one above the other as in earlier Mullard valves.

This combination of PCC84 cascode r.f. amplifier and PCF80 frequency changer is actually used in the Cyldon tuner. The unit is based on the American type of turret tuner and has a rotating drum carrying 12 aerial and 12 r.f. coupling and oscillator coils. These coils are mounted on low-loss Bakelite contact strips which are clipped on to the turret, and rotating the turret brings the desired set into circuit, leaving the others isolated.

Mullard were showing how the difficult and complicated processes of frequency-changer design can be simplified and made more exact by an interesting type of "three-dimensional" display which presents a large number of characteristics of a mixer valve (actually the PCF80) in their correct relationship on a single chart. It is called the "contour line method"

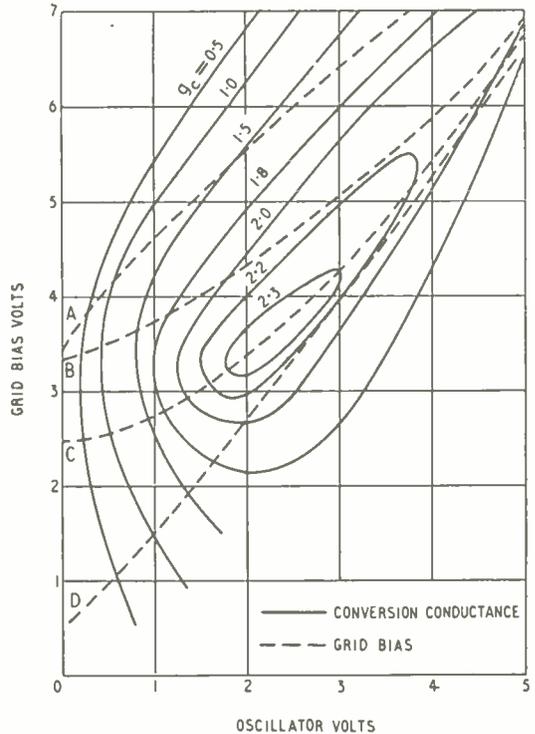
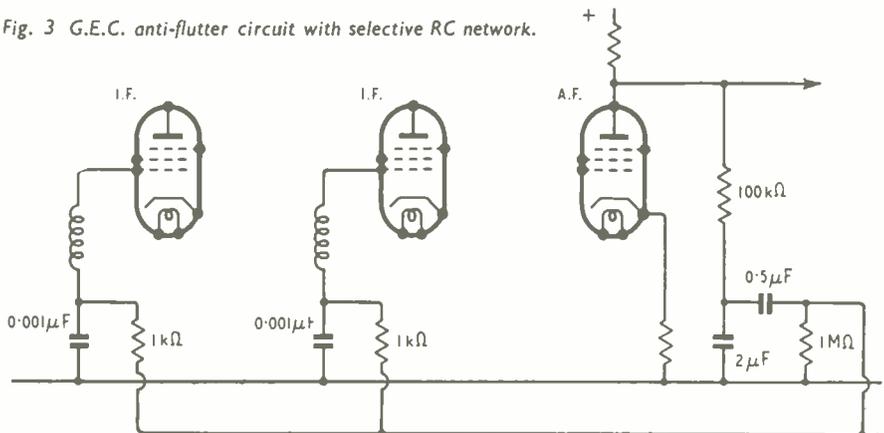


Fig. 4 "Three-dimensional" display of PCF80 characteristics. Control-grid bias of pentode section for different values of cathode resistor and grid resistor (A, B, C, D), plotted against oscillator volts, with superimposed "contour" lines of constant conversion conductance.

because on an ordinary two-dimensional graph are superimposed lines joining points of equal conversion conductance. Looking at Fig. 4 one can, in fact, imagine it as a bird's eye view of a relief map, with a "hill" rising to its summit in the middle at a conversion-conductance "height" of just over 2.3 mA/V. The dotted lines A, B, C, D represent different values of grid leak and cathode resistor. While the maximum conversion conductance lies on curve C, at an oscillator voltage of 2.3 V and a control-grid bias of -3.6 V, its value is affected considerably by changes in oscillator voltage. Optimum conditions are given by curve B, which runs almost parallel to the contours (along the side of the "hill" instead of straight up and down the slope) and is reasonably near the maximum conversion conductance.

Fig. 3 G.E.C. anti-flutter circuit with selective RC network.



Radar in Airliners

Is it a Practicable Aid to Extra Safety in the Air?

THE use of airborne radar as an aid towards safer air travel has recently attracted some attention in the daily Press; but it has been under consideration by the airlines ever since the end of the war, and a lot of work has been done towards developing a suitable set. In general terms, the requirement is to extend the "range of vision" from the aircraft, and to indicate clearly the presence of obstructions to flight. With increasing speeds of transport aircraft—up to 500 m.p.h.—the need for a lot of clear airspace is apparent, because transport aircraft, and their loads, are not normally subjected to violent manœuvres.

The routes which airliners follow are, of course, selected to avoid all dangerous ground, or else to fly over it at a height which provides a large margin of safety against a possibility of partial loss of power. Flying between mountain peaks is not airline business, and following an established route is an everyday exercise in air navigation, presenting neither novelty nor difficulty in normal circumstances. In fact, it is doubtful whether the use of aircraft radar as a form of map-painter will be any advantage, because the information on the radar screen is not detailed and the navigation systems available, such as for instance the Decca system, give precise information about position. In case of doubt, though, radar information can be used as confirmation of orthodox navigation, but it would be rather like using a watch to confirm the Rugby time signals.

Dangerous Cloud Formations

However, there is one particular application which can only be met in a satisfactory way by using radar, and this application is being followed up, with trials taking place at present by the Royal Canadian Air Force in a Comet. This application is the avoidance of obstacles which occur seasonally, and which are not stationary—dangerous clouds.

In and near the tropics at certain seasons the weather conditions produce a type of thundercloud (cumulo-nimbus) which has a core with a high percentage of water in it, and where the vertical currents are very severe, up to 60-80 feet per second. These clouds are avoided by aircraft, because of the very disturbed air around the cloud, which would cause a very rough ride. The interference increases as the aeroplane speeds are raised, and with high-speed jet aircraft it could become very troublesome.

As long as these clouds can be seen, they may readily be avoided, but at night they may be so severe as to cause flying to be suspended. Experiments with radar have shown that the dangerous clouds produce

strong echoes on the radar screen (and so do some non-dangerous clouds); so by fitting radar, aircraft may be able to fly by night in areas where "stuffed clouds" are likely to be, with sufficient warning of the presence and locality of the hazards to allow the aircraft to avoid them. This is an appreciable advantage.

A radar set has been developed in England, by Ekco* working with the Ministry of Supply, and it has been extensively tested as it has been developed. It has a maximum range of 40 miles, and has detected clouds, presumed to be dangerous, at maximum range. The equipment needs about 650 VA of power, and its output is 10 kW peak, on a wavelength of 3 cm, with 700 pulses per second, each of 1-microsecond duration.

The strength of the echo from clouds depends on the size of the water drops in the cloud, and on the wavelength of the radar. Experimenters in U.S.A. have found that in some cases a wavelength of about 6 cm produces a much stronger echo than does the 3-cm radar, and they have built an aircraft set to use these longer waves. It has rather more range, for the same power, than the 3-cm radar, but has the great disadvantage that the aerial assembly is so very much bigger. This will make the equipment difficult to accommodate in an airliner, for a very large section of the nose would not only become useless as stowage space, but would have to be encased in Perspex or something similar.

Economic Problems

Space and weight are at a premium on every aeroplane, and the British equipment weighs about 200 lb, installed. This is about the same as the weight of a passenger, so it is clear that even to carry the radar implies a substantial cost to an airline; it must only be carried where it can serve a useful purpose. This would be equivalent to reducing the payload in some localities to cater for weather hazards, as is done in ships which are less deeply laden for winter in the North Atlantic than elsewhere.

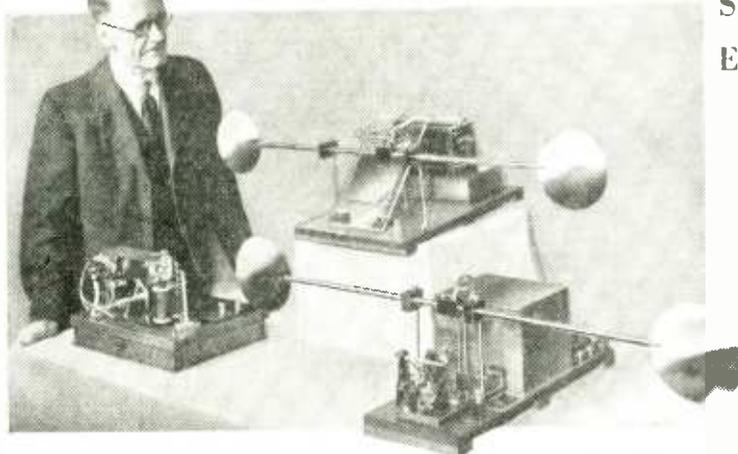
Aircraft radar has occasionally been suggested as a valuable preventer of collisions between aircraft, but the information displayed is not specific enough for collision prevention. However, collision between aircraft is not a serious hazard; there are few localities where air traffic is dense enough to create collision risks, and in all these localities there is an effective and rigid system of air traffic control, using ground radar as one of its principal tools. By means of two-way radio telephony, aircraft are given instructions on route and height, and the only danger would arise from an intrusion by an aircraft without two-way radio telephony. Such an intrusion is forbidden, but it has happened, though radar on aircraft would be of little value in such a case.

I have tried to show that there is a case for aircraft radar, which can be a useful aid in certain circumstances. This is far from recommending that all airliners should be fitted with radar as a permanent fixture, or from suggesting that without radar any operations carried out at present are less safe than they might be. The contrary is the case, and certainly radar will be used where its use is justified. The provision of a suitable equipment is actively being pursued, but the total costs will be so high that the article will have to be very good. J. M.

* "Radar Cloud Detector" *Wireless World*, December 1950

WORLD OF WIRELESS

Show News • Record Radio Exports • V.H.F. Report • TV Pioneer Honoured



MUSEUM-PIECE V.H.F. — A working model of the apparatus used by Marconi in his early experiments has recently been presented by the Marconi Company to the Science Museum, South Kensington, where its operation is being demonstrated to visitors. The apparatus, seen here with its maker, R. W. Piper, of the Marconi Marine Company, comprises a spark transmitter (top) and a coherer receiver (right). Operating frequency is 85 Mc/s

Instruments and Components

ANNUAL London exhibitions of the Radio and Electronic Component Manufacturers' Federation and the Physical Society will overlap by only one day this year. The R.E.C.M.F. components show will be held at Grosvenor House, Park Lane, W.1, from April 6th to 8th. Some 130 exhibitors will be participating in the exhibition. Admission is by invitation, limited to those interested in the industrial, scientific or trade aspect of components. The show will be open on each of the three days at 10.0 and will close at 6.0, 9.0 and 5.0 respectively. Tickets are obtainable from the Federation at 22, Surrey Street, Strand, London, W.C.2.

Tickets for the 38th Physical Society exhibition of scientific instruments and apparatus, which will be held at the Imperial College of Science and Technology, Imperial Institute Road, S.W.7, from April 8th to 13th, will be available from the Society from the beginning of March. As in previous years, tickets will be valid for specific sessions and days. The exhibition will open daily at 10.0 and will close at 8.0 on the 8th, 9th and 12th and at 5.0 on the 10th and 13th. On the opening day admission will be limited to Fellows and the Press from 10.0 until 2.0. The handbook covering the exhibition will be available on March 1st, from the Society, 1, Lowther Gardens, Prince Consort Road, London, S.W.7, price 6s, postage 1s 3d.

V.H.F. Broadcasting

THE LONG-AWAITED report of the Television Advisory Committee on v.h.f. broadcasting has, it is understood, been received by the Postmaster General. It is not known whether the findings of the Committee will be published, as, of course, the report has been prepared solely for the guidance of the Government and is not in itself a statement of Government policy. It is, however, known that the Committee recommends, as was anticipated, the use of frequency modulation, although there is an adverse minority report.

New Zealand Television

BRITISH 405-LINE TELEVISION standards having been recommended by a Government departmental committee for adoption in New Zealand, Pye recently shipped to Wellington complete transmitting equipment and a number of receivers to provide demonstration transmissions during the Wellington Show and Industrial Fair (January 7th-27th).

The Minister in Charge of Broadcasting has, however, stressed that there is no likelihood of the Government taking immediate action to establish a television service.

Radio Exports

ACCOUNTS for November recently issued by the Board of Trade show that the total value of radio exports during the month was £2,677,912, which, for the second successive month, broke previous records. The figure for the eleven months of 1953 (£23,328,347) is within £1.2m of the total for the whole of 1952.

The November figure and the eleven-month total (in £m) for each of the four sections of the industry are:

Transmitting and radio navigational gear	1.245	9.866
Components and sound reproducing equipment	0.955	8.222
Domestic receivers	0.276	3.225
Valves and c.r. tubes	0.202	2.015

Faraday Medallist

ISAAC SHOENBERG is to receive the 32nd award of the Faraday Medal of the I.E.E. "for his distinguished work in electrical engineering, in particular the outstanding contributions which he has made to the development of high-definition television in this country."

Mr. Shoenberg, who is director of research of Electric and Musical Industries, led the team (including A. D. Blumlein, C. O. Browne, G. E. Condliffe and J. D. McGee), which was responsible for the development of the 405-line television system and ancillary equipment adopted by the B.B.C. in 1936.

Born in Russia in 1880, Mr. Shoenberg was chief engineer of the Russian Wireless Telegraph and Telephone Company, Leningrad, from 1905 until he came to this country in 1914 as consulting engineer to the Marconi Company of which he became joint general manager. He has held his present position since the formation of E.M.I. in 1931 through the amalgamation of the Gramophone Company and the Columbia Graphophone Company of which he had been joint managing director for three years.



European Broadcasting Problems

DURING the meeting of the Technical Committee of the European Broadcasting Union at Monte Carlo in November, E. L. E. Pawley (B.B.C.) chairman of the

Committee, presented a report on the studies of a working party concerned with v.h.f. broadcasting, especially in relation to the Stockholm Plans. In its future studies this working party will consider the problems regarding the securing of the 216-223 Mc/s channel for television (this will extend Band 3 by 7 Mc/s) and the co-ordination of investigations into the use of Bands 4 and 5.

Three new working parties, were set up during the meeting. One will deal with the operational use of magnetic-tape recording, including its applications in television; another with the expansion of the television network in Europe, with special reference to the location and responsibility for standards-converters for international relays; and the third will be responsible for collaboration between the E.B.U. and the C.I.S.P.R.

The report of the Brussels Technical Centre given at the meeting included references to the standard of musical pitch, the choice of i.f.s for television sets, stereophony and the compilation of a bilingual technical glossary.

“W.W.” Index

COPIES of the index to the 1953 volume of *Wireless World* are now available from our Publishers price 1s (postage 2d). Cloth binding cases are also obtainable with index, price 6s 5d by post. The binding of readers' own issues can be undertaken by our Publishers, the cost, including binding case and index, being 17s 6d plus 1s 4d postage on the bound volume.

NEW YEAR HONOURS

Dr. W. G. Radley, C.B.E., Post Office engineer-in-chief, received a Knighthood in the New Year Honours. He joined the Post Office in 1920, was for five years controller of research and was appointed E.-in-C. in 1951. He is chairman of the Technical Sub-Committee set up by the Television Advisory Committee.

Norman C. Robertson, M.B.E., who recently concluded his two-year term of office as director-general of electronics production at the Ministry of Supply and returned to E. K. Cole, Ltd., where he has been deputy managing director since 1945, has been appointed a Companion of the Order of St. Michael and St. George (C.M.G.).

Rear-Admiral (L) C. P. Clarke, C.B., D.S.O., R.N.(ret.), and Cdr. S. S. C. Mitchell, C.B., O.B.E., R.N.(ret.), are created Knights Commanders of the Order of the British Empire (K.C.B.). Commander Mitchell has been controller of guided weapons and electronics (M.o.S.) since 1951 and has been in charge of all research, development and production of guided weapons in this country.

G. J. S. Little, G.M., an assistant engineer-in-chief, Post Office, and G. Darnley Smith, managing director of Bush Radio and Cinema Television, are among the new Commanders of the British Empire (C.B.E.). Mr. Darnley Smith is chairman of the Radio Industry Council and is one of the two representatives of the industry on the Television Advisory Committee.

Among the new Officers of the Order of the British Empire (O.B.E.) are T. H. Baines, deputy director radio equipment (production), Admiralty, A. S. Mitson, assistant director electronics production, M.o.S., and M. J. L. Pulling, senior superintendent engineer (television), B.B.C. Mr. Pulling has been in his present position since 1949 and was previously superintendent engineer (recording) for eight years. He recently visited the United States and gave his impressions of American television in our January issue.

New M.B.E.s include O. H. Barron, engineer, Planning and Installation Department, B.B.C., D. J. Bowman, B.B.C. Monitoring Service, F. Clark, Marconi Radio Officer in m.v. *Isipingo*, W. H. F. Griffiths, chief engineer, H. W. Sullivan, Ltd., who has contributed articles on standard measuring equipment to both *Wireless World* and *Wireless Engineer*, H. J. Harbour, test controller, Radio Division, E. K. Cole, Ltd., and G. Houghton, chief technical instructor, Radar Section, Technical Training College, Indian Air Force, Jalahalli.

Recipients of the British Empire Medal include W. McLaren, leading technical officer, P.O. Radio Station, Cupar, and G. Wilkins, experimental mechanician, McMichael Radio.

PERSONALITIES

Ernest Leete has been elected an Honorary Member of the I.E.E. “for his services as Honorary Treasurer . . . and also for his work on behalf of the Benevolent Fund of the Institution.” Mr. Leete joined the London Electric Wire Company and Smiths, Ltd., in 1904 and subsequently became managing director.

H. Faulkner, C.M.G., B.Sc., M.I.E.E., has retired after forty years' service in the Post Office where he has been deputy engineer-in-chief since 1948. He was a member of the team responsible for the design of the Rugby Station and was its first officer-in-charge (1925). Mr. Faulkner was chairman of the recent London meeting of the C.C.I.R. and is a member of the Technical Sub-Committee of the Television Advisory Committee. He has accepted the office of director of the Telecommunication Engineering and Manufacturing Association (see opposite page).

A. H. Mumford, O.B.E., B.Sc.(Eng.), M.I.E.E., succeeds Mr. Faulkner as deputy E.-in-C. at the Post Office, having been an assistant E.-in-C. since 1951. He joined the Post Office Engineering Dept. as a probationary assistant engineer in 1924, and after a short period at Headquarters went to the Dollis Hill laboratory. He took charge of the Radio Branch in 1928. Mr. Mumford is succeeded as assistant E.-in-C. by C. F. Booth, O.B.E., who has been deputy director, External Telecommunications Executive, for the past eighteen months. Both Mr. Mumford and Mr. Booth have been chairmen of the I.E.E. Radio Section. (Portrait opposite.)

Rudolph Kompfner, the originator of the travelling-wave valve which he described in the November, 1946, issue of *Wireless World*, is now at the Bell Telephone Laboratories, Murray Hill, New Jersey, U.S.A., where he is working on microwave valves and has recently contributed an article on backward-wave valves in the *Proceedings of the I.R.E.* He came to England from Austria in 1934 and joined the Admiralty as a temporary experimental officer in 1941, undertaking research in the Physics Department of Birmingham University. From 1944 until 1952 he was in the Clarendon Laboratory of Oxford University.

RECIPIENTS OF NEW YEAR HONOURS



DR. W. G. RADLEY
(Knighthood)



NORMAN C. ROBERTSON
(C.M.G.)



M. J. L. PULLING
(O.B.E.)



W. H. F. GRIFFITHS
(M.B.E.)

W. R. Nash, M.Inst.R.E.(Aust.), who has been London manager of Amalgamated Wireless (Australasia), Ltd., for the past seven years, has returned to Sydney as an assistant to the managing director of A.W.A. He is succeeded by D. Craig, who joined A.W.A. in 1936 after five years with Raycophone, Ltd. From 1937 to 1946 he was in the company's research laboratory where he was concerned with development work on crystal manufacturing machinery, aircraft equipment and mobile f.m. gear. For the past seven years he has been in the Technical Services Section.



A. H. MUMFORD



D. CRAIG

A. I. Bray, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., who joined the engineering staff of the B.B.C. in 1935 and was attached to the London Outside Broadcasts Section, has been appointed engineer-in-charge Television Outside Broadcasts (London). During the war he served in the R.A.F., attaining the rank of Squadron Leader, and returned to Television O.B.s in 1946.

L. Evans has been appointed engineer-in-charge of the Isle of Man television transmitter. He joined the B.B.C. in 1941 and has served at a number of the Corporation's sound and television stations, including Sutton Coldfield and Wenvoe.

OUR AUTHORS

S. Kelly, chief engineer of Cosmocord's electro-acoustic division, who writes on components for transistors in this issue, was on radar research at R.A.E., T.R.E. and at the Massachusetts Institute of Technology for the major part of his wartime service in the R.A.F. He was subsequently senior radar officer, Transport Command Development Unit. Before the war Mr. Kelly was in the development laboratories of Standard Telephones & Cables and Philco.

D. C. Pressey, author of the article on page 60, is at present developing analogue computing devices at Southern Instruments, which he joined in 1950. He commenced his radio career in 1944 at R.R.D.E. (now Radar Research Establishment), Malvern, where most of his work was concerned with the radio proximity fuse. Two years later he went to the Nuffield Department of Anaesthetics, Oxford University, where he undertook research on the application of electronics to medical problems, as a result of which an instrument for the recording of respiration rates and volume was developed.

T. W. Bennington, whose annual survey of the ionosphere appears in this issue, was from 1939 until recently in charge of the ionospheric and short-wave propagation work of the Overseas and Engineering Information Department of the B.B.C. He is now engaged on similar work in the Corporation's research department. He helped in 1930 to inaugurate the first long-distance ship-shore radio-telephone service and was in charge of the radio-telephone service in R.M.S. *Majestic*. Mr. Bennington, who joined the B.B.C. in 1934 after a period in the radio industry, is author of the book "Short-wave Radio and the Ionosphere."

H. S. Jewitt, contributor of the article on wideband i.f. amplifiers on page 86, worked on anti-aircraft radar while in the army from 1939 until invalided out in 1942. He then undertook research work on v.h.f. and a.f. until September, 1945, when he went to Queen Mary College, London University. He graduated in 1949 as B.Sc.(Eng.) and joined Ferranti's as development engineer working on pulse circuitry. Since mid-1952 Mr. Jewitt, who is now 31, has been with Decca Radar where he is senior engineer in charge of the receiver design group at the radar research laboratory, Tolworth, Surrey.

IN BRIEF

Receiving Licences.—During November the number of television licences in Great Britain and Northern Ireland increased by 119,157, bringing the total to 2,846,227. The total number of broadcast receiving licences, including sound, vision and 202,676 for car radio, was 13,216,644 at the end of the month.

East Anglian Transmitter.—A new low-power transmitter at Hempstead, near Cromer, was brought into service by the B.B.C. at the end of December. The 2-kW station, which operates on 434 metres (692 kc/s), has been provided with a directional aerial system designed to give a good service in Sheringham, Cromer, North Walsham and Aylsham without affecting reception of the Moorside Edge transmissions in north-west Norfolk and along the Lincolnshire coast.

Farnborough 1954.—The annual flying display and exhibition of the Society of British Aircraft Constructors at Farnborough, which is fast becoming the focal point for aeronautical radio, will this year be held from September 7th to 12th.

The Daventry Third Programme Transmitter (647 kc/s), the aerial of which had been undergoing repair for some time, resumed transmission on full power at the end of the year. Further adjustments to the aerial system are being made to reduce the fading which is experienced after dark in the more remote areas.

The Physical Society is organizing a conference on the Physics of the Ionosphere, to be held at the Cavendish Laboratory, Cambridge, from September 6th to 9th. Details of the Conference, which will be devoted to discussions on the lowest ionosphere, irregularities and movements in the ionosphere, the F2 layer and the mathematics of wave propagation, may be obtained from J. A. Ratcliffe, F.R.S., Cavendish Laboratory, Cambridge.

T.E.M.A.—The Telecommunication Engineering and Manufacturing Association, of which H. Faulkner has been appointed director (see "Personalities"), is concerned mainly with general policy matters in the telecommunication industry. Among the members of the association, which was formed in 1943, are A. T. & E., Creed, Ericsson, G.E.C., Plessey, S.T.C., Siemens and T.M.C. The address of J.E.M.A. is Stafford House, 40-43, Norfolk Street, London, W.C.2.

Magnetic Tape Standards.—A revised British Standard (BS1568:1953) has been issued on "Magnetic Tape Sound Recording and Reproduction for Programme Interchange." Dimensions are now included of an adaptor to permit the use of American N.A.B. spool hubs on machines designed primarily for European standard spools. Copies, price 2s 6d, are obtainable from the British Standards Institution, 2, Park Street, London, W.1.

Amateur Colour Television pictures have been transmitted over a closed circuit by C. G. Dixon, of Ross-on-Wye. The home-built equipment works on the frame-sequential system with rotating colour discs in front of the camera and c.r.t. monitor, and the scanning rate is 100 colour frames per second or 33½ complete pictures per second of 150 lines (non-interlaced) each.

Richmond Readers interested in the "technical aspects of the reproduction of music" might like to know that a group of music enthusiasts in the district is holding monthly meetings. Details may be had from B. J. Davis, 18, West Park Avenue, Kew Gardens, Richmond, Surrey.

As already announced, the fourth **Mechanical Handling Exhibition and Convention**, organized by *Mechanical Handling*, will be held at Olympia, London, W.14, from June 9th to 19th.

A booklet on the benefits of V.H.F. Mobile Radio-telephones in business and public services has been prepared by the Radio Communication and Electronic Engineering Association. It includes a list of the members of the Association supplying mobile radio equipment.

Amateur Call Book.—The winter edition of the R.S.G.B. Amateur Radio Call Book, which contains the calls, names and addresses of some 7,500 amateurs in the British Isles and Eire, is now available by post from the Society, price 2s 9d.

A new **Mullard Film** dealing with the technicalities of valve design and manufacture is now available for showing to clubs, colleges and schools. The "Manufacture of Radio Valves" as it is called, can be borrowed from Mullard's, Technical Publications Department, Century House, Shaftesbury Avenue, London, W.C.2.

Details of specialized **Higher Technological Courses** in a variety of subjects including electronics, high vacuum techniques, semi-conductors and transistors, which are available

at 26 establishments in London and the Home Counties, are given in a Bulletin issued by the Regional Advisory Council, Tavistock House South, Tavistock Square, London, W.C.1. The price is 1s 6d.

INDUSTRIAL NEWS

Belling & Lee are arranging to give talks to the trade on the reception problems associated with the proposed introduction of an alternative television programme. They will be given in areas in which it is intended to erect transmitters and will cover aerial adaptors, feeders, input arrangements, etc.

Marconi Marine Company has appointed as manager of its Grimsby Depot, J. W. Dalton, who commenced his service with the company as a sea-going operator in 1928. He was manager of the Cape Town Depot of Marconi (South Africa), Ltd., from 1946 to 1953.

An order valued at over £100,000 has been placed with E.M.I. Factories by the French Air Ministry for 100 airborne Rebecca Mark IV sets with spares and associated test gear.

A complete Pye duplex multi-carrier radio-telephone system has been installed in South Turkey for the police. The installation consists of a 15-watt control station at Adana which controls two 50-watt repeaters installed at points where maximum coverage can be obtained. A further fixed station at the port of Mersin is linked by radio with the police headquarters at Adana 75 km away.

A further three complete Emitron mobile television microwave radio links have been ordered by the Swiss Post Office from E.M.I.

Ediswan's Glasgow district office is now at 167, St. Vincent Street, Glasgow (Tel.: Central 0687). The cathode-ray tube service depot is at the same address, but its new telephone number is Central 2206. The company has also opened a c.r.t. service depot at 39-41, Jacksons Row, Manchester, 3 (Tel.: Blackfriars 2969).

Wharfedale Wireless Works, of Bradford, Yorks, celebrated in December the 21st anniversary of its formation.

MEETINGS

Institution of Electrical Engineers

London.—Faraday Lecture "Electro-Heat and Prosperity" by O. W. Humphreys, B.Sc., at 6.00 on February 16th at Central Hall, Westminster, S.W.1. (Admission by ticket obtainable from Savoy Place, W.C.2.)

"The Manchester Kirk o'Shotts Television Radio Relay System" by G. Dawson, B.Sc., L. L. Hall, K. G. Hodgson, B.A., R. A. Meers, O.B.E., T.D., and J. H. H. Merriman, on February 4th.

Radio Section.—"Basic Ground-Wave Propagation Characteristics in the 50-800 Mc/s Band" by J. A. Saxton, B.Sc., Ph.D., and "Ground-Wave Field Strength Surveys at 100 and 600 Mc/s" by J. A. Saxton, B.Sc., Ph.D., and B. N. Harden, M.Sc., on February 10th.

Discussion on "Acceptable Standards of Quality in Sound Broadcast Transmission and Reception"; opener, J. K. Webb, M.Sc. (Eng.), B.Sc.Tech.

The above meetings will be held at 5.30 at Savoy Place, London, W.C.2.

Cambridge Radio Group.—"The Use of Radio in the Ascent of Everest" by G. C. Band, at 6.30 on February 16th at the Cambridgeshire Technical College.

North-Eastern Radio Group.—"Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling, M.A., and F. Williams, B.Sc., at 6.15, on February 15th, at King's College, Newcastle-upon-Tyne.

North Midland Centre.—"Special Effects for Television Studio Productions" by A. M. Spooner, B.Sc.(Eng.), and T. Worswick, M.Sc., at 6.30, on February 9th at the British Electricity Authority, 1, Whitehall Road, Leeds.

"Ignition Interference with Television Reception" by A. H. Ball and W. Nethercot at 7.15 on February 25th at the Yorkshire Electricity Board, Ferensway, Hull.

North-Western Radio Group.—"The Reproduction of Signals Recorded on Magnetic Tape" by E. D. Daniel, M.A., and P. E. Axon, M.Sc., Ph.D., at 6.30, on February 17th, at the Engineers' Club, Albert Square, Manchester.

South Midland Radio Group.—"What is an Amplifier?" by D. A. Bell, M.A., Ph.D., at 6.0, on February 22nd, at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Rugby Sub-Centre.—"Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling, M.A., and F. Williams, B.Sc., at 6.30, on February 3rd, at the Rugby College of Technology and Arts.

Southern Centre.—Faraday Lecture "Electro-Heat and Prosperity" by O. W. Humphreys, B.Sc., at 6.30, on February 18th, at the Guild Hall, Southampton.

"Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling, M.A., and F. Williams, B.Sc., at 7.30, on February 24th, at the R.A.E. Technical College, Farnborough.

Western Centre.—Faraday Lecture "Electro-Heat and Prosperity" by O. W. Humphreys, B.Sc., at 6.30, on February 1st, at Sofia Gardens Pavilion, Cardiff.

"Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling, M.A., and F. Williams, B.Sc., at 6.0, on February 8th, at the South Wales Institute of Engineers, Park Place, Cardiff.

South-Western Sub-Centre.—"Printed and Potted Electronic Circuits" by G. W. A. Dummer and D. L. Johnston, B.Sc.(Eng.), at 4.30, on February 11th, at Dowlish Ford Mills, Ilminster, Somerset.

British Institution of Radio Engineers

London Section.—"Electronics in Film Making" by W. D. Kemp and B. R. Greenhead (High Definition Films), at 6.30 on February 17th at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

Scottish Section.—"Electronics in Film Making" by W. D. Kemp and B. R. Greenhead (High Definition Films), at 7.0 on February 4th at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.

North-Western Section.—"Police Radio, Its Past, Present, and Future Possibilities" by I. Auchterlonie (Manchester City Police) at 7.0 on February 4th at the Reynold's Hall, College of Technology, Manchester.

North-Eastern Section.—"Some Aspects of Micro-Wave Aerial Design" by J. Bilbrough (Microwave Instruments), at 6.0 on February 10th at the Neville Hall, Westgate Road, Newcastle-upon-Tyne.

Merseyside Section.—"Micro-Wave Test Gear" by J. Bilbrough (Microwave Instruments), at 7.0 on February 4th at the Electricity Service Centre, Whitechapel, Liverpool, 1.

West Midlands Section.—"Applications of Electronic Techniques to the Testing of Magnetic Materials" by J. MacFarlane (Guest, Keen & Nettlefold), at 7.15 on February 23rd at the Wolverhampton & Staffordshire Technical College, Wulfruna Street, Wolverhampton.

British Sound Recording Association

London.—"Stereophonic Sound Reproduction" by J. Moir, at 7.0 on February 19th at the Royal Society of Arts, John Adam Street, London, W.C.2.

Manchester Centre.—"The Problems of Hearing" by J. E. J. John (Manchester University), at 7.30 on February 15th at the Engineers' Club, Albert Square, Manchester.

Television Society

London.—Fleming Memorial Lecture on "Colour Television" by G. G. Gouriet, B.Sc., at 7.0 on February 10th and 24th at the Royal Institution, Albemarle Street, London, W.1.

Leicester Centre.—"Modified Murphy Receiver Using 24-in G.E. Tube" by H. Fairhurst (Murphy Radio), at 7.0 on February 28th at the College of Art and Technology, The Newarke, Leicester.

Institute of Navigation

"The Requirements for Marine Pilotage" by Commander L. W. Akerman and R. F. Hansford, at 5.0 on February 19th at the Royal Geographical Society, 1, Kensington Gore, London, S.W.7.

Institution of Production Engineers

Wolverhampton.—"Electronics in Production Engineering" by D. R. Whatley, B.Sc. (Eng.), at 7.15 on February 3rd at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

Edinburgh.—"Electronics in Industry" by G. Horsfall, at 7.30 on February 17th at the North British Station Hotel, Edinburgh.

Radar Association

"Some Unsolved Radar Problems" by K. E. Harris (Cossor) at 7.30 on February 10th in the Anatomy Theatre, University College, Gower Street, London, W.1.

Institute of Practical Radio Engineers

Midlands Section.—"Ultra Television Receivers" by H. G. Trapp (Ultra), at 7.30 on February 1st at the Crown Hotel, Broad Street, Birmingham.

Radio Society of Great Britain

London.—"Practical Aspects of Tape Recording" by S. A. Lacey (Murphy Radio), at 6.30 on February 26th at the I.E.E., Savoy Place, London, W.C.2.

Electron Optics

By "CATHODE RAY"

How Electron Paths are Controlled by Electric Fields

WHAT is electron optics? Well, for one thing it is a contradiction in terms. My dictionary says that "optics" is derived from a Greek word meaning "pertaining to sight; visible." Now one of the most obvious things about electrons is that they are *not* visible. You may perhaps have read somewhere that the fluorescent screen in a cathode-ray tube is for rendering the electron stream visible, but of course that is not literally true; it is the effect of their impact that is visible, not the electrons themselves. But "electron optics" does not even mean the technique of rendering effects visible. It is often very closely connected with such technique, notably in the cathode-ray tube, but it is really quite a distinct science. Roughly it could be defined as doing with electrons much the same kinds of things as can be done with light. Such things as focusing and deflecting rays. But I would like to make it clear from the start that "optics" only comes into the title on the strength of an analogy, and what is called electron optics could quite well be practised if there were no such thing as optics or even light. The analogy between optics and electron optics is by no means perfect and can actually mislead. One might almost as well call the subject of ordinary current electricity "electron hydraulics" because there is an analogy between electric currents and water. As we shall see, optics is not the only analogy that can be used in explaining "electron optics." However, that is the name it is known by, for good or ill, so we shall just have to use it.

I suppose we had better begin by establishing the resemblance between electron optics and optics, or electron rays and light rays; and the customary starting place is the Maltese-cross experiment, described by Sir William Crookes (as he later became) in 1879. This experiment, as you probably well know, was performed with a glass vacuum tube (Fig. 1) in which "cathode rays" were produced by applying a high voltage between two electrodes. The glass of the tube fluoresced under the impact of the rays, except where it was protected from them by the anode, which cast a shadow. The anode was in the form of a Maltese cross, but as far as I can see there is no special merit in that shape; it could just as well be a silhouette of Marilyn Monroe, and in fact that would probably ensure closer attention to the demonstration; though, in that comparatively unsophisticated age, the cross seems to have made such a hit that a less picturesque demonstration of the same phenomenon no less than ten years earlier by a man named Hittorf was quite overshadowed. However it did show strikingly that what was coming from the cathode bore some resemblance to light, notably in normally travelling in straight lines and in being stopped by metal. There was, even in 1879, a strong suspicion that these rays consisted of negatively charged particles, which were later (after the suspicion had been confirmed) named electrons.

The study of light had shown that its rays can be bent ("refracted" is the scientific term) by various

means, such as lenses; and when it was found that similar things could be done with electron rays (though not by the same means) there was enough of an analogy for people to begin to talk about "electron optics," "electron lenses," and so forth. The tie-up with light was made practically unbreakable by the arrival of the electron microscope, which does the same sort of thing as a light microscope only more so. Some of the vast existing store of knowledge about optics has been used to develop electron optics, but it needs a good deal of adaptation, and much of it cannot be applied at all.

We shall probably be doing well enough if we confine this first view of electron optics to its use in cathode-ray tubes, for that is what interests most of us. In their raw state, the cathode rays would just make a splodge of light on the screen, which would be no use for anything (beyond the childish pastime of throwing electronic shadows). A prime necessity is to focus the rays to a fine point—the very words emphasize the analogy with the "burning glass." But the

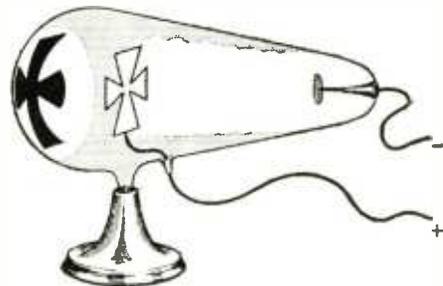


Fig. 1. The celebrated Maltese-cross experiment, by which Crookes demonstrated that cathode rays resemble light in travelling in straight lines and being stopped by metal. The cross casts a shadow on the fluorescent glow caused by the rays.

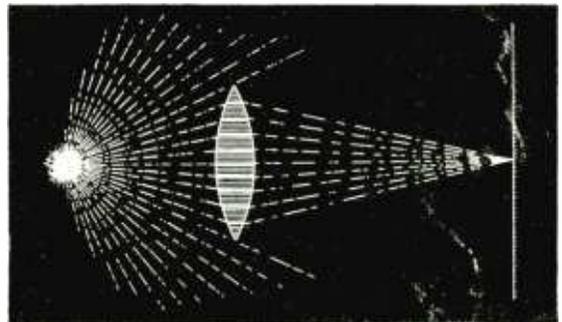


Fig. 2. Light rays can be focused on a screen by means of a glass lens, which bends the rays. Any device that does the same thing for cathode rays is called an electron lens.

resemblance is more in the results than in the means for achieving them. So I think it would be a mistake to spend a lot of time studying optics as a preliminary to electron optics, much though I would enjoy illustrating it in terms of the effects of local boggy ground on the movements of columns of troops. But I don't want to be classed with the lecturer on electricity whose students complained that they learnt a great deal from him about water in pipes but not very much about electricity. All we need, I think, is a passing glance at the probably very familiar diagram, Fig. 2, which shows a lens focusing a diffuse beam of light by bending its rays so that they all converge on the same point. The corresponding kind of electron lens is one that makes electrons do the same thing, and that is the kind we are going to consider.

Bending Electron Paths

The principle used in an optical lens for bending the rays of light is the change in speed of light when it passes from one medium to another, such as from air into glass. How are the paths of electrons bent? There are two means—electric fields and magnetic fields. So here once more we find ourselves confronted with these twin fantasies that seem so elusive and unreal and yet are the basis of everything electrical—and in fact of the whole universe. Our understanding of things electrical—including emphatically electron optics—can be no better than our understanding of fields. Unfortunately, being basic, there is nothing more basic that can be used for describing them, and in the attempt to “unscrew the inscrutable” one is almost bound to make use of imaginary things shown as lines drawn on paper. It must be remembered all the time that such things are no more than artificial aids towards apprehending something whose ultimate nature may be beyond our grasp but about whose behaviour there is no doubt.

However, let's get down to it. Most electrical people have a more or less clear picture of the workings of Ohm's law. And even though it is nearly always applied to circuit elements such as wires, where one does not have to bother much about the sideways distribution of current but only the length, it ought not to be too difficult to visualize what happens in wide conductors. (There is no need to fear another departure into “skin effect”; we shall be considering d.c. only!) Suppose we were to coat a rectangular sheet of plastic with a perfectly uniform layer of carbon, and connect a 100-V battery to opposite ends, using strips of copper to make sure that the whole width was at the same potential (Fig. 3). Then if we were to reckon the lower edge as zero potential, the top edge would be at +100 V, and the potentials in between would be proportional to the height up the strip. If we had a voltmeter that took no current at all we could quite easily check this by applying point probes to the carbon surface. We could, in fact, map out the surface with “equipotential lines,” as shown dotted. But in this simple case we can easily fix their positions theoretically by Ohm's law.

We might also draw another kind of dotted line to show the directions in which the current would flow as a result of this potential pattern. The current, of course, consists of free electrons in the carbon, and they take the shortest route towards a more positive potential. Or, more correctly, what appears at the moment to be the shortest route. Like J. H. Newman, they say “I do not ask to see the distant scene; one

step enough for me.” And what appears to the short-sighted electron to be the shortest route is *always at right angles to the equipotential lines*. Fig. 4 is an enlarged view of a bit of Fig. 3, and it must be obvious that a stationary electron at A will take the shortest route to the higher potential, viz., along AB, and, of course, that shortest route is at right angles to the dotted lines. Any other route would necessitate sideways movement, and that could not take place without a sideways attraction, and if there were any sideways attraction, the potential pattern could not be as shown.

With such a simple set-up as Fig. 3 one could hardly go wrong. The equipotential lines and the lines of electric force (for that is what the electron paths are called) together make a sort of squared-paper pattern. But what happens when the short view and the long view disagree; that is to say, when the equipotential lines are not parallel to one another. Suppose the carbon sheet had the shape shown in Fig 5. A zero-potential electron at A, if it were far-sighted, would see that the nearest maximum-potential point was B and would make straight for it along the chain-dotted line. But this would mean that during the first stage of the journey it would *not* be taking the shortest route between 0 V and +10 V. The electron can only respond to the direction of the attractive force where it actually happens to be at the moment, and that force is beckoning not from the +100-V line, nor the +10-V equipotential line (which is visibly out of parallel with the 0-V “starting grid”), nor even the +1-V line, but from a line so close in front as to be practically parallel to the 0-V line; and so the electron moves off at right angles to that line. But as it progresses the increasing inclination of the equipotentials bends its path around, so that when complete it is the curve leading to B'.

Potential Gradients

Does that mean that there will be just as much current flowing along the outer edge of this wide track as along the shorter inner path? Certainly not, if Ohm's law is true, for the total voltage is the same for every path, whereas the resistance is proportional to the length of the path. So the current density is greatest on the inside and decreases towards the outer edge in the same proportion as the distance increases. (The current density along a surface is the amount of current per small unit of width.) Another way of putting it is to say that the current density increases with the closeness of the equipotential lines. One advantage of this way is that if one knows anything at all about contour maps a very pretty analogy fairly leaps to the mind. Contour lines, of course, are lines

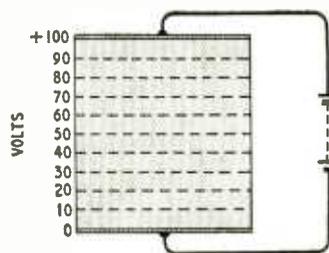


Fig. 3. Equipotential lines (dotted) of electric field along a uniformly conducting strip having a difference of potential between the ends.

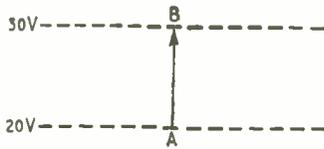


Fig. 4. An electron starting from rest at A tends to take the shortest path to a more positive potential, and in doing so always moves along the line of force and at right angles to the equipotential line passing through its position.

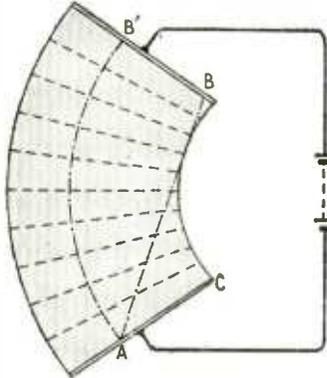


Fig. 5. When the equipotential lines are, as here, not parallel to one another, the electron does not take the shortest route (AB) to the highest potential. It still tends to keep at right angles to its own equipotential line, which means a curved path (AB').

joining all points at the same height above sea level, so they might be called equi-height lines; and since electrical potential is often likened to height the analogy is obvious. A steep gradient is revealed on the map by the contour lines being close together. The steeper the gradient the stronger the pull of gravity along the surface. That pull always acts at right angles to the contour lines; one might say that the lines of gravitational force are at right angles to the equi-height lines. Fig. 5 can now be regarded as a plan diagram of a spiral stairway, except that instead of steps we must imagine a smooth slope, to correspond with the smoothly continuous change of electrical potential along the carbon strip. If the slope is downwards from A, a marble released there does not roll straight to B; it cannot see, so it does not know anything about B, all it knows about is the slope where it actually is, at A, and that slope is at right angles to CA, so it starts off on the AB' curve, just like the electron in the carbon strip. Will it then, like the electron, follow that line all the way to B?

You have only to try it—or perhaps even imagine it—to realize that it will not. Because the slope is smooth, the marble gains speed, and the direction of its movement is then determined not only by the direction of the slope but also by the direction in which it was moving when it reached that slope. The marble always tends to go straight on, and cannot respond immediately and fully to a change in direction of slope. The faster it is going the less readily it responds.

The electron in the carbon conductor can be likened to a marble rolling down a slope thickly studded with pins, rather like a Corinthian bagatelle

board but with no permanent stops. Every time it hits a pin its journey is interrupted and it has to start afresh, so its speed is no greater at the end than at the beginning. Its average speed is so low that its movement is controlled almost entirely by the slope, and when the slope stops the marble stops. Similarly the electron in the carbon is constantly bumping into carbon molecules, and so is kept down to a constant average speed, which as we saw last month is very low. It continues to move only so long as it is on a potential slope. If the strip in Fig. 3 were extended beyond the 100-V terminal into a sort of blind alley, would they go on into it? Not they!

Introducing Free Electrons

But what we are supposed to be studying is the movement of electrons that are *not* hindered by resistance. So our carbon conductor, although it may serve as an introduction to electric field and equipotential lines, is actually a complication. If we throw it out of Fig. 3, leaving only the battery and copper electrodes, the potential pattern remains. The space between the electrodes is still occupied by an electric field, and any free electrons there are attracted along nearly the same lines of force as before. The trouble is that there aren't any free electrons there. So we have to introduce some. A convenient way of doing this is to coat the negative electrode (i.e., the cathode) with a suitable material such as barium oxide, and heat it. Electrons then boil off, but their space trip is complicated by encounters with air molecules, so to give them a clear run it is necessary to put the electrodes in a glass bulb and pump the air out. Then, at last, the electrons can really display their own simple nature, which is (as Newton saw long before electrons were thought of) to remain in a state of rest or uniform motion in a straight line unless acted upon by external forces, and to accelerate in proportion to any acting force. The particular force we are concerned with just now is the electric field.

In the carbon or any other resistance the electron speed is very limited because it gives rise to a kind of frictional force that neutralizes the force of the electric field, and directly it is fast enough to do so exactly there is no net force and the electron continues uniformly at that speed, in accordance with Newton's first law. But in the clear vacuum it continues to gain speed, like the marble, as long as it is falling down a potential gradient.* As we saw last month, the speed it gets up depends only on the voltage it "falls" through, and if that voltage is denoted by V the speed reached from a standing start is $593\sqrt{V}$ kilometres per second, which is $368\sqrt{V}$ miles per second. The analogy with marbles rolling down frictionless slopes holds good, for the speed they acquire in losing height to the extent of h feet is $8\sqrt{h}$ feet per second, regardless of whether the slope is gradual or precipitous; and when they have acquired it they continue at that speed indefinitely on the level. But whereas in practice friction always interferes with rolling balls (otherwise the game of bowls would be unplayable) our electrons in a vacuum really do keep on accelerating so long as the voltage is rising, and in a constant-potential region they keep up the speed and direction with which they entered it. (They are

* It may be necessary to remind ourselves that because an electron is negative a downward gradient to it is one that becomes increasingly positive. Any confusion in the fact that a "rising" potential is (from the electron's point of view) a downward slope is the fault of whoever persuaded everybody to call the electron-attracting end "positive."

so light that the force of gravity on them can be neglected.) The only restriction on their speed is that when they have accelerated through about 10,000 volts (to 59,300 kilometres per second) their increase of mass due to "relativity" begins to become appreciable, and this makes the speed curve flatten off to an absolute limit of 299,792 km/sec, which would be reached if the voltage were infinite. But even in modern high-voltage cathode-ray tubes the relativity correction is quite small, so we shall not bother about it here.

Steering the Electrons

We can sum up our knowledge of electron optics so far by saying that we know how many volts we need to accelerate electrons to any desired speed (up to about 40,000 miles/sec, anyway!), and having got them up to speed can keep them going in a straight line at that speed, simply by arranging for their route to be at a constant potential. Presumably also we can retard them as desired, using a negative voltage; for retardation is just negative acceleration. But all that is not enough to gain us an electron-driver's licence. We must now tackle the much more difficult problem of steering. Unlike electrons in wires, those in space are not "vehicles steered by their own tracks." Nor is it enough to lay down lines of electric force in the required directions (though that may seem difficult enough, seeing they are imaginary!) because there can be no lines of force without change of potential, and change of potential causes change of speed, and the quickness of response to changes in direction of the lines of force depends on the speed. It is no more use expecting a high-speed electron to follow a sharp bend in a line of force than it is to expect a car to get round a sharp corner at 80 m.p.h.

But let us get back to our marbles. Suppose we release a gentle cascade of them from the top of a long straight ridge, AB in Fig. 6. If the contour lines of the slope were parallel to AB all the way down, the lines of gravitational force would run at right angles to AB and parallel to one another, and the cascade of marbles, though gaining speed, would continue to spread thinly over the whole width. But hollowing the slope out, as shown by the curving inwards of the contour lines CD etc., would make the lines of force converge. If the marbles followed these lines exactly (as they would were it not for their momentum) they would take the paths at right angles to the contour lines as shown, and converge into a raging torrent of marbles at P. Note that it would not be necessary to continue the slope all the way to P; provided that the marbles were going in the right directions by the time they reached the line KL the ground from there on could be perfectly flat.

Near the start, before the marbles had time to get up much speed, their actual paths would follow the lines of force fairly closely; but as they gained momentum they would respond less and less to the inward curvature of the slope. So it would seem to be a good idea to do the focusing as near the start as possible; partly because least curvature would be needed, and partly because the marble tracks could be predicted the most accurately from the lines of gravitational force, which can be plotted by means of a simple slope-indicating device or arrived at from the contour lines. But of course one would not really care to leave the matter quite so vague as this; what exactly is the principle determining the actual paths taken by the marbles?

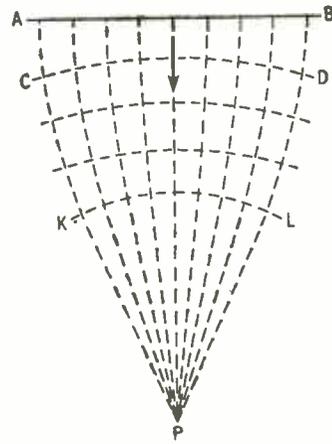


Fig. 6. Contour lines (CD, etc., to KL) of a hollow downward slope that would make marbles released along AB converge towards P. If their directions are correct by the time they reach KL the rest of the run can be flat, as shown by absence of further contour lines.

Well, this is really a matter of mechanics, and if that is a totally unknown subject it is a little late to give a full course on it here and now. But I suppose most *Wireless World* readers are sufficiently knowledgeable to need only an outline, at most. Suppose then that A in Fig. 7 is the position of a marble—or electron—which is travelling with a known velocity in the direction AB. If there were no other influence it would arrive at B after a certain interval of time. But suppose that a certain gravitational—or electric—field is acting in the direction AC. This force can be resolved in the usual way into one force acting along AB and another at right angles to it, along DC. The marble—or electron—is therefore accelerated in both of these directions in proportion to the separate forces. If the length AC represents the combined force the component forces are represented by AD and DC. The acceleration in any direction is equal to the mass of the marble—or electron—multiplied by the force acting in that direction. So the effect of the force here is to increase the velocity along AB so that the position in that direction after the interval of time is not B but E, and the right-angles acceleration has meanwhile carried it a distance EF, so the actual position is F. By plotting the position after different intervals of time, its track can be found—the dotted curve. All this may sound rather complicated, but such tracks are familiar from our earliest youth, for a ball thrown into the air is a body with an initial velocity in an arbitrary direction, combined with a steady acceleration (downwards). The faster the ball is thrown horizontally, the less is its curvature downwards and the longer it takes to come into line with the gravitational lines of force.

Designing the Electrodes

Given a field pattern, the foregoing principles can be used to calculate the track of an electron from any point in it. But that is not quite the problem; usually one is given the desired electron tracks and wants to find the arrangement of electrodes and voltages that will provide the field pattern that will produce those tracks. And that is quite a different matter. It is

usually solved by a combination of calculation, intelligent guesswork, and experiment.

The first stage is to find the field patterns between various electrodes. For a few specified configurations they can be calculated mathematically; some fairly easily, others not so easily. Usually the easier they are to calculate the less likely they are to be directly useful in practical c.r. tube design. It is not very helpful, for example, to have to accept a proviso that the electrodes are infinitely large, or that there is nowhere for connecting the sources of p.d. Even a pair of parallel plates does not provide a simple rectangular field pattern, unless the plates are infinitely large; with finite plates the lines barrel out at the edges, something like Fig. 8. We can easily guess, however, that one way to obtain a converging or diverging pattern is to make one electrode smaller than the other, as in Fig. 9. Note that the potential changes more rapidly where the lines of force are close together. This is what one would expect by analogy with the carbon sheet; if the lower electrode in Fig. 3 were made smaller than the upper, the greater current density near it would cause a greater voltage drop per inch there than near the wider electrode. As we have already noted, one could actually use a uniform carbon sheet to plot field patterns experimentally, by placing electrodes on it—preferably lead, so that they could easily be bent into different shapes—and plotting the potentials with a pointed probe and “infinite-input-impedance” voltmeter; but to simulate infinite space the sheet would have to be much larger than the inter-electrode space. Another and better method is to use a tank of liquid instead of the carbon.

Final Adjustments

Having found the field pattern around the electrodes being studied, one can make a slope model with contour lines coinciding with the equipotentials, and try rolling marbles down it, or, better still, ball-bearing balls. This shows the tracks of electrons, and gives some idea of how the electrodes should be modified to get nearer the desired result. Alternatively, there are graphical methods of plotting the electron tracks on the field patterns, and even more or less automatic apparatus for plotting them direct from the electrolytic tank.

Fortunately a good focus does not depend on the electrode system having been manufactured dead right in the first place. Electron lenses are, so to speak, flexible, like the little optical lenses forming the fronts of our eyeballs, which change shape without conscious effort when changing our distance of looking. The

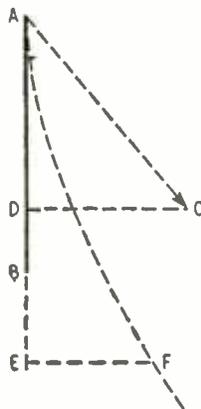


Fig. 7. How to find the net result of constant speed along AB and constant acceleration along AC.

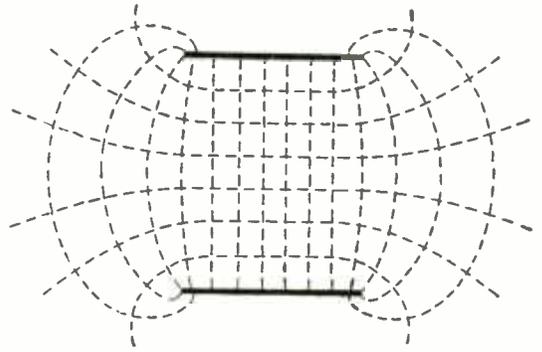


Fig. 8. Pattern of lines of electric force and equipotential lines between and around a pair of parallel charged plates.

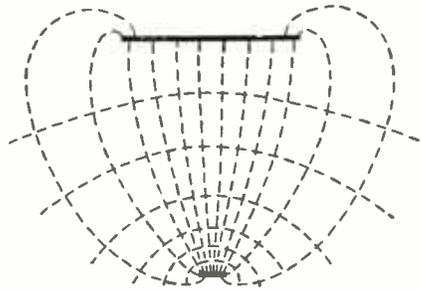


Fig. 9. The pattern when one plate is relatively small.

focus of electric lenses can be varied within considerable limits by adjusting the voltages applied to the electrodes.

Obviously the plate kind of electrode we have been thinking about is not likely to be much good in an electron lens, however useful it may be in a valve; nor is the grid kind, because it stops some of the electrons altogether and on those that get through it imprints a pattern of its mesh. Most of the electrodes forming lenses in electrostatically focused c.r. tubes are hollow cylinders, rings, or disks with holes in the middle.

Rolling-Ball Analogy

Time is just about up, and we have not yet looked at any examples of electric lenses, still less the more difficult subject of magnetic focusing. They will have to wait till next month.

In the meantime, to stop anybody writing in to complain that I am deluding the proletariat by giving the impression that the analogy between rolling balls and flying electrons is perfect, I would mention that whereas the electric force on an electron is inversely proportional to the distance between equipotential lines, the gravitational force on a ball is inversely proportional to the distance *along the slope* between the contours, not the horizontal distance shown on the contour plan. But provided the gradient does not exceed 1 in 7 the difference is less than 1%. There is also a discrepancy due to the fact that rolling balls roll and thereby acquire some rotational energy, but this also makes little difference.*

* "Determination of Electron Motion in Two-Dimensional Electrostatic Fields," F. H. J. A. Kleynen, *Philips Technical Review*, 1937, p. 338.

Magnetic Tape Recording

Problems of Standardization : Accidental Printing Phenomena

EXCELLENT as are the results obtained with magnetic tape as a medium for high-quality reproduction of sound, it is nevertheless liable to irregularities and inconsistencies which assume importance when attempts are made to measure and standardize a recording characteristic—which is necessary when tapes have to be exchanged between broadcasting organizations.

A systematic study has been undertaken by the B.B.C. and an outline of some of the results was given in a recent lecture to the British Sound Recording Association, "Problems of Magnetic Tape Reproduction," by P. E. Axon, M.Sc., Ph.D. One of the main difficulties is that the surface intensity of magnetization on the tape can be measured only indirectly, and that the flux is modified by association with the reluctance of the magnetic core used in the normal type of pick-up head. This manifests itself in discrepancies between the slopes of curves taken with short and long gaps—even after allowance has been made for variations of eddy-current losses with frequency.

Better agreement is found when a non-magnetic single-turn head is used for calibration. This consists of a thin strip of copper foil between ebonite clamps mounted edge-on to the tape and supplied with thicker soldered leads at the ends. A series of minima appear when the thickness of the conductor equals an integral number of wavelengths, but unlike the magnetic head the "effective" gap is equal to the physical thickness of the conductor, and the frequencies of the minima are all harmonically related.

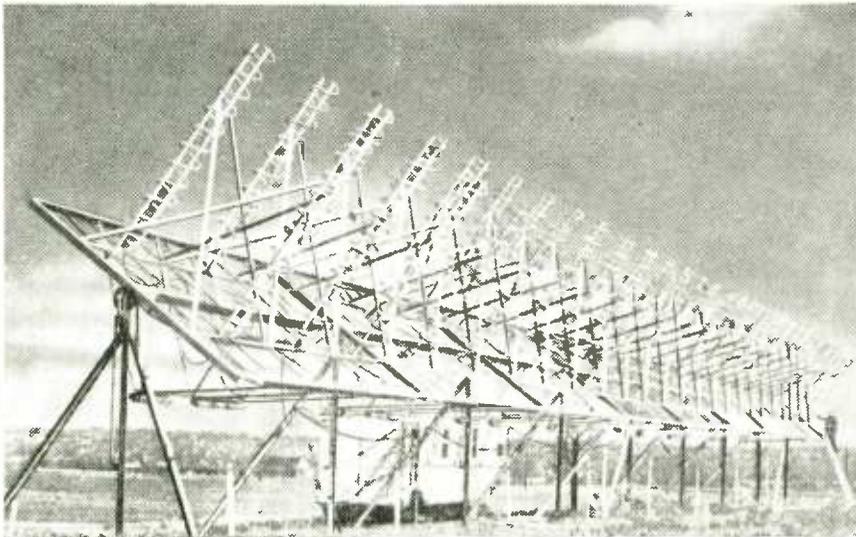
The virtue of the single-turn head is that with it a tape can be recorded and calibrated with a surface induction rising exactly at the theoretical rate of 6 db/octave, and this standard tape can be used

subsequently to calibrate existing iron-cored heads.

Intimate contact between tape and head is of great importance in all calibration work, and both the tape and the head in the region of the gap must have a smooth surface finish if consistent measurements are to be made. It has been calculated that the loss due to separation is about 55 db per wavelength (λ) of the recorded frequency. At 7½ in/sec and 7.5 kc/s, $\lambda = 0.001$ in, and a separation between tape and head of only a tenth of this distance gives a drop in signal strength of nearly 6 db. Under normal recording conditions such irregularities manifest themselves as amplitude modulation noise.

Mr. Axon also discussed the phenomenon of accidental printing, and showed that the print level between adjacent layers could increase nearly 10 db after a rise of temperature of 10 C lasting only 5 minutes. Other factors known to affect printing are external magnetic fields and the physical tension of the tape during spooling.

Fortunately, accidental prints, made without h.f. bias, were less stable than the master signal and showed a tendency to decrease rapidly over a period of minutes from the instant of separation. The stability of the print increases with the duration of contact before separation, and all effects which tend to increase the printing level also increase its stability. Provided that the accidental print is not too deeply established, successful differential erasure between the wanted and unwanted signals is possible, using a weak h.f. field in the erasing head. This may even force the print below the noise level of the system, without reducing the main recording more than a few db. It is always worth while to re-spool immediately before replaying and at intervals during the storage life of the tape.



RADIO TELESCOPE

THIS broadside array of 48 helical beam aerials mounted on a pivoted earth screen has been built by the Ohio State University, U.S.A., for studying celestial radio sources. It has a beam width of only 1.2 degrees at 250 Mc/s. Each helix has 10 turns and is 10ft long by 15in in diameter. Receiving equipment is in the van underneath.

(Photo: Courtesy Electronics)

Megawatt Transmitter

*Dependable World-wide Communication
on Very Low Frequency*

A GIANT radio transmitter which has taken six years to build was recently handed over by the Radio Corporation of America to the United States Navy. It was conceived with the idea of providing dependable communication with U.S. Fleet units in any part of the world at any time of the day or night and under all atmospheric conditions.

This requirement is best fulfilled by a powerful, very low frequency transmitter, as such frequencies are far less dependent on changeable wave propagation conditions than any of the frequencies normally used for long-range communications. If the power is great enough and the wavelength long enough signals will penetrate to arctic and tropical outposts and to submerged submarines, despite magnetic storms and ionospheric disturbances of the worst kind.

Special Valve

This transmitter is designed for operation on frequencies between 14.5 and 35 kc/s and is capable of a maximum power output of 1,200 kW. It consists of two nominal 500-kW units operating in parallel and arranged so that each can be used independently if required. The transmitters were designed around the special RCA Type 5831 high-vacuum transmitting triode. Each of the two r.f. amplifier units employs three of these valves, two in a push-pull circuit with the third as spare. The valves measure 10 in in diameter and $38\frac{1}{2}$ in high, weigh 135 lb and are water cooled. The six-volt filament structure of thoriated tungsten requires 13 kW. Each valve needs 500 watts of grid driving power for 285 watts output at 80% anode efficiency with an anode voltage of 11.5 kV.

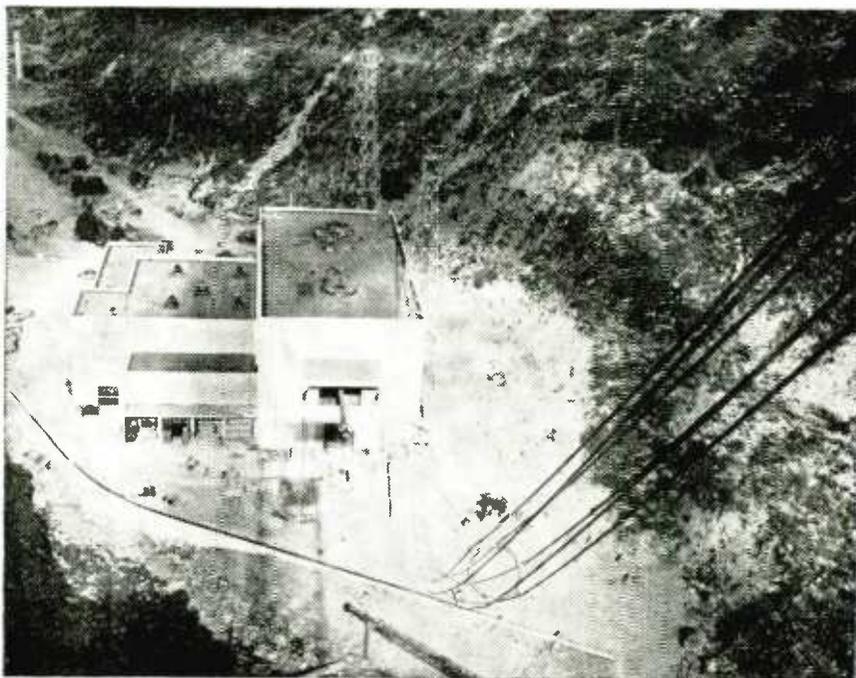
The design and erection of the aerial system constituted a gigantic task. The site chosen was the Jim Creek Valley, situated in rough country some 55 miles north east of Seattle. The station lies in a valley at the foot of twin 3,000-ft mountain peaks from which is suspended an impressive aerial system.

Prior to the erection of the aerial thousands of trees were felled on the valley slopes to facilitate rigging work and eliminate possibilities of forest fires. Most important of all, however, was the necessity to improve the transmitter efficiency as trees tend to absorb large amounts of r.f. energy radiated by nearby aerials.

The actual aerial consists of ten trans-valley spans each over a mile in length and forming a zig-zag pattern high above the floor of the valley. Twelve 200-ft steel towers erected along the crests of the twin mountains support the aerial. Owing to the tapering nature of the valley the spans are of unequal length; the longest measures 8,700 ft and the shortest 5,640 ft.

Like the transmitter, the aerial system is divided into two parts, each independent of, and isolated from, the other. This arrangement makes it possible to operate one-half of the transmitter and one-half of the aerial system in the event of repairs being required to the other halves.

With an aerial at such a great height there is a marked tendency to pick up static electricity from the air and if left unearthed for any time voltages can build up to a point where sparks a foot or so long will jump gaps in the system. As a safety measure the system is kept securely earthed when not employed for transmission. More than 200 miles of copper wires, cables and screens are buried in an intricate pattern across the valley floor to provide an efficient "earth."



Bird's eye view through steel framework of 200-ft summit ridge tower shows transmitter building in a valley between 3,000-ft mountain peaks.

Wide-Band I.F. Amplifiers

*Design Technique Using
Negative Feedback*

By H. S. JEWITT,* B.Sc. (Eng.)

IN many electronic systems using pulses the trend at present is towards the use of shorter pulses, and pulse lengths of 0.1 microsecond and less are now common in the radar field. This development has necessitated the design of intermediate frequency amplifiers of large bandwidths, so that the reproduction of such short pulses will not be degraded. Bandwidths (to the -3db points on the response curve) for amplifiers are now commonly greater than 10 Mc/s, and the problem of achieving wide bandwidth and higher gain, yet producing an amplifier which is an economic possibility to manufacture, is very real and pressing. On the one hand the designer must use a large number of valves and tuned circuits to obtain the required gain and bandwidth; on the other, he is pressed to design his amplifier in such a way that it is easy to manufacture and maintain in service.

There are two methods of obtaining wide bandwidths in common use, one utilizing transformers as the tuned elements and the other frequency-staggered circuits. Both of these give satisfactory results as far as obtaining the necessary gain and bandwidth is concerned, but both tend to give difficulty in manufacture and service. These difficulties arise from one major cause, which is the tolerances to be expected on the parameters of the valves used. The difficulty is that

an i.f. amplifier may be aligned with a given set of valves before it leaves the laboratory or factory to be put into service: if a valve fails in service and has to be replaced it is only too probable that the alignment process will then have to be repeated to restore the original bandwidth, as the capacitances of the new valve will differ from those of the old one. Alignment in the field is not easy on wide-band amplifiers: in the transformer-coupled case the difficulty of adjusting the inductances of the two windings and the coupling factor between them is considerable; in the staggered amplifier the frequencies of individual circuits and their damping resistors need adjustment.

In assessing the value of any particular circuit configuration the desirability of "pre-plumbing" must not be overlooked. By this term is meant the manufacture of the amplifier from components of reasonable tolerance without provision for any aligning: the amplifier when fitted with valves from stock should then give the required performance within the permissible limits. Clearly, if this can be achieved valve-changing in service will no longer be a problem.

A means of obtaining wide bandwidths in i.f. amplifiers which has been known for a considerable time, but which appears to have been somewhat neglected in comparison with those noted above, is the application of negative feedback. That the use

* Decca Radar.

TABLE 1: COMPONENT VALUES FOR FEEDBACK PAIRS

B = -3 db bandwidth of response curve
 C = Total capacitance = $C_{in} + C_{out} + C_{strays}$
 g_m = Valve mutual conductance
 from which $R_T = \frac{1}{2\pi CB}$ = effective damping required
 and $G = g_m R_T$ = approximate gain per stage
 K = Shape coefficient

	FIGURE 1		FIGURE 2	
	$R_1 (= R_3)$	R_2	$R_4 (= R_6)$	R_5
General Case $2 > K > -2$	$\frac{4GR_T}{2(\sqrt{2+K})G - (2-K)}$	$\frac{4GR_T}{2-K}$	$\frac{4GR_T}{2-K + 2(\sqrt{2+K})G}$	$\frac{4GR_T(2-K)}{4G^2(2+K) - (2-K)^2}$
Special Cases $K = 0$ (flat pair)	$\frac{2GR_T}{\sqrt{2G} - 1}$	$2GR_1$	$\frac{2GR_T}{1 + \sqrt{2G}}$	$\frac{2GR_T}{2G^2 - 1}$
$K = -1$ (pair in flat triple)	$\frac{4GR_T}{2G - 3}$	$\frac{4GR_T}{3}$	$\frac{4GR_T}{3 + 2G}$	$\frac{12GR_T}{4G^2 - 9}$
$K = +\sqrt{2}$ (pairs in flat quadruple)	$\frac{4GR_T}{3.7G - 0.58}$	$6.9GR_T$	$\frac{4GR_T}{0.58 - 3.7G}$	$\frac{2.32 GR_T}{13.7G^2 - 0.335}$
$K = -\sqrt{2}$	$\frac{4GR_1}{1.52G - 3.42}$	$1.17GR_T$	$\frac{4GR_T}{3.42 + 1.52G}$	$\frac{13.7GR_T}{2.32G^2 - 11.6}$

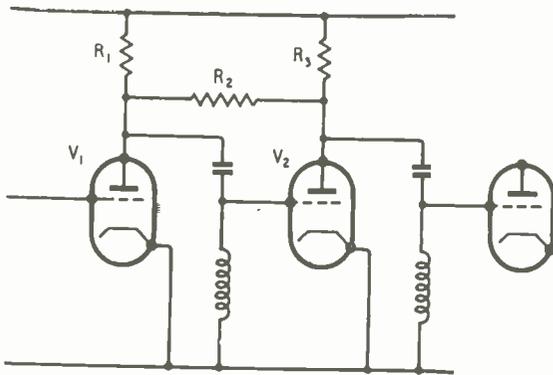


Fig. 1. Simple negative feedback amplifier with feedback applied through R_2 .

of negative feedback will broaden the response curve of an amplifier is immediately apparent from consideration of the effect of the feedback. If all stages of the amplifier are tuned to the same frequency (the centre i.f.), then the feedback will be strongest at this frequency. Provided that the feedback circuit is not frequency-sensitive, the feedback will decrease on each side of centre frequency, thus increasing the response at off-centre frequencies. The shape of the resultant response curve depends upon the degree of feedback used: for small amounts of feedback the curve will exhibit one peak at centre-frequency, but as the feedback is increased the curve will become first flat-topped and then double-humped, with humps spaced equally about the centre frequency.

The original conception of this method appears to have been a chain of amplifier stages, over each of which the feedback was applied, but this has been simplified to the application of feedback over alternate stages. Thus the amplifier is divided up into a series of pairs of valves, the first valve of each pair operating without, the second valve with, feedback. It will be seen, then, that this type of amplifier will produce the flat-topped response curve usually associated with the staggered pair or transformer-coupled amplifier. It will be shown that the flatter, steeper-sided curves given by staggered triples, quadruples and so on can also be produced.

The feedback amplifier has been analysed mathematically,[†] and Table I, which is a simplification of the results of this analysis, gives the required component values for the circuit with a minimum of computation. The expressions are accurate enough for normal design processes. It should be particularly noted that the shape and width of the response curve and the gain of the amplifier are governed solely by the relative values of the resistors whose values are given. In comparison with the two other methods mentioned above, the use of single-tuned circuits eliminates the difficulties of the i.f. transformer, and since these circuits are all tuned to the centre i.f. there are no problems of accurate maintaining of stagger frequencies or different Q-factors in individual circuits.

The simple feedback pair of Fig. 1 shows how the feedback is applied. V_1 and V_2 are the valves forming the pair, R_1 and R_3 being their respective anode loads. The resistor R_2 is for applying feedback across V_2 . From the practical point of view this circuit has dis-

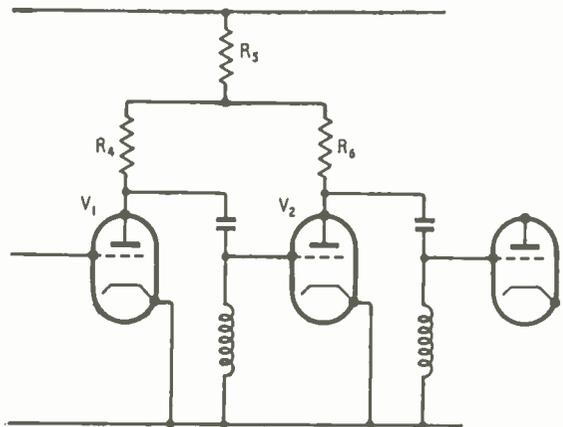


Fig. 2. Modified version of Fig. 1, giving more symmetrical response curve.

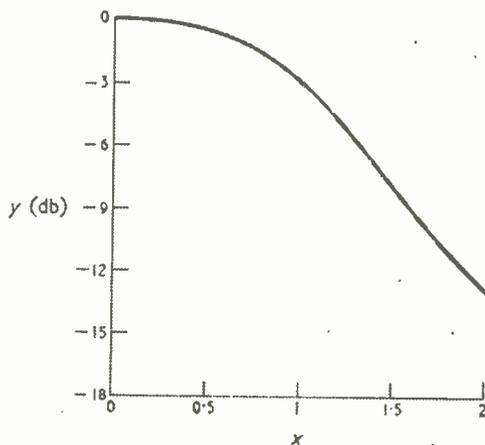


Fig. 3. Flat pair response curve. Only one half is shown as the curve is symmetrical about $x = 0$.

advantages, however. It was noted above that the feedback circuit should not be frequency-sensitive; if this condition does not hold the feedback will be greater on one side of centre frequency than on the other, and the resultant response curve will be tilted instead of being symmetrical about the i.f. Returning to Fig. 1, the resistor R_2 possesses self-capacitance (of the order 0.5 pF) which causes such a tilt; in addition the anode-grid capacitance of V_2 is in parallel with the feedback resistor, which increases the tilt.

The resistor network R_1, R_2, R_3 of Fig. 1 may be replaced by its T-equivalent, producing the circuit of Fig. 2. In this circuit the feedback is produced by the voltage drop across R_5 due to anode current in V_2 , R_5 being common to the anode circuits of both valves. Now the effect of capacitance across R_5 will be to reduce its apparent value, and hence the feedback, at higher frequencies, so that the output of the amplifier will increase above centre frequency. The effect of the anode-grid capacitance of V_2 is to reduce the feedback at lower frequencies and increase the response below centre frequency. Thus the effects of these unavoidable but unwanted capacitances tend to cancel each other. Cancellation may be made complete by

[†] "Vacuum Tube Amplifiers" by Valley and Wallman, Chapter 6. (M.I.T. Radiation Laboratory Series, Vol. 18), McGraw Hill.

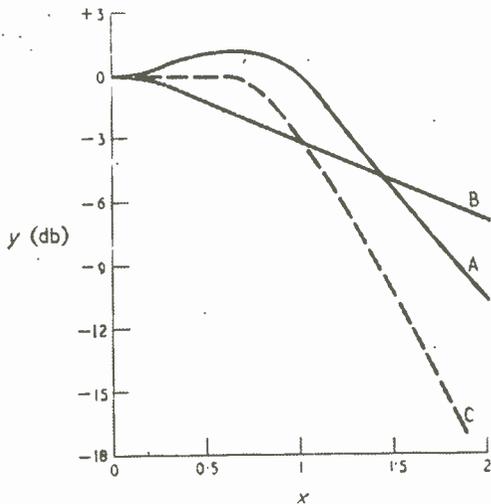


Fig. 4. Synthesis of flat-topped curve (C) associated with staggered or feedback triples.

increasing one or the other capacitance as indicated by the response curve tilt, and a symmetrical response curve may thus be obtained.

It was stated above that a wide variety of response curves can be produced according to the relative values of the resistors. One such curve is the flat-topped curve usually associated with the staggered pair, the mathematical expression of which is

$$y = \frac{1}{\sqrt{1+x^2}}$$

where x represents frequency difference from centre frequency and y is the relative amplitude at the frequency considered (x). Clearly, $y = 1$ at centre frequency ($x = 0$), and where $x = \pm 1$, $y = \frac{1}{\sqrt{2}}$. In

other words, $x = \pm 1$ gives the -3 db points on the response curve and hence the bandwidth. This curve is shown on Fig. 3. The feedback pair to produce it has been found to be very non-critical and may be easily pre-plumbed. Slight staggering of the tuned circuit frequencies (due, for instance, to valve capacitance variation) has little effect on the response curve beyond broadening it.

To produce other curves of the flat-topped form a process of synthesis must be used, as is done with staggered circuits. The difference between the two types of circuit in this respect lies in the fact that a feedback pair, correctly designed, will generate a double-humped response curve with its circuits all tuned to the same frequency, whereas in the staggered system one circuit must be tuned to each side of centre frequency and appropriately damped to produce such a curve. The idea of synthesizing a flat-topped curve from two curves which are not flat-topped may be better understood from Fig. 4. This diagram illustrates the synthesis of the flat-topped curve associated with staggered triples or feedback triples. Three circuits are used (hence "triple"): two, in a feedback pair, give curve A, while the other circuit on its own gives curve B. These circuits are cascaded, and the resultant overall response may therefore be obtained by adding the two curves (a decibel scale

being used for relative amplitudes). Curve A is slightly double-humped, the rise each side of centre frequency boosting the falling response of curve B. The result of the addition is the flat-topped curve C, which, if compared with the flat pair curve of Fig. 3, shows flatness over a wider range together with steeper sides. The first characteristic, flatness, is generally the desired one in this application, as several such circuits may have to be cascaded to obtain the necessary overall gain. Each additional circuit added will narrow the overall bandwidth, but the bandwidth narrowing will be less for the curve with the wider flat top. The mathematical expression for the triple curve is

$$y = \frac{1}{\sqrt{1+x^6}}$$

and $x = \pm 1$ again gives the -3 db bandwidth.

In general, any curve of the form

$$y = \frac{1}{\sqrt{1+x^{2n}}}$$

may be synthesized, and n indicates the number of stages required in the synthesis. The general expression for the response curve of a feedback pair is

$$y = \frac{1}{\sqrt{1+Kx^2+x^4}}$$

in which x and y have significance as before.

The constant K , which may be called the "shape coefficient," determines the form of the response curve obtained. One case already discussed, that of the flat pair, is seen to correspond to $K = 0$ when the above expression reduces to that for the flat pair curve. Other values of K will give different forms of response curve: K can lie between $+2$ and -2 . The value $K = 2$ corresponds to no feedback. Such a pair is identical with two single-tuned stages on the same frequency and should give the same response curve. Mathematically, this may be checked by substituting $+2$ for K and observing that

$$\frac{1}{\sqrt{1+2x^2+x^4}} = \frac{1}{\sqrt{1+x^2}\sqrt{1+x^2}}$$

and that $y = \frac{1}{\sqrt{1+x^2}}$ is the equation describing the

single-tuned circuit response curve. Negative values of K give a double-humped curve: positive values give a single-peaked response. The value of shape coefficient for the synthesis of other flat-topped curves may be easily found. The expression for the desired flat-topped curve is first set down, for example

$$y = \frac{1}{\sqrt{1+x^6}} \text{ for a flat quadruple.}$$

Now, the general expression, with shape coefficients K_1, K_2 , etc., may be used to build up the desired equation:

$$\frac{1}{\sqrt{1+x^6}} = \frac{1}{\sqrt{1+K_1x^2+x^4}} \times \frac{1}{\sqrt{1+K_2x^2+x^4}}$$

In this case only two pairs are needed because the final term of the right side of the equation is x^8 , as required on the left side. By multiplying the terms on the right side together, we obtain:

$$1+x^6 = 1 + (K_1+K_2)x^2 + (2+K_1K_2)x^4 + (K_1+K_2)x^6 + x^8$$

The left side contains no terms in x^2, x^4 and x^6 , so

that the coefficients of these terms must be zero, and hence

$$\begin{aligned} K_1 + K_2 &= 0 \\ 2 + K_1 K_2 &= 0 \end{aligned}$$

and from these equations $K_1 = +\sqrt{2}$, and $K_2 = -\sqrt{2}$. Therefore a flat-topped quadruple curve will be produced if two pairs are cascaded, one having shape coefficient $+\sqrt{2}$, the other $-\sqrt{2}$. Fig. 5 shows these two curves and the resultant curve. Similarly, curve C of Fig. 4, the curve of a triple, is generated by putting the equation of the triple curve

$$y = \frac{1}{\sqrt{1+x^6}} = \frac{1}{\sqrt{1+K_1x^2+x^4}} \times \frac{1}{\sqrt{1+x^2}}$$

and, following the same process, finding that $K_1 = -1$ so that the triple is built up from a pair with shape coefficient -1 and a single-tuned stage of the desired bandwidth.

Table I gives component values for certain commonly used values of shape coefficient, and enables flat feedback pairs, triples or quadruples to be quickly designed. For other curve shapes, the first line gives the general values of the components in terms of the shape coefficient K . As an example of the use of this table, the design of a typical amplifier may be carried out thus:

Bandwidth (to -3db) required (B) = 10 Mc/s.

Total parallel capacitance present = $C_{in}(V_2) + C_{out}(V_1) + C_{strays}(C) = 15\text{pF}$.

Valve mutual conductance (g_m) = 7 mA/V.

Curve shape decided to be flat quadruple form, using circuit of Fig. 2.

From the above

$$R_T = \frac{1}{2\pi CB} = \frac{10^6}{2\pi \times 15 \times 10} \text{ ohms} = 1060 \text{ ohms}$$

and $G = g_m R_T = 7 \times 1.06 = 7.4 = 17\text{dB}$

Since the curve is to be of flat quadruple shape,

$K_1 = +\sqrt{2}$, $K_2 = -\sqrt{2}$.

First Pair ($K_1 = +\sqrt{2}$)

$$R_4 = R_6 = \frac{4GR_T}{0.58 + 3.7G} = 1120 \text{ ohms}$$

$$R_5 = \frac{2.32GR_T}{13.7G^2 - 0.335} = 24 \text{ ohms}$$

Second Pair ($K_2 = -\sqrt{2}$)

$$R_4 = R_6 = \frac{4GR_T}{3.42 + 1.52G} = 2140 \text{ ohms}$$

$$R_5 = \frac{13.7GR_T}{2.32G^2 - 11.6} = 930 \text{ ohms}$$

and the two pairs are so designed. In practice the nearest standard values of resistors in the 5% range would be used. The complete circuit would be as shown in Fig. 6; the inductors (L) of Fig. 6 would be wound to resonate with 15pF at the chosen centre frequency. The overall gain will be approximately 68db ($4 \times 17\text{db}$). If gain control is desired, it must be applied to V_1 or V_3 or both.

As is to be expected, the use of negative feedback is accompanied by a loss of gain. Except for extremely wide bandwidths, this loss is very small indeed and is usually within the normal uncertainties of gain computation. The feedback has a slight effect in stabilizing the gain of the amplifier, an effect which increases as bandwidth increases, but this stabilization

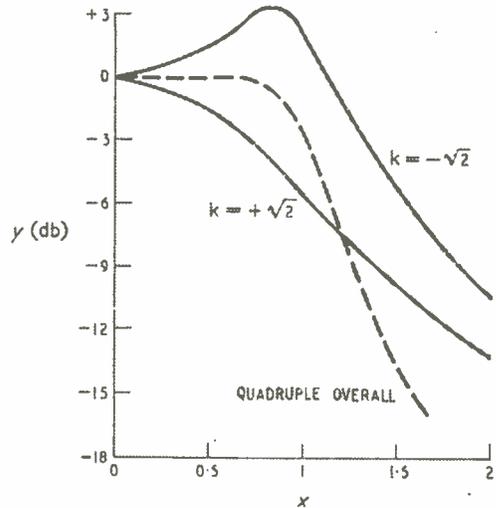


Fig. 5. Synthesis of flat-topped curve from two curves with different shape coefficients.

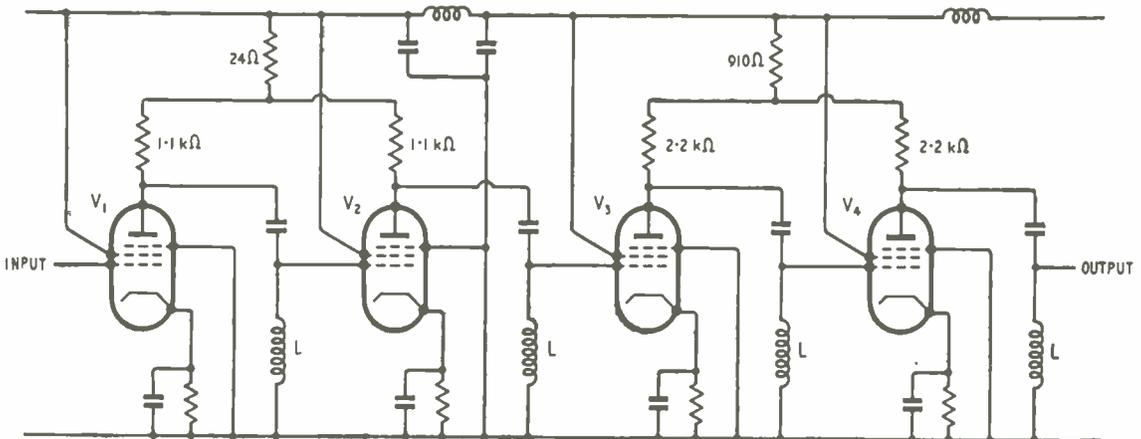


Fig. 6. Complete circuit of an amplifier designed to give a flat quadruple response curve with a bandwidth of 10 Mc/s.

is not enough to compensate for changes of mutual conductance in the valves. An additional disadvantage is that gain control can only be applied to those stages to which feedback is not applied. This is not normally serious as amplifiers of the type for which such circuits are used commonly have many stages, and control of two or three alternate valves gives an adequate gain control range. Application of bias to the feedback stages may, however, be used as a bandwidth control. The use of feedback pairs often results in a saving of decoupling components as stages may be decoupled in pairs. All amplifiers so far built have been found to be exceptionally stable, compared with amplifiers of similar characteristics using other methods of obtaining wide bandwidths.

The original setting-up procedure is very simple. The amplifier is built with resistor values chosen as detailed above. The feedback is removed (short circuiting R_5 in Fig. 2) from each pair in turn and the tuning coils within each pair are adjusted to tune to the centre i.f. In practice, it is found that adjustment of one coil is sufficient, all others then being wound to be identical with the correct coil. If feedback-resistor capacitance or valve anode-grid capacitance effects produce an objectionable tilt in the response curve a small capacitor is added (usually on one or two pairs only) across the appropriate points, and is adjusted until the curve is flat. If the feedback resistor capacitance is the controlling factor in curve tilt, the response is greater on the high frequency side of the centre i.f., as previously stated, and compensation is applied by adding a small

capacitance between the anodes of V_1 and V_2 (Fig. 2) to reinforce the anode-grid capacitance of V_2 . Similarly, if the inter-electrode capacitance of V_2 is the controlling factor and the tilt is from low- to high-frequency, then capacitance must be added in parallel with the feedback resistor R_5 .

A number of amplifiers of various bandwidths have been constructed using this system, and all have been satisfactory. After a long alignment process needed for the previously-used staggered amplifier, the time and effort saved by adopting the feedback system has been most noticeable, as have the excellent response curves obtained. Amplifiers have been built with centre frequencies of 30, 45 and 60 Mc/s, with bandwidths ranging from 5 to over 20 Mc/s. In one particular instance the i.f. amplifier, of twelve stages, had a bandwidth of 20 Mc/s to -1db at a frequency of 60 Mc/s and used a quadruple curve. The overall gain at i.f. was about 90db. In order to find out whether change of valves affected this amplifier, all twelve valves were changed *en bloc*. Twelve valves of a different make were inserted and the response curve was measured again. This was done for six sets of valves, the final set being a mixture of valves produced by various English and American manufacturers. The worst response curve change was a rise of 1db on one side of centre frequency. When a duplicate amplifier was built, the only adjustment needed was in the tilt-compensating capacitance, a small 5-pF trimmer. In most instances Mullard EF95 valves have been used, but some amplifiers have been built using the EF91.

EDUCATION AND TRAINING

WE are all prone to be insular and this is particularly noticeable in many Londoners, who tend to think of the metropolis as England. It was, therefore, refreshing for *Wireless World*, which so often attends discussions and meetings in London, to hear educationists in the Provinces discuss the question of "Education and Training in the Radio and Electronics Industry." The meeting, which was convened by the Merseyside Section of the British Institution of Radio Engineers, was addressed by representatives of Liverpool's University and Technical College, the Post Office, the Radio and Television Retailers' Association and the Automatic Telephone and Electric Company. There followed a lively discussion during which it was obvious that the speakers had their feet on the ground. It is also true that the speakers did not "pull their punches"; we doubt if we would hear a London graduate forcefully criticize the training scheme of the firm in which he was a student apprentice during a meeting attended by the company's training and education officer.

Both the introductory speakers and those taking part in the general discussion interpreted the title as including education both for and in the industry. We were particularly pleased to see the stress laid upon the need for a pass in English as an essential for apprentices. Technicians should be able to lucidly convey in writing their findings to others.

J. Durnford (Liverpool University) concluded his introductory remarks with these questions: (a) Are the Universities in fact giving the right sort of training? (b) Are there enough graduates being turned out? (c) Does industry in general know how to use its graduates to the best advantage? and (d) Should there be a period of practical training before as well as after a University course?

Some felt that the training was not sufficiently

specialized, and to this end students should be encouraged to take part-time vocational training in industry, possibly between the "inter" and degree courses.

The question of technical qualifications, which is now being debated in our correspondence columns, and the confusion which exists regarding professional status in the industry was discussed. In this connection it may not be generally known that the Burnham Committee, which decides teachers' salaries, accepted some time ago associate membership of the Brit.I.R.E. (with certain provisos) as a degree equivalent for teachers in further education establishments.

CLUB NEWS

Cambridge.—The February meetings of the Cambridge University Wireless Society (G6UW), which will be held at St. John's College, include lectures on electron microscopy (1st), electronic organs (8th) and miniaturization (15th). The club plans to visit the Pye radio works on February 17th. Sec.: R. C. Marshall, St. John's College, Cambridge.

Cleckheaton.—At the meeting of the Spen Valley and District Radio and Television Society on February 10th, D. Skirrow (G3GFD) will speak on "Principles of Radar 1945-52." Meetings are held on alternate Wednesdays at 7.30 at the Temperance Hall, Cleckheaton. Sec.: N. Pride, 100, Raikes Lane, Birstall, Nr. Leeds.

Southend.—J. Missen, of the G.E.C. Research Laboratories, who recently described in *Wireless World* a circuit for a push-pull transistor amplifier, is to speak on transistors at the meeting of the Southend and District Radio Society on February 5th. At the meeting on February 19th, H. T. Stott (Bulgin) will speak on "Time Standard Upon NH." Meetings are held at 7.45 at the Municipal College Laboratories, Queen's Road, Southend. Sec.: J. H. Barrance, 49, Swanage Road, Southend-on-Sea.

Eliminating C.W. Interference

Some Experiments in a Television Fringe Area

By B. L. MORLEY

AMONG the many trials and tribulations of the fringe area viewer is the marring of the picture by continuous wave interference. The radio interference branch of the Post Office is very helpful in these matters, but it has no powers of compulsion and if the owner of the offending apparatus is unhelpful there is very little that can be done to remedy matters.

A case of this kind led to the experiments described in the following paragraphs. In this instance the interference caused bright bands of light, the thickness of one or two lines, to cover the whole of the picture. The lines not only made the scene appear as though it was being viewed through prison bars but it also played havoc with the line synchronization.

Another form of interference which was cured was the appearance of a broad band of light across the screen which was from $\frac{1}{4}$ to $\frac{1}{2}$ in wide. This was intermittent; sometimes on for a few minutes, sometimes on for an hour or more like the first type, but it yielded to the treatment to be described.

The receiving point was located almost at sea level 80 miles from Sutton Coldfield. A Yagi aerial array comprising director, folded dipole and reflector spaced 0.1 and 0.15 wavelength respectively was in use. The array was mounted on a 16-ft mast fitted to the chimney stack; a typical domestic type of installation.

Now the obvious answer to unwanted c.w. is simply a matter of filtering, so the first step was to construct filters of various forms which were inserted in the aerial circuit. The filters completely eliminated the interference—and the picture! It appeared that a circuit with a sufficiently high "Q" could not be obtained. The method was abandoned.

The next approach to the problem was on a different line. It is a well-known fact that each transmission line has a certain propagation velocity which directly affects its electrical length. In the television aerial the incoming signal generates currents and voltages which are carried down the transmission line to the receiver. An interfering signal will also generate in the aerial a current and a voltage which likewise are carried down the transmission line. At the receiving end we may have the position shown in Fig. 1.

The phase relationship between the two signals

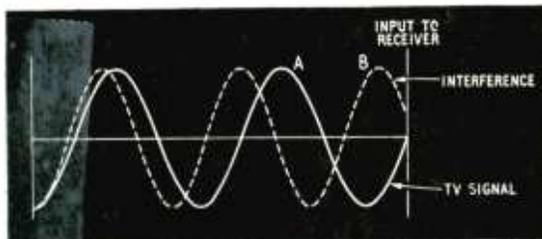


Fig. 1. Wanted (full line) and unwanted (broken line) signal currents flowing along the feeder of a typical television aerial.

remains substantially the same throughout the whole length of the line and the time taken for the two to reach the receiver will depend upon the length of the line.

The physical length of a transmission line corresponding to the electrical length is given by:—

$$L = \frac{984V}{f}$$

where,

L=length in feet

V=velocity factor of the line

f=frequency of the signal in Mc/s.

It will be seen, therefore, that the time taken by the signals to traverse the length of the line depends upon the velocity factor of the line and the frequency of the signals.

TV signals occupy a broad band of frequencies but if the interference covers a single or narrow band then matters can be so arranged that the interference is eliminated without detracting too seriously from the quality of the picture; indeed it is generally preferable to sacrifice some quality in order to get rid of the interference.

The method employed was to arrange that the signal plus interference arrived at the receiver on two separate paths, the electrical length of the second path being such that the arrival phase of the interference was 180 deg out of phase with that in the first path (Fig. 2).

In the experiment an "X" aerial's feeder was connected directly to that of the Yagi array at the aerial socket of the receiver. The electrical length of the secondary path was adjusted quite simply by the rather laborious method of cutting one inch from the end of the line, testing, then cutting a further inch and so on until the correct conditions were found.

Eventually a stage was reached where the two signals completely cancelled each other and the picture, though decreased in strength by a small amount, was quite clear. The actual loss of quality was not noticed as the bandwidth of the vision receiver had been adjusted to just under 2 Mc/s so as to obtain as much gain as possible. (This reduction in bandwidth is

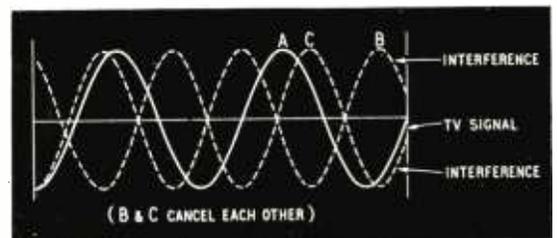


Fig. 2. If a second aerial is used and its feeder cut to the proper length the interfering signals can be cancelled out at the receiver.

not really so serious as it may appear at first sight, as generally the picture quality at extreme ranges leaves much to be desired, except on very rare occasions).

The system worked on both types of interference, the "prison bars" and the broad white band being eliminated from the screen, the single secondary path serving for both.

The word "eliminated" has been used deliberately; the interference was not merely obliterated; picture detail which had been concealed previously by the broad white band was once again visible, and beyond a slight loss in picture brightness (restored by adjustment of the contrast control) there appeared to be no

noticeable deterioration in the overall quality of the picture.

For those who would like to try the scheme for themselves it will be found that, during the process, points will be found where (a) the picture is seriously attenuated, (b) the sound is seriously attenuated, (c) both are seriously attenuated, but a point can be reached where the interference alone is attenuated, there being little effect on the sound or the picture.

The writer does not claim that this is an ideal arrangement though it works quite well in practice. There are other methods of producing the necessary reversal of phase between the two signals—there is plenty of scope for the keen experimenter!

"Plug and Socketry"

A Plea for New Standardization of Nomenclature

By C. LISTER

WHEN is a plug not a plug?" From the evidence to hand at this moment the answer would appear to be, "When it is a socket."

Consider Fig. 1. A is a device equipped with metallic contact pins and intended for attachment to the end of a cable. B is a device equipped with metallic contact-pin receptacles and intended for mounting in some relatively fixed position. C is a device equipped with metallic contact-pin receptacles and intended for attachment to the end of a cable. D is a device equipped with metallic contact pins and intended for mounting in some relatively fixed position.

There appears to be no argument whatever about the nomenclature of A and B: A seems to be universally accepted as a plug, B as a socket. The difference of opinion arises over C and D. Party No. 1 maintain that C is a socket and D is a plug. Party No. 2 maintain that C is a plug and D is a socket. In effect, Party No. 1 see a common factor in the physical appearance of certain constituent parts of the objects, whilst Party No. 2 see a common factor in the function and location of the object as a whole.

The main argument appears to go as follows:—

Party No. 1. The device known in electrical work as a "pin" may be inserted into a receptacle of similar size and shape which it will fill completely. The pin is then by dictionary definition a plug (something fitting into and filling a hole) whilst the receptacle is a socket (a hole for something to fit into). It therefore appears reasonable that the term plug should be applied as a collective noun to any assembly of such pins, whilst the term socket should similarly be applied to any assembly of such receptacles.

Party No. 2. From the dictionary definition just given, X in Fig. 2 is clearly a plug whilst Y is a socket. Whatever arrangement of smaller plugs and sockets we make on the two surfaces 1, 2 and 3, 4 should not alter the names already given to the

two devices X and Y. Whichever way the smaller plugs and sockets are moving X will still be plugged into Y, and X will still be attached to the end of a cable whilst Y will still be mounted in some relatively fixed position.

If we accept the recommendations of the first party, then we must find some way of indicating whether we require our plug (or socket) to be "loose" (i.e. cable attached) or "fixed." Each manufacturer appears to devise his own method of effecting this discrimination and their catalogues reveal such descriptions as, "with mounting brackets," "chassis mounting," "flex-mounting," "cable mounting," "panel mounting" etc.

If we accept the recommendations of the second party then we must find some means of indicating whether our plugs (or sockets) are equipped with pins, or pin-receptacles. One method which has been in satisfactory use in some factories for many years utilizes the term "male" to indicate pins and "female" to indicate pin-receptacles. Thus A, B, C, D, (Fig. 1) are described as "male-plug," "female-socket," "female-plug," and "male-socket" respectively.

Support for Party No. 1 is found in the drawings of

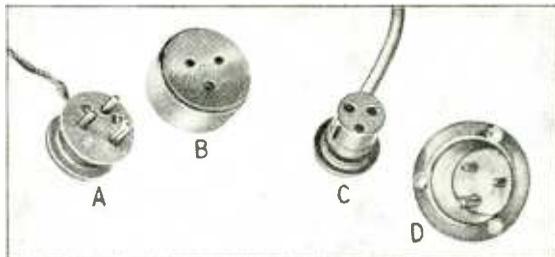


Fig. 1. Some plugs and sockets in common use.

some Government departments and in the catalogues of some manufacturers whilst support for Party No. 2 comes from other Government departments and other manufacturers.

Let us see what the British Standards Institution has to say on the subject. We look up British Standard No. 205 "Glossary of Terms Used in Electrical Engineering," Part 3 (1943) Section 3, Sub-section 37. It looks at first sight as though the issue has been very carefully side-stepped, for reference 3701 reads: "Plug-and-socket. A device consisting of two portions, a plug and a socket, having metallic contacts and arranged to engage with each other, so that it forms a ready means of connecting or disconnecting current-using apparatus to or from a source of supply." However, looking further, we discover the following:—

- "3706. Outlet plug-and-socket. A plug-and-socket intended for use at a supply point.
- 3707. Inlet plug-and-socket. A plug-and-socket intended for use on current-using apparatus.
- 3708. Outlet socket. One portion of an outlet plug-and-socket, intended for mounting at a supply point and provided with untouchable metallic contact-tubes.
- 3709. Outlet plug. The other portion of an outlet plug-and-socket, intended for attachment to a cable and provided with metallic contact-pins.
- 3710. Inlet plug. One portion of an inlet plug-and-socket, intended for attachment to a cable and provided with untouchable metallic contact-tubes.
- 3711. Inlet socket. The other portion of an inlet plug-and-socket, intended for mounting on current-using apparatus and provided with metallic contact-pins."

Clearly in the light of these definitions the British Standards Institution regards our original C and D (Fig. 1) as plug and socket respectively. In other words it supports Party No. 2. At the same time, however, it introduces these terms "inlet" and "outlet" which, in my personal view, tend to confuse the issue rather than to clarify it.

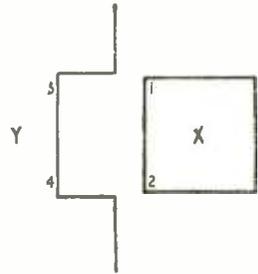
Consider the two references 3709 and 3711. In each the following words appear "provided with metallic contact-pins" (Similarly in both the references 3708 and 3710, the words "provided with untouchable metallic contact-tubes"). With a common factor in the description we might, therefore, reasonably expect to find a common factor in the accepted titles; instead of which we find "outlet-plug" and "inlet-socket"—two precise opposites.

The trouble arises here, I think, from use of the terms "inlet" and "outlet." I have already suggested that once we accept the arguments of Party No. 2 (as the B.S. clearly does) all that we then need consider is how to indicate which device has the pins and which the pin-receptacles. To my mind the terms "outlet" and "inlet" do not perform this function in a sufficiently clear-cut manner. On the other hand the terms "male" and "female" leave no one in any doubt. Moreover, the argument of "no common factor in the titles" cannot be levelled against "male-plugs" and "male-sockets" (which would be the equivalent of references 3709 and 3711).

What we might term this "physiological system" would appear, at first sight, to be the most logical for standardization. However, further consideration now leads me to the conclusion that we have readily available an even simpler method of differentiation.

Suppose we wish to purchase the device which answers the description of reference 3709. If we belong to Party No. 1, and we stroll up to the counter and ask for "a plug" the assistant will immediately

Fig. 2. Illustrating one method of defining a plug and socket.



come back at us with either two or three questions:

- (a) How many pins?
- (b) Cable mounting or fixed mounting?
- (c) (If it is a power plug) What current rating?

If we belong to Party No. 2 and ask for "a male-plug" we shall still be asked question (a). If we belong to the B.S.I. section of Party No. 2 and ask for "a outlet-plug" question (a) will still be fired at us. Does it not seem reasonable, then, that, whatever party we belong to, our title for the device which we require should contain a term specifying the number of connections that we desire this plug-and-socket to be capable of handling?

"But," it might be objected, "this we already do; we don't ask for things in the vague manner suggested above." Taking "n" as representing any number, if we belong to Party No. 1 we ask for an "n-pin plug"; Party No. 2 "an n-pin male-plug"; and Party No. 2 (B.S.I.), "an n-pin outlet-plug". In reply I should say "I agree with you entirely: that is precisely what we all do; and look at the redundancy that we involve."

Take Party No. 1 member. He asks for an "n-pin plug"; and yet the whole basis of the argument which divides Party No. 1 from their fellows is "that the device with the pins is *always* the plug." He is on an even stickier wicket when he asks for "an n-pin socket," for then redundancy gives place to inconsistency. If he changes from "an n-pin socket" to "an n-hole socket" he is back to redundancy again.

Precisely similar arguments apply to the terms put forward by both sections of Party No. 2. In the expressions "an n-pin male plug" and "an n-pin

Designation	Definition	Equivalent BS205 Number
N-hole socket	One portion of a plug-and-socket, intended for rigid mounting, and having n untouchable contact-tubes.	3708
N-pin plug	The other portion of a plug-and-socket, intended for attachment to a cable, and provided with n metallic contact-pins.	3709
N-hole plug	One portion of a plug-and-socket, intended for attachment to a cable, and having n untouchable contact-tubes.	3710
N-pin socket	The other portion of a plug-and-socket, intended for rigid mounting, and provided with n metallic contact-pins.	3711

outlet plug" neither "male" nor "outlet" contributes one iota to our specification of the device which we require, once we have accepted the main contention of Party No. 2 that the portion of a plug-and-socket which is designed for attachment to a cable is the plug, whilst the portion which is designed for more rigid mounting is the socket.

What sort of definitions, then, do these considerations suggest? Surely something on the lines indicated in the table.

Well, that is my system. Until I meet a simpler system that is how I, as an individual, shall classify these objects within my own mind. If you, dear reader, can produce an even simpler system, good luck to you. I for one shall be only too happy to discard mine and to embrace yours. Meanwhile I think I have written sufficient to indicate that a problem exists and requires attention. If it does not receive attention then it would seem that we are to be faced for ever with the state of affairs in which drawings of plugs and sockets made by one Government department are converted to sockets and plugs by a second Government department, only to be converted back to plugs and sockets again when they are passed on to the manufacturer. Moreover, as the last British Standard on this subject was in 1943, I feel that the time may now be ripe for once again reopening discussion of this matter.

In closing I must hasten to take evasive action against the reader who is even now reaching for his scissors to clip out that extraordinary "plug-and-socket" recently advertised in an American contemporary. I've already seen it, and I suggest that, in the terms of the "physiological" system the most apposite title would appear to be the "hermaphrodite" plug.

Manufacturers' Literature

Switches, lampholders, jacks, knobs, connectors and other chassis fittings listed in a new revised catalogue (No. 192) available from A. F. Bulgin & Co., Bye Pass Road, Barking, Essex; price 1s including postage.

Television Pre-amplifier with gain control, available with any number of coaxial outlets up to eight. Leaflet from the Rainbow Radio Manufacturing Co., Mincing Lane, Blackburn.

Miniature Plug and Jack (approx. 1½ in long) and a B7G plug are amongst new products listed in a catalogue of Edison Clix chassis fittings; available from The Edison Swan Electric Company, 155, Charing Cross Road, London, W.C.2.

Television Pattern Generator (40-70 Mc/s) with simple controls, giving patterns of seven horizontal bars and six vertical bars, described in a leaflet from Homelab Instruments, 615-617, High Road, Leyton, E.10. Seven types of test can be carried out.

Circuit-symbol Stamps for rapid printing of circuit diagrams; mounted on transparent blocks so that the user can see where he is placing them. Leaflet describing a complete kit from John Griffin Company, 2157, James Avenue, St. Paul 5, Minn., U.S.A.

Aircraft Intercommunication Equipment consisting of three units weighing 8½ lb (total) capable of operating up to ten headsets. Specification and general description on a leaflet from Airmec, Ltd., High Wycombe, Bucks.

Signal Generator covering 100 kc/s to 100 Mc/s on fundamental frequencies in six ranges, with output variable from 1 μV to 100 mV. Specification on a leaflet from Advance Components, Back Road, Shernhall Street, London, E.17.

Books Received

TV Repair Techniques. Gernsback Library No. 50. Collection of hints by practising servicemen on unusual faults occurring in American television receivers. Pp. 128; Figs. 98. Price \$1.50. Gernsback Publications, 25, West Broadway, New York, 7.

Introduction à l'Électronique by P. Gran, L.ès S. Survey of electron tube devices and their applications. Pp. 212; Figs. 205. Price 1,650 Fr. Dunod, 92, Rue Bonaparte, Paris, 6.

Cours Pratique de Television by F. Juster. Vol. 1. Design of wide-band r.f. amplifiers for use in television. Pp. 127; Figs. 71. Price 490 Fr. Editions Techniques et Professionnelles, 18 bis, Villa Herran, Paris, 16.

Cours sur les Ondes Ultra-Courtes by Y. Place. Elementary theory and practical application of metric, decimetric and centimetric waves. Pp. 186, Figs. 232. Price 1,300 Fr. Edition Eyrolles, 61, Boulevard Saint-Germain, Paris, 5.

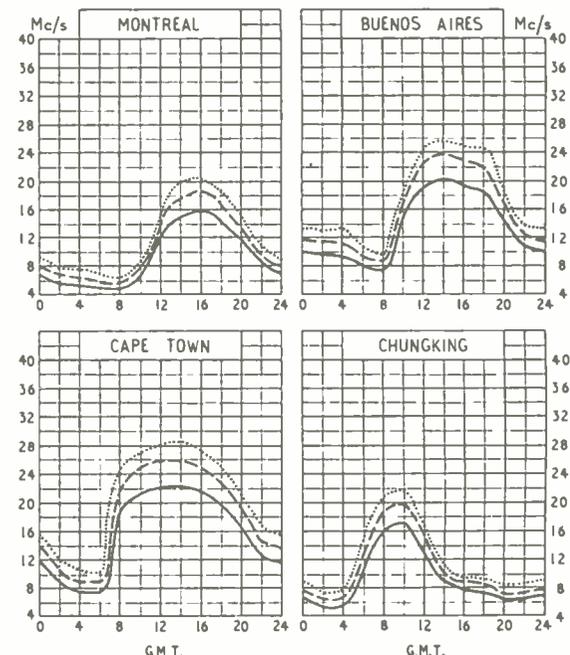
Industrial Electronics, by R. Kretzmann. Survey of vacuum and gas-filled valves, photocells, voltage stabilizers and cathode-ray tubes and their application as relays, counting and control devices, etc., in industrial processes. Sections are devoted to radio-frequency heating of dielectrics and metals. Pp. 236; Figs. 266. Cleaver Hume Press, 31, Wrights Lane, London, W.8. Price 25s.

Short-wave Conditions

Predictions for February

THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during February.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.



— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS
 --- PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY
 FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

Resistances in Parallel

Calculating Effective Values on the Slide Rule

By FRANCIS OAKES,* M.Inst.E.

A NUMBER of methods for rapid calculation of the equation

$$R_{1,2} = \frac{R_1 R_2}{R_1 + R_2}$$

have been published in recent years. Unfortunately these suffer either from considerable inaccuracy (particularly when R_1 and R_2 are of different orders of magnitude) or when they have the drawback of necessitating tiresome intermediate calculations, such as the finding and adding of reciprocals, adding of resistance values, or calculation of auxiliary currents. The method described here suffers from neither of these disadvantages, and lends itself readily to a number of further applications.

To find the numerical solution of the equations above, proceed as follows:

- (1) Bring cursor line over R_1 on the stock (Fig. 1, one arrow).
- (2) Move the end-mark of the slide (1 or 10 as required) over R_2 on the stock (two arrows).
- (3) Read R_1/R_2 on the slide under the cursor line (three arrows) and add 1 to this reading.
- (4) Move the slide so as to bring this sum, i.e. $R_1/R_2 + 1$ under the cursor line (four arrows).
- (5) Read result $R_{1,2}$ on the stock under the end-mark of the slide (five arrows).

In the example shown in Fig. 1 the following numerical settings are indicated:

$R_1 = 770$, $R_2 = 124$, $R_1/R_2 = 6.2$, $R_1/R_2 + 1 = 7.2$ and the result $R_{1,2} = 107$.

Proof: *1st step:* The section on the slide between

the end-mark and R_1/R_2 is equal to the section on the stock between R_1 and R_2 . Therefore $\log R_1/R_2 = \log R_1 - \log R_2$.

2nd step: The section on the slide between the end-mark and the new setting $R_1/R_2 + 1$ is equal to the section on the stock between R_1 and $R_{1,2}$, thus

$$\log R_{1,2} = \log R_1 - \log \left(\frac{R_1}{R_2} + 1 \right)$$

$$\therefore R_{1,2} = \frac{R_1}{\frac{R_1}{R_2} + 1} = \frac{R_1 R_2}{R_1 + R_2}$$

A series combination of capacitances C_1 and C_2 is equivalent to a capacitance $C_{1,2} = C_1 C_2 (C_1 + C_2)$. It is therefore obvious that the same method can be used also for the solution of series-capacitance problems. An analogous relationship holds good for parallel inductances.

It should be observed that the settings are so arranged that the result appears on the stock. This is of importance when more than two resistances are connected in parallel, or more than two capacitances in series.

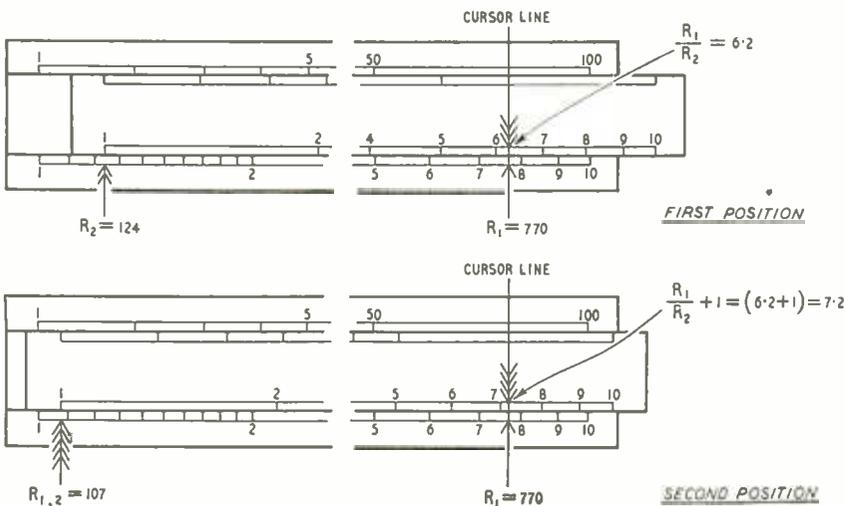
If, for example, the parallel equivalent $R_{1,2,3}$ for the three resistances R_1, R_2, R_3 is required, the calculation is started by finding $R_{1,2}$ in the manner described above. To continue, the cursor line is moved over $R_{1,2}$ and the process repeated with $R_{1,2}$ instead of R_1 , and with R_3 instead of R_2 . In other words, $R_{1,2}$ is considered as one single resistance to be shunted by R_3 . The result $R_{1,2,3}$ then appears in the same way as $R_{1,2}$ was found in the original example. In this way any number of resistances in parallel, or capacitances in series, can be worked out.

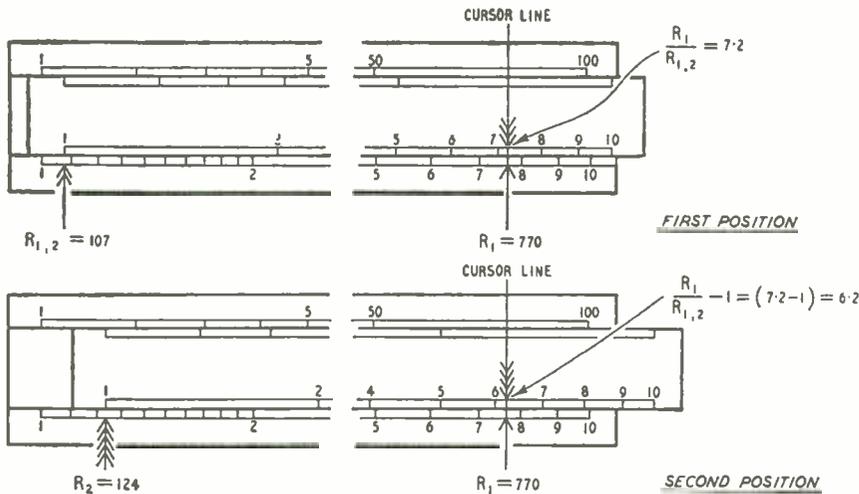
A similar process, with the only difference of subtracting 1 instead of adding, can be used to find the shunt value R_2 required to reduce a resistance R_1 to a desired value $R_{1,2}$. This is illustrated in Fig. 2 on the next page and is carried out as follows:

- (1) Bring cursor line over R_1 on the stock (one arrow).
- (2) Move the end-mark over $R_{1,2}$ on the stock (two arrows).
- (3) Read $R_1/R_{1,2}$ on the slide under the cursor

* Ferguson Radio Corporation

Fig. 1. Slide rule settings for calculating the effective value of 124 and 770 ohms in parallel. Answer 107 ohms.





line (three arrows) and deduct 1 from the reading. (4) Move the slide so as to bring this difference, i.e. $R_1/R_{1,2} - 1$ under the cursor line (four arrows). (5) Read resulting shunt resistance R_2 under the end-mark of the slide (five arrows).

The proof is quite analogous to the additive operation. Similarly, as the result falls on the stock, it can

be used as a starting point for further calculations. The subtractive method can be used for numerical solution of resonant circuit problems. Since the reactance of a parallel resonant circuit above resonant frequency is a capacitive reactance of magnitude $X_u = X_L X_C / (X_L - X_C)$ and below resonance of the magnitude $X_b = X_L X_C / (X_C - X_L)$ inductive reactance, the method described is obviously valid. Other problems of this kind, having the same mathematical formalism, and therefore being solved by the same slide rule operations, are the equivalent admittance of a series resonant circuit off tune, or the equivalent resistance of a positive and a negative resistance in parallel.

Manufacturers' Products

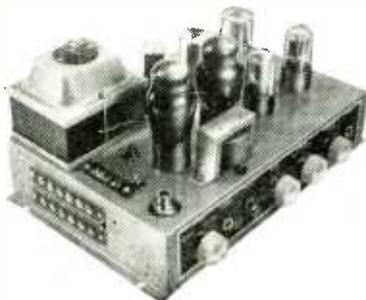
NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

Recording Amplifier

DESIGNED for use with the leading makes of tape recording mechanisms, the "Elpico" Model AC/54 Mark II amplifier is suitable for use with either high- or low-impedance heads, and alternative levels of bias and erasing output are provided. Wide-range tone compensation circuits enable an overall characteristic level from 80 to 8,000 c/s, within ± 4 db, to be obtained at a tape speed of $7\frac{1}{2}$ in./sec.

In this redesigned version, the negative feedback has been increased, and precautions have been taken to

"Elpico" Model AC/54 Mark II tape amplifier



prevent audio frequencies from getting into the erase head via the bias feed network. A biased neon lamp level recorder is fitted, and calibrated on each individual amplifier.

The makers are Lee Products, 63 Great Eastern Street, London, E.C.2, and the price is £16 16s.

High-quality Record Player

AN unusual disposal of two identical loudspeakers in opposite sides of a $\frac{1}{2}$ -inch thick mahogany cabinet is said to give "presence" and the

atmosphere of the concert hall in the reproduction from the "Black Box," the latest record player, produced by Pye, Radio Works, Cambridge. A "Monarch" three-speed record changer is incorporated and the push-pull amplifier is provided with tone and volume controls. The record changer will play up to ten 7in, 10in or 12in records mixed at any one of the following speeds: 33 $\frac{1}{3}$, 45 or 78 r.p.m. The price is £40 19s (including tax).

Pye "Black Box" record player.



New Ceramic Capacitors

AMONG the new capacitors introduced recently by the Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3, are two series of ceramic types of unusual interest. One consists of small-capacitance tubulars (Type CC.125A) primarily intended for "top-end" coupling in bandpass filters. Capacitances range from 0.5 pF to 5 pF at 500 V d.c. working, the closest tolerance being $\pm 10\%$, for all except the 0.5-pF model, for which it is $\pm 20\%$. Overall size is 0.5 in. \times $\frac{7}{8}$ in (approx) and side exit connecting wires of No. 22 s.w.g. are fitted.

The other series is for high working voltages, such as the e.h.t. positions in television sets and pulse-feed capacitors in radar transmitters and

WIRELESS WORLD, FEBRUARY 1954

The price of the "1954 Monarch" is £16 10s 3d (including tax), and the makers are Birmingham Sound Reproducers, Claremont Street, Old Hill, Staffs.

New Loudspeaker Enclosure

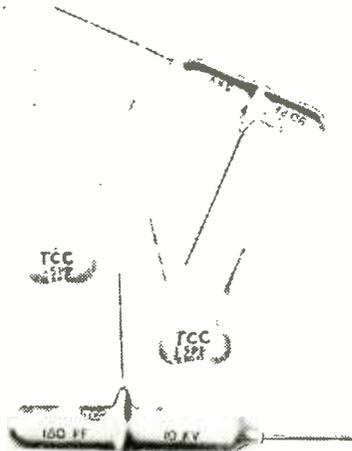
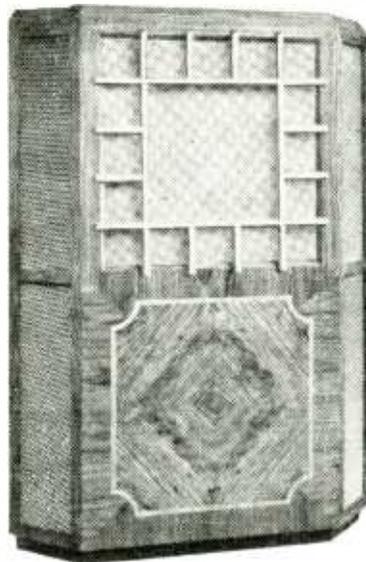
IN order that the full potentialities of the Dual Concentric loudspeaker unit may be realized, Tannoy have recently developed a new enclosure which provides horn loading throughout the frequency range. Hitherto the horn principle has been applied only above 1,000 c/s, but now the front of the large cone is loaded by a short horn with a flare efficient down to 200 c/s, while the back of the diaphragm is coupled to a larger folded horn covering frequencies from 200 c/s downwards. Radiation above 200 c/s from this larger horn is deliberately restricted by absorption at the discontinuities in the direction of the emerging sound.

The result is twofold: there is a noticeably "tight" control of transients and freedom from excitation of cavity resonances, often apparent in vented enclosures; and there is an effect of spaciousness consequent on the increase of source area. Since frequencies above 200 c/s are radiated from the single central source, there is no incongruity when speech or solo voices are being reproduced.

A 15-inch Dual Concentric unit is used, and this has now been re-designed for ease of dismantling and is fitted with a new phenolic-resin impregnated corrugated centring device. Plug-in connections are provided for the cross-over filter unit.

The makers are Tannoy Products, Norwood Road, West Norwood, London, S.E.27.

Tannoy "expanding source" enclosure for the Dual Concentric loudspeaker.



T.C.C. high-voltage tubular and small capacitance tubular capacitors, both are ceramic types.

receivers. These are tubular ceramics also but with one axial wire and one centrally wrapped connecting wire.

Working voltages range from 1 kV to 10 kV and capacitances from 50 pF to 620 pF according to type and voltage rating. The largest capacitance for 10-kV working is 180 pF and for 1-kV 620 pF. They are quite small considering the high working voltages, a 250-pF, 3.5-kV capacitor, for example, measuring 1 in long and $\frac{1}{8}$ in diameter.

Redesigned Record Changer

WHILE retaining the essentially simple and reliable design of the earlier mechanism, and its quick-changing characteristics, the latest version of the "Monarch" three-speed changer has been given a more attractive appearance. The pickup pivot and corner trip mechanisms are now housed in a single "streamlined" moulding, and an ivory finish is standardized.

More important from the technical point of view, the record release arm has been reshaped and is now made in Perspex instead of metal to give more silent operation. The pickup arm has also been reshaped to give better accessibility to the centralized control knob.

Redesigned "Monarch" three-speed record changer.



SOUND

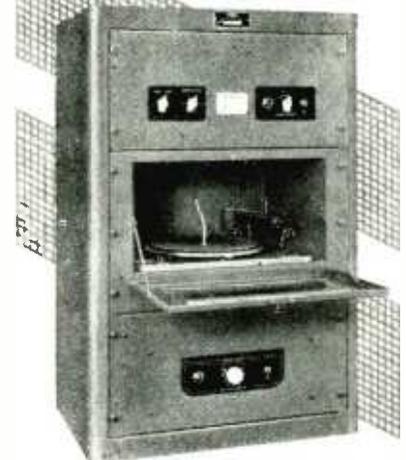
Versatility in

No problem of sound reproduction is too large or too small for the TRIX organisation to solve. Whether for Indoors or Outdoors, Mains or Batteries, Portable or Permanent installations, TRIX equipment will give lasting, efficient service.

Consult the TRIX Catalogue, therefore, or ask for our expert advice.



Model RE48. A heavy duty reflex type weatherproof horn speaker with exceptional range and performance. Very suitable for all public address work.



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RANDOM RADIATIONS

By "DIALLIST"

Sticking My Neck Out?

A LETTER in a recent issue of the *Wireless Trader* called attention to the inconvenience caused to servicemen by a method of soldering leads to tags used in many—if not most—of our radio and television factories. This consists in securing the wire to the tag by twisting or hooking before the solder is applied. The serviceman's complaint is that it makes the substitution or replacement of components always a slow, and sometimes an exasperating business. One can see, and to some extent sympathize with the manufacturers' point of view. In the absence of that third hand which all solderers would like to possess, the preliminary securing of wires to tags speeds up the work. In most kinds of soldering, too, it is sound practice to make joints mechanically strong before the solder is applied. Manufacturers feel, no doubt, that sets made in this way are more likely than others to stand up to the shocks and bumps that come their way in transit. True; but I couldn't agree less that this kind of soldered joint is the right one to use in *factory-made* apparatus. Why? Well, because it can, and too often does, enable a dry joint to be passed as sound by inspectors applying the usual tests. Sooner or later a dry joint, even though the wire is twisted to the tag, is likely to give rise to one of those horrible intermittent faults which are responsible for the entry of so many black marks in the Recording Angel's notebook.

Alarm and Despondency

TRYING OUT a television set the other day on Test-card C, I was surprised to find it suffering from what appeared to be a markedly jittery frame scan. In particular, the black and white rectangles of the horizontal borders were quite unstable in their height. They just wobbled. A 'phone call to the Alexandra Palace elicited the information that film was being used and that a slight up-and-down movement was to be expected. Now, I don't think that that's quite fair. Test-card C should be something on whose faithful transmission experimenters and servicemen can bank. It should surely be *the* television image whose

faultless transmission is guaranteed. Things become pretty difficult if this isn't so.

A Little Learning

THE VAST MAJORITY of radio dealers are first-rate fellows, who know their job and do well by their customers. But there is, more's the pity, nothing to prevent any Tom, Dick or Harry with a small amount of capital from taking a shop and erecting a sign describing himself as an "electrical, electronic, radio and television engineer," even though his knowledge of the very elements of any of these wide fields is of the scantiest and his practical experience *nil*. He can, without let or hindrance, undertake the wiring of houses and the installation and maintenance of electrical equipment of all kinds. The result is too often that electricity, the best and safest servant that Man has yet devised, becomes a menace to life and to property. One evening, long after the shops had closed, a neighbour came, with many apologies, to seek my help: with a child seriously ill in his house, all the lights had "gone"; fuses blew as soon as they were replaced. What I found left me gasping. One of these dabblers

had sometime previously put electric light into two rooms. Since then the lighting had been extended by him to the rest of the house simply by tapping off the original cables. One fuse-box served not only all the lights, but also numerous 2-pin wall sockets feeding a variety of gadgets, such as a couple of 1-kW heaters and a washing machine. The whole 5-amp wiring system had been "strengthened" by fitting 15-amp fuses in the single fuse-box. . . .

When it Comes to TV

It is a lamentable fact that up and down the country thousands of non-technical owners of radio and television receivers are completely at the mercy of these black sheep. I can't think why manufacturers don't exercise more care in appointing retailers of their wares; for there is no question that a first-rate make of radio or television set can gain a quite undeserved local reputation for lack of reliability through the misdeeds of one ignorant or unscrupulous dealer. Here are a few cases that have come to my knowledge. (1) The typical horizontal bars of sound-on-vision ascribed to camera faults; (2) Five radio and television sets installed by one dealer in a 230-V area with the mains tapplings at 200 volts; (3) A new c.r. tube fitted, at a cost of over £20, to "cure" distorted reproduction of sound; (4) Poor results with an elaborate aerial array found, on investigation by its manufacturer, to



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be due to an error of some 40 deg. in its orientation; (5) An H-type array erected with its reflector towards the transmitting station. And I could go on and on.

Battery Operated TV

ONE FIRM of manufacturers of television receivers demonstrated at the Earls Court Radio Show that any of their sets could be operated from a pair of 12-volt car starter accumulators, or from a private lighting plant, if sufficient "juice" could be spared. For all that, I'm not persuaded that a standard television set, with power requirements of the order of 150 watts, is suitable for use in this way. I've put up the idea for a genuine battery-and-converter receiver to several firms without arousing any marked enthusiasm. What I'd like to see is a set equipped mainly with battery miniature valves, whose requirements in the way of power are very small indeed. It would probably be necessary to use specially designed battery valves with high-consumption filaments for most of the functions. I'm told that there wouldn't be a big enough market to make such a set worth while. That I just don't believe. I live in a small country town and I can think right away of over a score of people within a few miles of my home who want television and would have it if reasonably economical battery operation were possible. And that's just one small town. There must be tens of thousands of folk in television service areas—townsmen, villagers and farmers—who would give no uncertain welcome to such a set, if it became available.

Soldering Aids

HERE ARE TWO soldering aids that I've found most useful since I made them a good few years ago. The first is a 230V-12V step-down transformer, mounted on a rectangular switch block. The primary and the core are connected by heavy flex to a 3-pin plug. The secondary connections go to a 2-pin socket, mounted on the same block. Each of my three small 12-V irons has a 2-pin plug at the end of its flex. The second gadget enables one to use the larger irons at some distance from a wall-socket. It is the simplest thing you can imagine. Just a 3-pin socket mounted on a circular switch block, which is itself attached to a plywood disc. To the contacts of the socket a 3-pin plug is connected through four yards of good flex.

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K.411 P	Dial	ditto, not engraved



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K.406	Skirt	2 1/4" (52.4 mm.) \varnothing x .17" (6.8 mm.) thick
K.412	Dial*	2 1/2" (69.9 mm.) \varnothing x .21 S.W.G., engraved 0-100 over 180
K.412/P	Dial	ditto, not engraved



List No.	Item	Dimensions, etc.
K.403	Knob	2 1/2" (60.3 mm.) \varnothing x 3/4" (24.6 mm.) high
K.407	Skirt	3" (76.2 mm.) \varnothing x .17" (6.8 mm.) thick
K.413	Dial*	4" (101.6 mm.) \varnothing x .21 S.W.G., engraved 0-100 over 180
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Plastic Plumbing

A KINDLY READER has sent me a bunch of cuttings from the local paper at Barnet, where they appear to be having a lot of trouble separating the Light and the Home Service programmes. Apparently the trouble is due to a rectification effect set up by the corroded joints in the guttering and piping and also in the metal window frames of Barnetonian houses. Such corrosion exists in all districts, of course, and doesn't have any serious effect but Barnet is so close to Brookman's Park that the resultant rectification causes the two main B.B.C. programmes to break through on each other in hopeless fashion.

It is astonishing that nobody seems to have thought of any really drastic method of tackling the problem. Irritating palliatives of doubtful efficiency seem to be all that the local experts can suggest. The obvious solution, of course, is to scrap the offending pipes and to substitute plastic plumbing; metal window frames and guttering could be similarly dealt with. The benefit to the nation of the large supplies of scrap metal which my plan would make available would be enormous and would more than justify the Treasury in making a substantial grant towards the cost out of the ill-gotten 15 per cent blood money which it squeezes out of the B.B.C.

Patients' Preference

ON MORE THAN one occasion in these columns I have complained of the inadequacy of hospital radio. In many of the cases brought to my notice the maintenance of the equipment has apparently been nobody's responsibility. When the hospitals were nationalized in 1948 the Government, through the various hospital boards, took over responsibility for all such necessary services as the plumbing and the electric lighting, but not apparently the radio installation—judging by the sorry state in which I have found it in certain cases. In some hospitals the headphones are in a bad state of repair; very often too, the reproduction is far too loud and an individual volume control for each patient is an unheard-of luxury.

It was, therefore, an agreeable surprise recently when I found a new installation being put in at an establishment which I had previously criticized. It is designed to give each patient a separate volume control and the choice of no fewer than four programmes.

I was unable to obtain any official information as to what these programmes were to be, but as the installation was being carried out by a well-known radio relay company I presume that the programmes—which I understood are to be fed to the hospital by landline—will be the usual ones that are "on tap" to subscribers to this particular company.

I cannot help feeling, however, that each of our large hospitals should reserve one of their audio channels for its own internal programme provided by gramophone records chosen by the patients themselves; in other words a "patients' preference" or "sufferers selection" service. The number of patients in even the largest hospital is infinitesimal compared with the B.B.C.'s listeners, and, therefore, each patient would have a certainty of hearing his own favourite record played. There would be little difficulty, I think, in obtaining the services of amateur disc jockeys from the local branches of voluntary organizations like the W.V.S.

I suppose that one day a TV screen will be found at the foot of every hospital bed or on the ceiling above. The expense of installation would be very great, but I do wonder why our cinema magnates do not seize their opportunity to boost business by bringing movies to each patient's bedside by means of a scanning unit in the local cinema and a closed-circuit link to the local hospital. Patients would almost certainly tell all their visitors to be sure and see such-and-such a film. Maybe commercial TV could be tried out in this way using films and a scanning unit in the hospital.

Baseless Ballyhoo

THE AMERICANS ARE a very likeable people and I number a great many among my readers and my friends—not always the same thing. But certain of them have the irritating habit of thinking that nothing ever happens or has its being outside "God's own country." Incidentally I may remind them that even the use of this expression to describe their homeland is not original. It was first employed by Dick Seddon, a famous premier of New Zealand, to describe that delectable land and is in fact recorded on his tomb in Wellington; it was probably shown to the Queen on her recent visit.

I recall being very irritated on one occasion by an American who had just been on a visit to what he kept on referring to as Cairo, Egypt. Eventually exasperation got the

better of my manners and I pointed out that few people were ignorant of the fact that Cairo was in the land of the Pharaohs, but he promptly flooded me by blandly explaining that there was another Cairo in the U.S.A., as indeed there is. Needless to say, I gave up.

After this incident it scarcely surprised me a few months ago when, at an international radio gathering, a tribute paid by the chairman to Franklin, the pioneer of long-distance beam telegraphy, drew vociferous applause from the Americans present. It was clear that the chairman ought to have said C. S. Franklin of England, as the applauders obviously thought that he meant that gifted American Benjamin Franklin who, in the 18th century, drew sparks from a kite



"They have the irritating habit . . ."

string. Maybe they were not altogether wrong to think of him as, after all, Marconi, when he first used an aerial for wireless purposes, was possibly not unmindful of Franklin's work.

However, it is not about Franklin that I wish to write but of the ballyhoo that is being made in the U.S.A. about the recording of TV programmes on magnetic tape. This is undoubtedly a first-class achievement and is without question "pregnant with possibilities," as one typical writer puts it. I would, however, remind people not only in the U.S.A. but over here also that Baird recorded television on discs some twenty years ago and I think it is axiomatic that what can be recorded on discs can also be done by means of tape, film or any other recording media.

I hope my American readers will not regard my remarks as unmannerly. No doubt they suffer equal irritation at certain of our national habits and are exasperated at instances of our unjustified ballyhoo.

The PERFECT TEST TEAM



The illustration depicts a set of modern "AVO" testgear being used to measure the "Q" of the secondary winding of the second I.F. transformer on a chassis of unknown characteristics—just one of many tests which can be performed by this combination of instruments.

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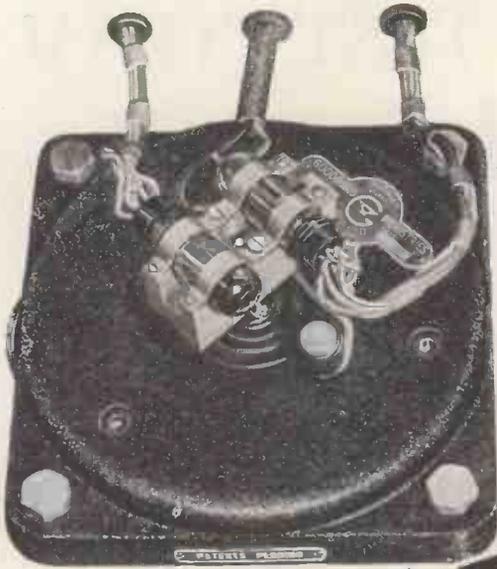
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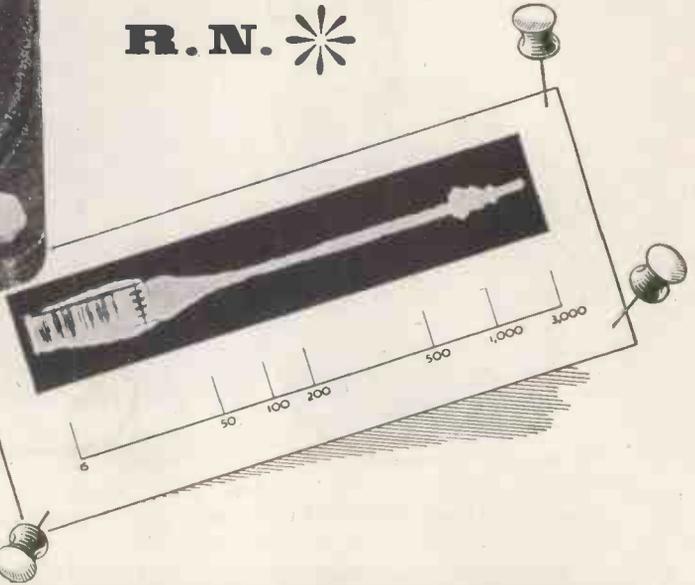
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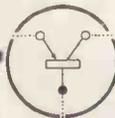
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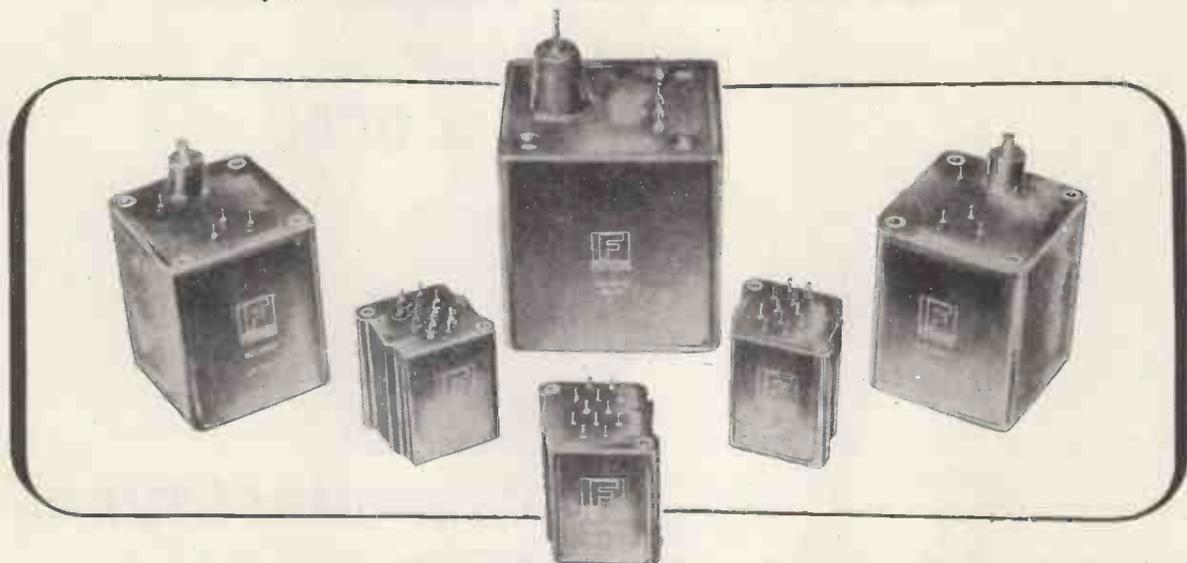
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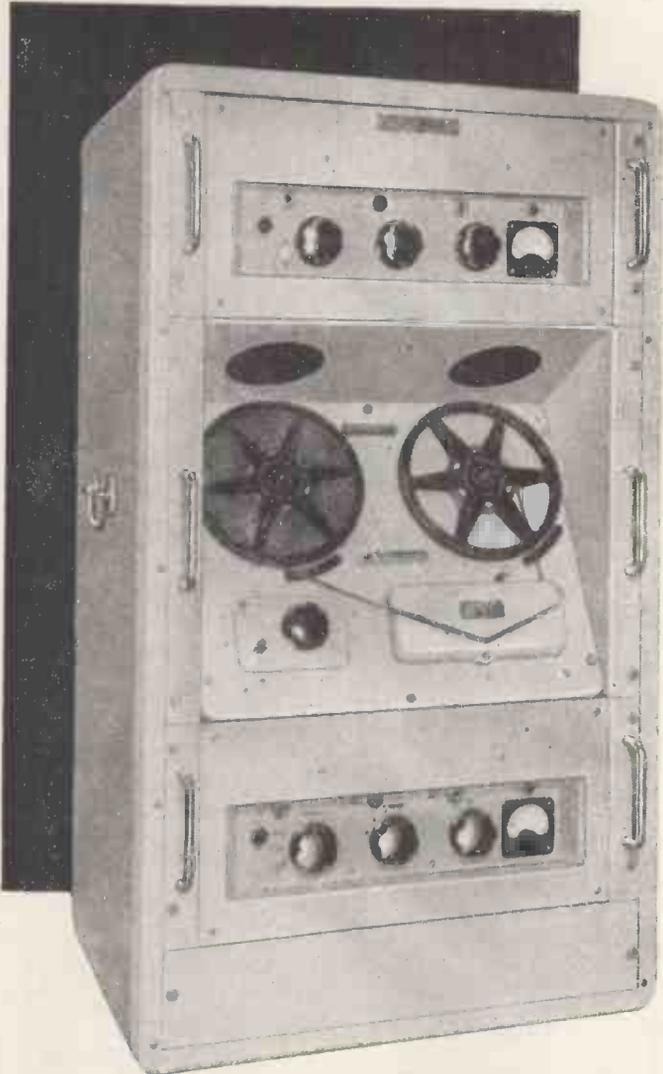
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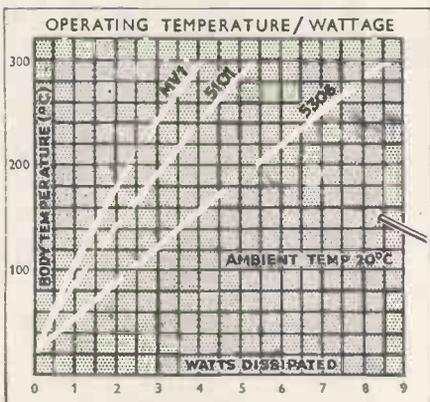
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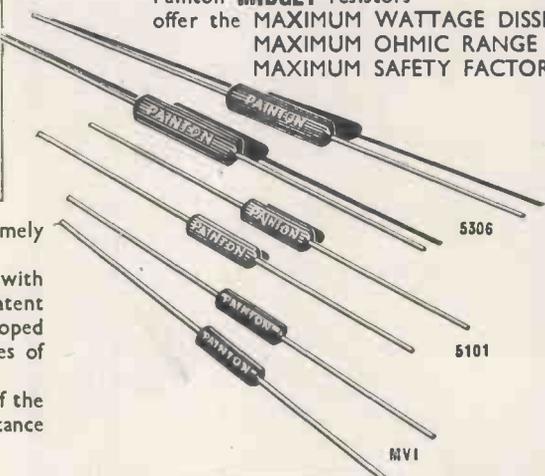
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Specification

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INPUT FREQUENCY	50 c/s $\pm 10\%$	HARMONIC DISTORTION	3% max.
OUTPUT VOLTAGE	220-240 (<i>adjustable</i>)	P.F. RANGE	Down to 0.7
	LOAD RANGE	No load to full load	

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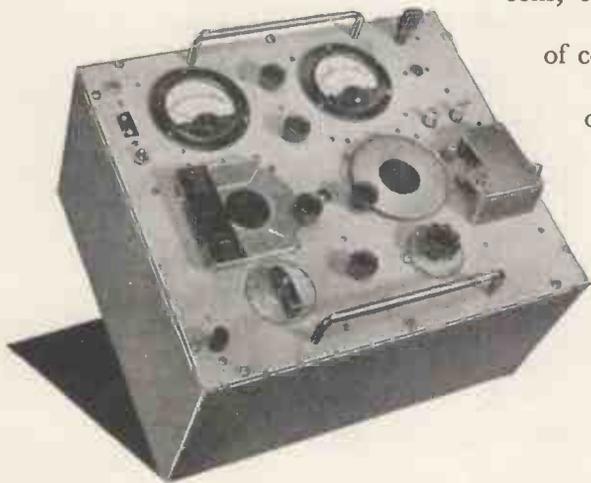
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Excellent Opportunities for the right men

We are a young firm just four years old. In these four years we have achieved an outstanding reputation for a vigorous policy of research, development, production and commercial enterprise. Working as a team we have secured the position of the world's leading marine radar company.

Our present programmes embrace a wide field of radar research, covering some of the most advanced techniques in the world, and the breadth and scope of these programmes ensures our future success. Our achievements have been won by team work, and we have now a unique group of men, able, experienced and, above all, enthusiastic and energetic. Our expanding activities however demand that we seek more men of this type.

Excellent opportunities exist at various levels in all branches of our organisation, and particularly in our Research and Development Laboratories for radar and electronic engineers, mechanical designers and draughtsmen. If you are experienced in these fields or feel you have qualifications which would enable you to make a real contribution to our activities please write to us at once. There is plenty of scope for men of ability to move forward in this progressive company. Your letter which will be treated in the strictest confidence should be addressed to :

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D.R.335



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When there's a special recording to be done . . . when there's no chance of a second take, or repeats will send costs soaring — that's when you need the M.S.S. White Label Master Disk.

Out of every hundred recording disks made at M.S.S. most are graded as excellent for direct play-back, but only about *three* meet our stringent demands for master recordings. That will give you an idea what *we* mean by perfection! And that is why so many of the World's recording and broadcasting companies rely upon M.S.S. Disks. There is a range of M.S.S. Disks to suit all types of recording work. May we send you further information?

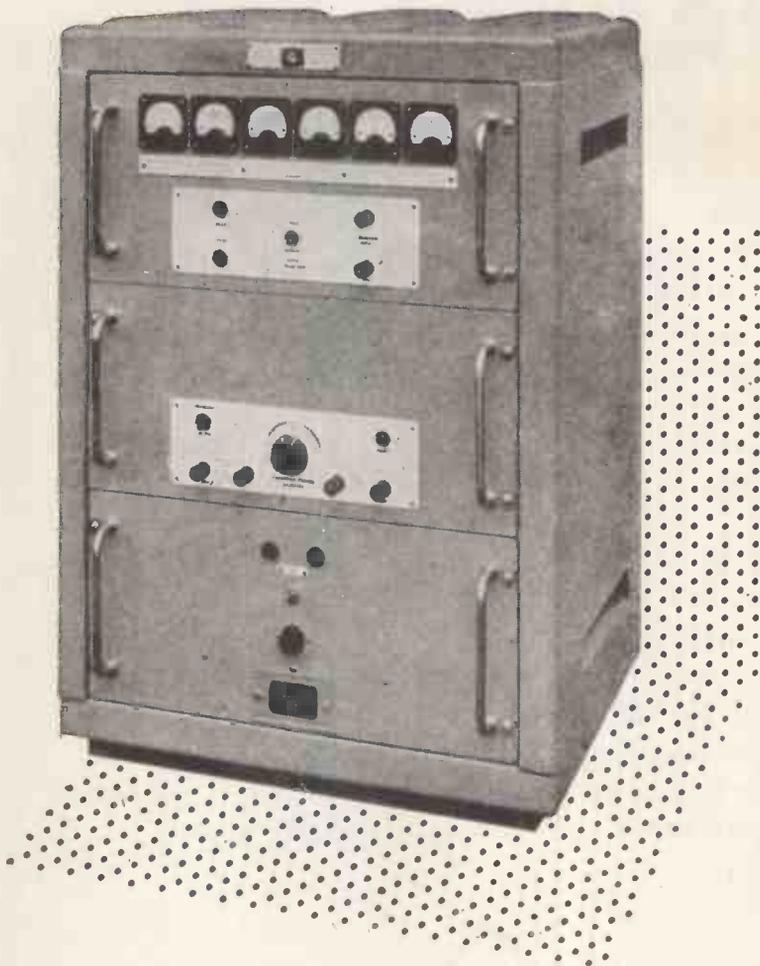
MSS DIRECT RECORDING DISKS



M.S.S. RECORDING COMPANY LTD, POYLE CLOSE, COLNBROOK, BUCKS, ENGLAND. COLNBROOK 284.

MANUFACTURERS OF SOUND RECORDING EQUIPMENT

**AUTOMATIC
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MONITOR (1 Mc/s)**



Designed for the measurement of any frequency in the range 10 c/s to 1 Mc/s with a basic accuracy of $\pm 0.005\% \pm 0.1, 1.0, \text{ or } 10 \text{ c/s}$.

Higher accuracies available if required. The unknown frequency is determined by counting the number of cycles that pass through a 'gate' open for a selectable time interval of 0.1, 1.0, or 10 seconds. The result is presented on six panel mounted meters each scaled 0 to 9 and is in decimal notation. Full information available on request.

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A Company within the J. Arthur Rank Organisation

WORSLEY BRIDGE ROAD · LONDON · SE26

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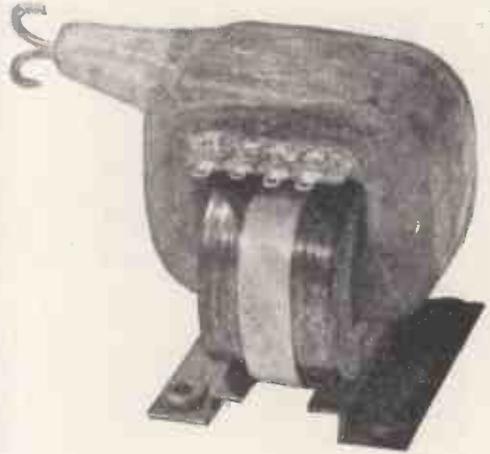
'Araldite' epoxy resins

for potting electrical equipment

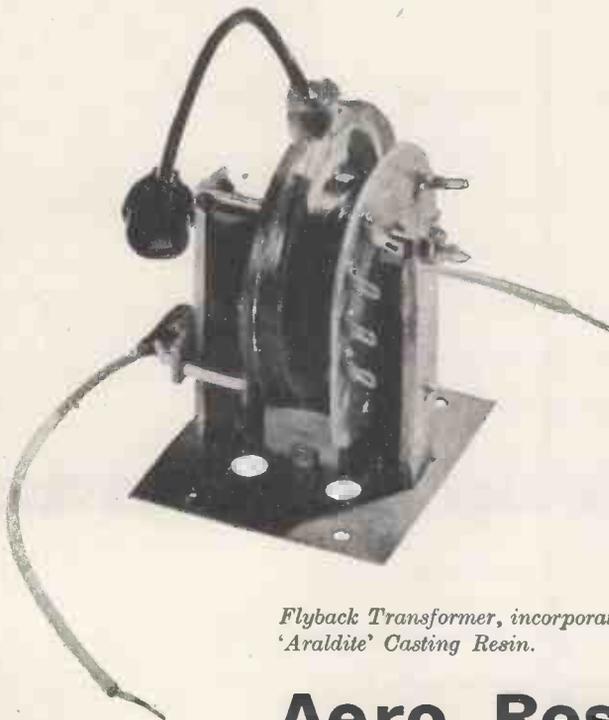
The most important properties required for potting transformers, capacitors, motor windings and other electrical equipment are now available in one and the same resin — 'Araldite' Casting Resin.

'Araldite' offers outstanding adhesion to metals, porcelain, mica, quartz and other non-porous materials. It provides good resistance to "tracking" combined with excellent insulating qualities. Equipment enclosed in 'Araldite' is sealed against moisture and protected against high temperatures and corrosive agents.

Simple to use, 'Araldite' hot- and cold-setting ethoxyline resins are proving especially suitable for large-scale production processes. No water or volatile substances are given off during setting and shrinkage is therefore extremely low.



The potting of transformer coils makes good use of 'Araldite's' excellent dielectric properties combined with outstanding adhesion to metals.

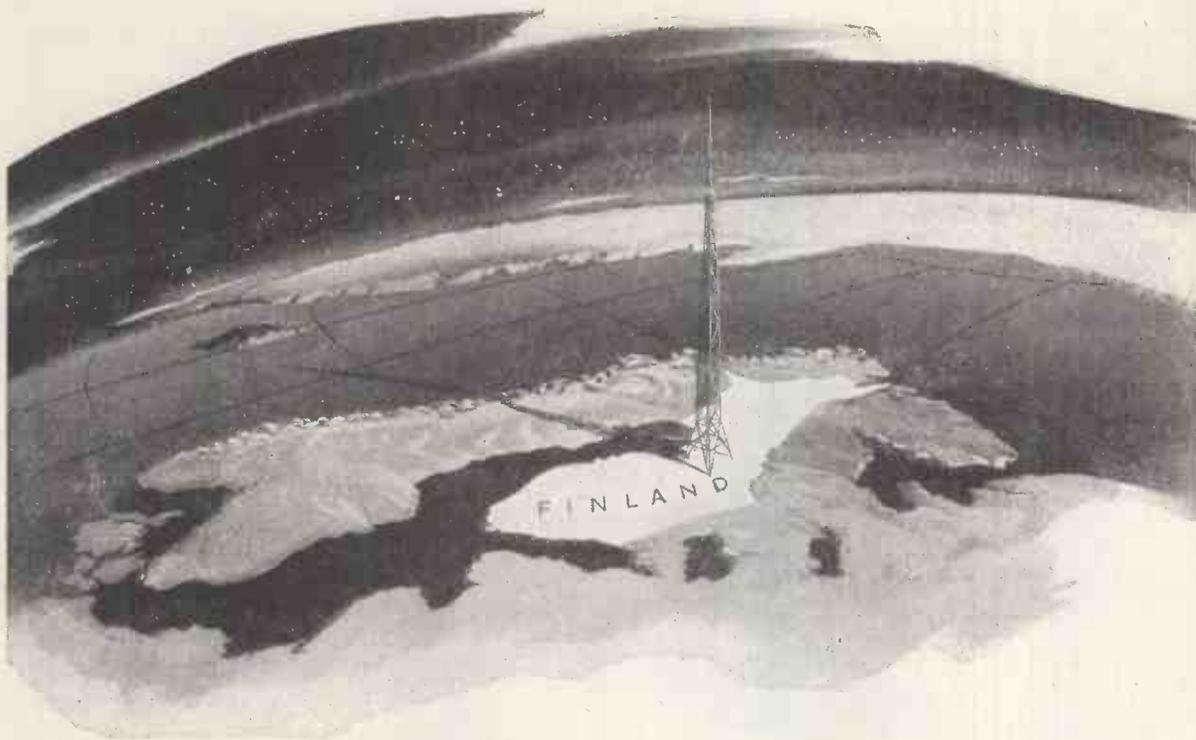


Flyback Transformer, incorporating 'Araldite' Casting Resin.

Note: 'Araldite' (Regd.) is also available in the form of hot- and cold-setting adhesives for bonding metals, ceramics, etc., and as a surface coating resin for the protection of metal surfaces.

Aero Research Limited

A Ciba Company, Duxford, Cambridge Telephone: Sawston 187



Finland expands her radio services with 19 RCA Transmitters

Frequency Modulation Network Broadcasting aids her people

ONCE AGAIN, Finland's traditional foresight has carried her people forward in the march of progress.

From Lahti—where Finland's new broadcast center is growing toward completion—a *Frequency Modulation* network will reach out to all parts of the land. The network's nineteen RCA FM transmitters will carry the benefits of modern radio to Finnish people from Helsinki on the Gulf of

Finland to Utsjoki in the far North.

. . .

The Radio Corporation of America is proud of the opportunity to have cooperated in this significant achievement and joins Havulinna Oy, its distributor in Finland, in saluting the Government of Finland, and the Finnish Broadcasting Company . . . a pioneer in FM networking on the European continent.



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Designed to obtain the best results from Modern Gramophone Technique

THE BURGOYNE R.G.1.

8 VALVE SUPERHET Custom Built RADIOGRAM CHASSIS



Price **22** gns.

We offer this de luxe radiogram chassis made by Tape Recorders (Electronics) Ltd., confident that you will gain the greatest satisfaction from the superior quality of both radio and record reproduction. So sure are we of the R.G.1's reliability that we offer with every chassis a **TWO YEAR GUARANTEE** (valves subject to the usual makers' guarantee).

SPECIFICATION

- ★ Illuminated full vision coloured tuning scale 11in. x 6in.
- ★ Negative feedback.
- ★ Designed for minimum mains hum.
- ★ Bass and Treble controls for cut and lift.
- ★ 200-250 v. A.C. 50 c/s (110 v. A.C. available for export).
- ★ Wavebands 16-50, 190-550, 1,000-2,000 metres.
- ★ Magic eye tuning indicator and precision fly-wheel tuning.
- ★ 8 watts push-pull output.
- ★ 3 or 15 ohms impedance output to choice.
- ★ We recommend high quality 10in. or 12in. Goodmans, Wharfedale and W.B. speakers for use with this chassis (3 or 15 ohms). All these available from stock.

H.P. Terms and Credit Sale

H.P. Terms: Deposit 154/- with 12 monthly payments of 29/-.
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Carr. & Packing 7/6 extra.

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We specialise in speedy shipment to any overseas destination. Our price (exclusive of P.T.) for export buyers is £17/10/- sterling ex works.

**HAVE YOU TOLD YOUR FRIENDS
about the M.O.S. PERSONAL CREDIT PLAN?**

Any type of equipment in our vast range of merchandise may be purchased under this plan which is essentially a personal one, as everyone has different requirements.

- ★ Two methods of purchase are available:—CREDIT SALE OR HIRE PURCHASE. The first allows you to own your equipment on payment of a first instalment of nine which are spread over 9 months. We quote the first instalment as one-ninth of the total purchase price, but if you so desire the first instalment can be any sum you please (within reasonable limits).
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- ★ Our range of electronic equipment is unequalled by any other firm, and can be inspected at your leisure in our spacious modern showrooms.
- ★ Your enquiries and orders will be dealt with confidentially whether by mail or personal shopping. We have years of experience behind us to advise and help you on your choice of goods. Carriage and packing is extra, all prices quoted being ex warehouse and subject to market fluctuations. Comprehensive lists are available upon request.
- ★ We specialise in export, and, having a world wide market for our merchandise, we have had to create a special export packing department, which, having had long experience of all types of packing for all markets, will ensure that your order reaches you safely wherever you are.
- ★ Satisfaction is always guaranteed to our customers, no matter how small the order, it will be valued by us.



Send us your Enquiry or Order Today!

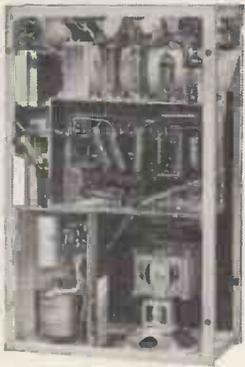
E. & G.

M A I L O R D E R

Telephone: MUSeum 6667.

THE RADIO CENTRE.

Why we recommend the "EDITOR" start with...

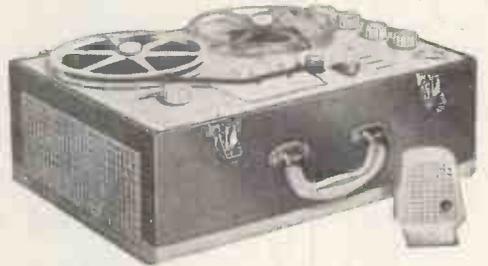


a new lightweight chassis—embracing the latest techniques of recorder construction. It has an output of 4 watts and achieves high quality reproduction with negligible wow and flutter. Precision built, the ingeniously planned circuitry is mounted on a steel frame that is easily removed from the case for inspection and maintenance in 30 seconds.



add a case...

only 5in. high of sturdy but lightweight construction with a strong carrying handle. It is available in various combinations of two tone leather-cloth with attractive gilt fittings.



add a lid...

an integral part of the case, secured by neat clips—but is completely detachable. This allows unrestricted access to the easily operated controls. A magic eye ensures balanced recording and listening. High speed rewind motors facilitate ease of playback selection.



and you have...

The Editor—the smallest lightweight mains operated fully automatic tape recorder—and only 45 gns! Weighing 33 lbs., the Editor is comfortably portable and can be freely used to capture vital moments of business or of social and domestic events.



PRICE ONLY **45** gns.



Made by
TAPE RECORDERS
(ELEPHRONIOS) LTD

SPECIFICATION. ★ Tape speed 7½ in. per second. ★ Mullard miniature recording valves. ★ Twin track heads. ★ Three high grade specially designed recording motors give fast forward run and 50 sec. rewind without unclamping tape. ★ Independent Bass and Treble Controls for recording and playback. ★ Overall negative feedback. ★ 1,200ft. reel of tape gives over ONE hour playing time. ★ Amplifier may be used independently for very high quality record reproduction and public address. ★ High fidelity Record head. ★ Special high grade speaker. ★ Provision for external speaker. ★ Speaker muting switch. ★ 4 watts output—brilliant reproduction. ★ Positive servo braking on all functions. ★ Size only 16½ in. x 12 in. x 7 in. (with lid). ★ Radio/gram and microphone inputs.

ACCESSORIES. The "Editor" is supplied complete and ready for use with a crystal desk microphone made specially for this equipment by RONETTE. The Coronation microphone can be supplied as an alternative if desired. A 1,200ft. reel of high coercivity specially recommended BURGOYNE tape is also issued with every recorder. Extra reels are available at 35/- per 1,200ft. reel or 21/- per 600ft. reel.

H.P. TERMS. £15.15.0 Deposit, 12 monthly instalments of 60/-. Or 18 monthly instalments of 42/-.

CREDIT TERMS Send only £6 to secure with further monthly payments of £6.

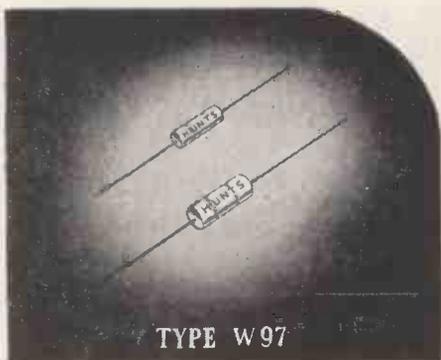
SEE IT—AND HEAR IT—AT THE RADIO CENTRE

SUPPLY COMPANY

The Radio Centre, 33 Tottenham Court Road, London, W.1. Telephone MUSEum 6667



REVOLUTIONARY
*in design—
 and performance!*



TYPE W97

HUNTS "THERMETIC" MIDGET METALLISED PAPER CAPACITORS WITH A TRUE HERMETIC SEAL

TEMPERATURE RANGE: -100°C to +120°C

and to CATEGORY 'A', CLASS H.1

With the hitherto unattainable temperature range of -100°C. to +120°C., Hunts W.97 "Thermetic" midget metallised Paper Capacitors are to Category A (100°C.) Class H1 (84 days tropical exposure) and are the smallest capacitors for their rating to this, the most stringent test condition of the R.C.S.C. Specifications.

Construction is the well known Hunts "castellated" metallised paper with rugged end connections ensuring freedom from intermittent open circuit and open circuits at low voltage. The capacitor unit is sealed in a metal tube with Hunts "Thermetic" compound, which also ensures mechanical rigidity of the end wires thus avoiding any reliance on foil and wire contacts for mechanical strength.

W97 Capacitors are non-inductive and suitable for operation at frequencies up to and in excess of 200 mc/s.

They are impregnated with a new material which is absolutely stable over the specified temperature range, and the temperature/capacitance co-efficient is infinitely superior to other types of capacitors in this class.

This unique capacitor is designed to withstand very high rates of "g", its rugged construction enabling it to be used in equipment where such conditions are encountered.

W97 can be supplied with a transparent plastic sleeve where insulation of case is required.

TYPE W97 STANDARD RANGE

LIST NO.	CAP µF.	DIMENSIONS (inches)	
		L	D.
		200 volts D.C.	Wkg. up to 100°C.
		150 volts D.C.	Wkg. up to 120°C.
BM7	0.002	0.610	0.135
BM8	0.004	0.610	0.135
BM11	0.004	0.500	0.180
BM9	0.005	0.610	0.135
BM12	0.005	0.500	0.180
BM10	0.01	0.610	0.135
BM13	0.01	0.500	0.180
BM14	0.02	0.610	0.180
BM15	0.03	0.610	0.260
BM16	0.04	0.610	0.260
		400 volts D.C.	Wkg. up to 100°C.
		300 volts D.C.	Wkg. up to 120°C.
BM4	0.0004	0.610	0.135
BM5	0.0005	0.610	0.135
BM6	0.001	0.610	0.135
BM17	0.001	0.500	0.180
BM18	0.002	0.500	0.180
BM19	0.003	0.500	0.180
BM20	0.005	0.610	0.180
BM21	0.01	0.610	0.260
		600 volts D.C.	Wkg. up to 100°C.
		450 volts D.C.	Wkg. up to 120°C.
BM22	2.5 pF.	0.500	0.180
BM23	4 pF.	0.500	0.180
BM24	10 pF.	0.500	0.180
BM25	50 pF.	0.500	0.180
BM1	0.0001	0.610	0.135
BM26	0.0001	0.500	0.180
BM2	0.0002	0.610	0.135
BM27	0.0002	0.500	0.180
BM28	0.00022	0.500	0.180
BM29	0.00025	0.500	0.180
BM3	0.0003	0.610	0.135
BM30	0.0003	0.500	0.180
BM36	0.0004	0.500	0.180
BM31	0.0005	0.500	0.180
BM32	0.001	0.500	0.180
BM33	0.002	0.610	0.260
BM34	0.003	0.610	0.260
BM35	0.004	0.610	0.260

A. H. Hunt (Capacitors) Ltd, Wandsworth S.W.18-BAT 1083

REGISTERED TRADE MARK

HUNTS

CAPACITORS

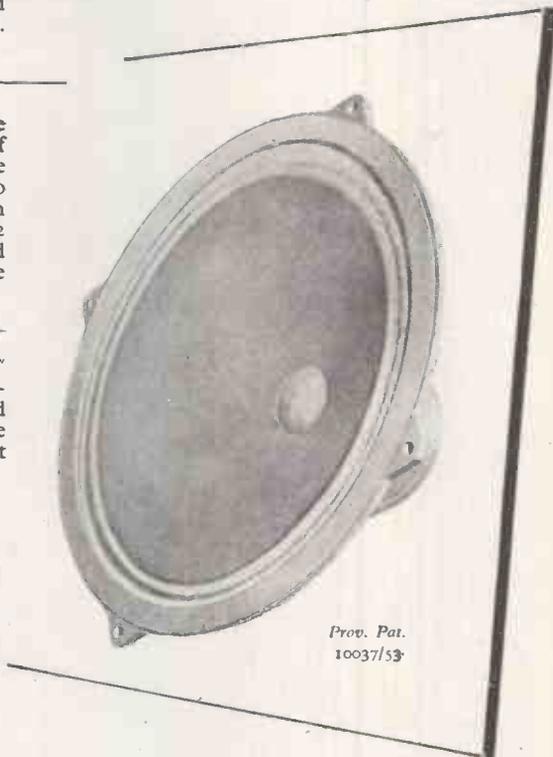
THE TRADE MARK OF RELIABILITY

READ WHAT USERS SAY

" May I tender my thanks to you for providing such an excellent job at a price which poor mortals like we can afford. It certainly is a big step towards realism in sound reproduction which until now I considered out of my reach. More power to your elbow "

" I have purchased one of your H.F.1012 speakers, the results from which have astounded me. At the time of purchase I was sorely tempted to pay a much higher price for another make of speaker, but fortunately, I was able to try both under varying conditions, good and bad, and then there was no hesitation about the decision. If the H.F.1012 has a good life, and there seems no reason why it should not, then it is a most outstanding achievement in performance and price "

" After reading P. Wilson's report of your new 10" speaker, H.F.1012, in the *Gramophone*, I immediately purchased one. Used in conjunction with a Leak Amplifier and a Leak Pick-up, the results were indeed remarkable. One would be tempted to say that at three times the price it would be exceptional "



Prov. Pat.
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Stentorian

HIGH FIDELITY UNITS

WITH THE PATENTED
CAMBRIC CONE

*...and remember
what the experts said:*

MODEL H.F.610. 6" Steel unit, Incorporating 10,000 gauss magnet. Handling capacity, 3 watts. Frequency response, 60 c.p.s.-12,000 c.p.s. Bass resonance, 70 c.p.s. Price **£2.10.6** (Tax Paid)

MODEL H.F.810. 8" Steel unit, incorporating 10,000 gauss magnet. Handling capacity, 5 watts. Frequency response, 50 c.p.s.-12,000 c.p.s. Bass resonance, 65 c.p.s. Price **£3.0.6** (Tax Paid)

MODEL H.F.912. 9" Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity, 7 watts. Frequency response, 40 c.p.s.-13,000 c.p.s. Bass resonance, 45 c.p.s. Price **£3.7.0** (Tax Paid)

MODEL H.F.1012. 10" Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity, 10 watts. Frequency response, 30 c.p.s.-14,000 c.p.s. Bass resonance, 35 p.c.s. Price **£3.13.6** (Tax Paid)

These new speakers have scored a sensational success: even we are amazed at the enthusiasm they have aroused. Hear what the experts say: "A great advance in speaker technique" (F. J. Camm); "A new thrill in high fidelity reproduction" (John Gilbert); "An extension of the bass response which is truly remarkable" (H. J. Barton-Chapple); "The smoothness of response is one of the really remarkable characteristics" (P. Wilson).

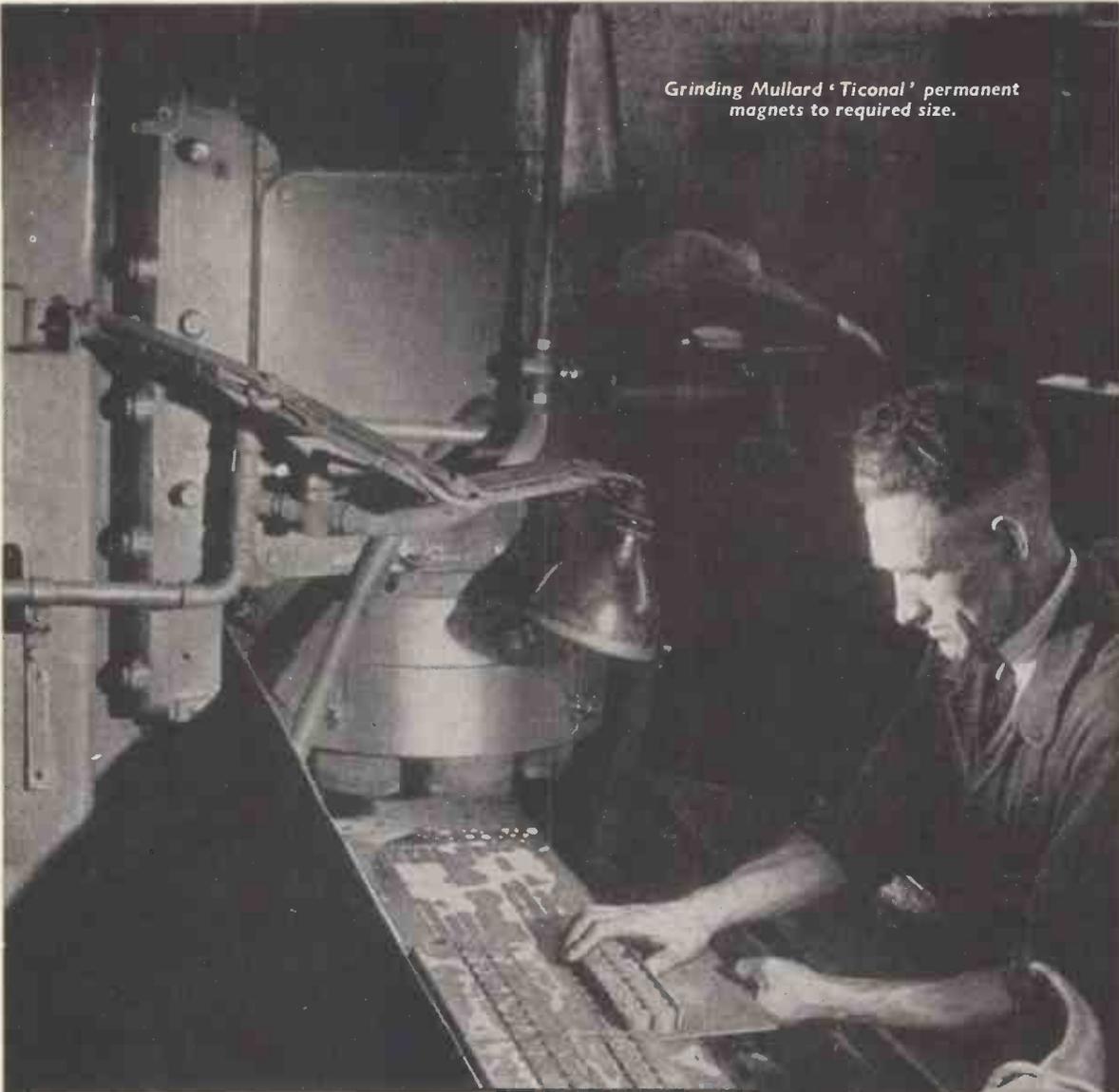
This consensus of opinion proves that the introduction of the cambric cone represents an amazing advance in loudspeaker design and performance. This achievement by W.B. engineers crowns thirty years' experience and progress in sound reproduction.

● Write for leaflet giving full technical details, or ask your dealer to demonstrate. Alternatively, these speakers may be heard at our London Office, 109 Kingsway, W.C.2, any Saturday between 9 and 12 noon.

WHITELEY ELECTRICAL
RADIO CO. LTD.
MANSFIELD · NOTTS



Transformer available if required
All models available either 3 or 15 ohms.



Grinding Mullard 'Ticonal' permanent magnets to required size.

MAGNETIC MATERIALS Extensive research and manufacturing facilities have established Mullard as the leading producers of magnetic materials. They were the first, for example, to introduce Ferroxcube, the world's most efficient magnetic ferrite; 'Ticonal' anisotropic permanent magnets, renowned for their high stability and high energy output; and Magnadur, an entirely new type of permanent magnet with the insulating properties of a ceramic.

The wealth of experience gained from these developments is available to all users of magnetic materials through the Mullard advisory service. An enquiry to the address below will put a team of specialised engineers at your disposal.



Mullard

• TICONAL' PERMANENT MAGNETS • MAGNADUR (Formerly Ferroxdure)
PERMANENT MAGNETS • FERROXCUBE MAGNETIC CORE MATERIAL

MULLARD LTD., COMPONENT DIVISION, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2.

To start you talking —and listening



Those who have followed the growth of high quality reproduction in recent years may wonder how it is possible to improve still further the amplifier part of the system. Yet, like its predecessor, the QUAD II introduces entirely new features of importance to the final objective—features anticipating trends in design of both amplifier and associated equipment.

Engineers will readily appreciate among the many salient points of design of this amplifier, the complete stability under all load conditions. They will delight too in the unique low noise pickup matching system and in the new wide range filter developments.

The gramophone enthusiast will be pleased to find that his moving coil pickup no longer requires a transformer; that each of the seven playback characteristics is accurately provided at the touch of a button; that the logical system of filter control gives him low distortion without the sacrifice of correct musical balance.

Above all, the musician will find that the QUAD II gives the closest approach to the original sound. . . . The QUAD II booklet will tell you why.

A booklet
describing the
QUAD II
is available
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PRICE £42.0.0 RETAIL

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Telephone : LARKSwood 4366/7/8



THE ADVANCE TYPE HI

The Advance type HI Audio Signal Generator completely covers the unusually wide range of 15 c/s to 50,000 c/s. It is characterised by its extremely low distortion and level output over the entire range; provides both sine and square wave output. A robust, reliable and accurate instrument for the discriminating service engineer

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Full technical details available in Folder W/16.

Advance
audio generator

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Telephone : LARKSwood 4366/7/8

Modesty forbids...

...that we reproduce all the letters of appreciation we receive. But when one like this turns up what can we do?

261 Heather Road,
Small Heath,
Birmingham.

Dear Sir,

I do a great deal of record reproducing as a pastime. I have already made a corner cabinet for the Audiom 60 and the sound production is simply marvellous, and in my honest opinion I think it is superb.

I have had all different types but never have I found anything to equal the Audiom type of reproducer.



What other loudspeaker could bring forth greater genuine praise?—except, perhaps, another Goodmans' High Quality reproducer. What immense versatility this high-powered, single cone AUDIOM 60 has! The secret?—fine sensitivity plus robust construction. The AUDIOM 60 will work as well from a battery set as it does in an Electronic organ. And as for radio and record reproduction of varied input, it will reduce background noise encountered in the playing of vintage recordings—and more—because of its low harmonic and intermodulation distortion the AUDIOM 60 is extensively used as a bass unit in cross over networks, whilst its success as a P.A. unit is widely acclaimed.

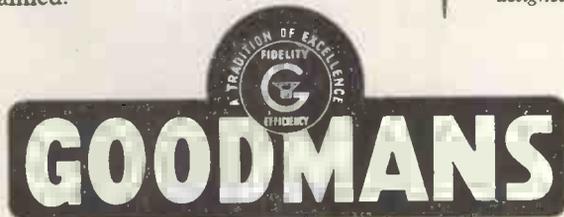
AUDIOM 60

BRIEF SPECIFICATION

Fundamental Resonance	.....	75 c/s
Voice Coil Impedance	.....	15 ohms
Power handling capacity	.....	15 watts peak A.C.
Flux density	.....	14,000 gauss
Net weight	.....	12 lb 3 oz.
Price	.....	£8 12 6

(Free of Purchase Tax)

Remember there is a loudspeaker in the Goodmans AXIOM and AUDIOM range for every application and you are invited to write for full details, advice and free dimensioned drawings of specially designed reflex cabinets.



GOODMANS INDUSTRIES LIMITED AXIOM WORKS, WEMBLEY, MIDDLESEX, ENGLAND.

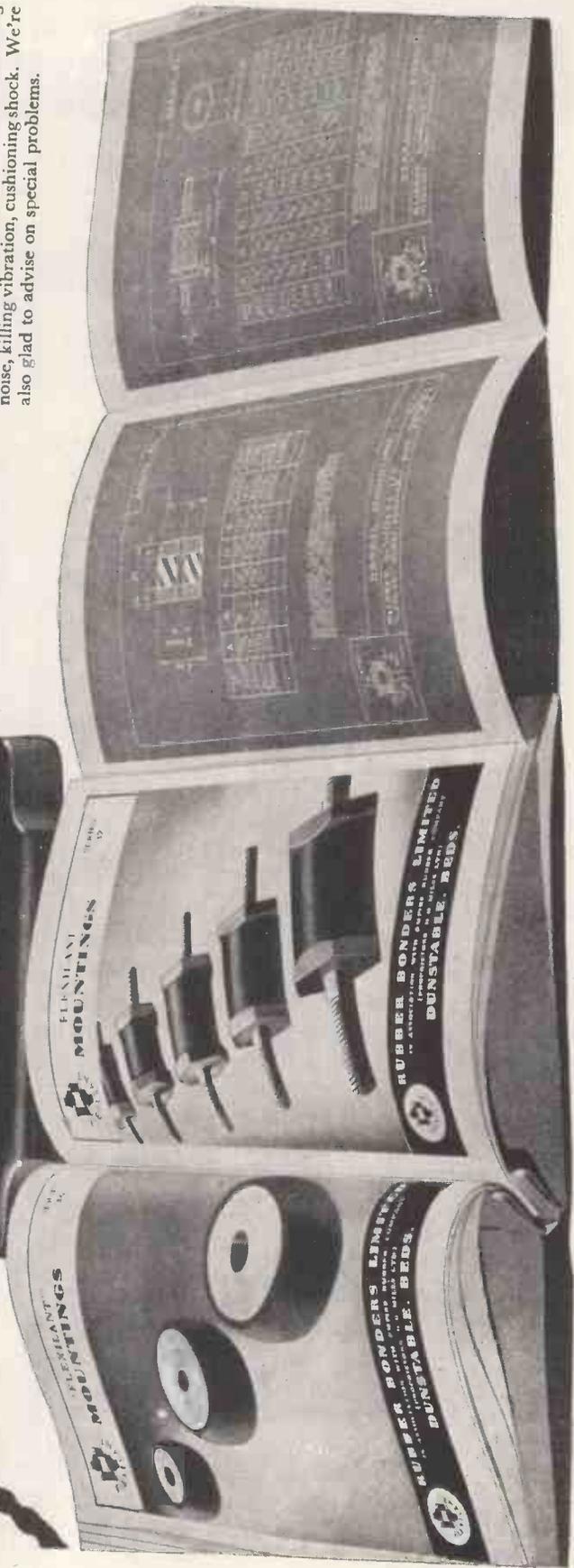
Telephone: WEMbley 1200. Cables: Goodaxiom. Wembley. England.

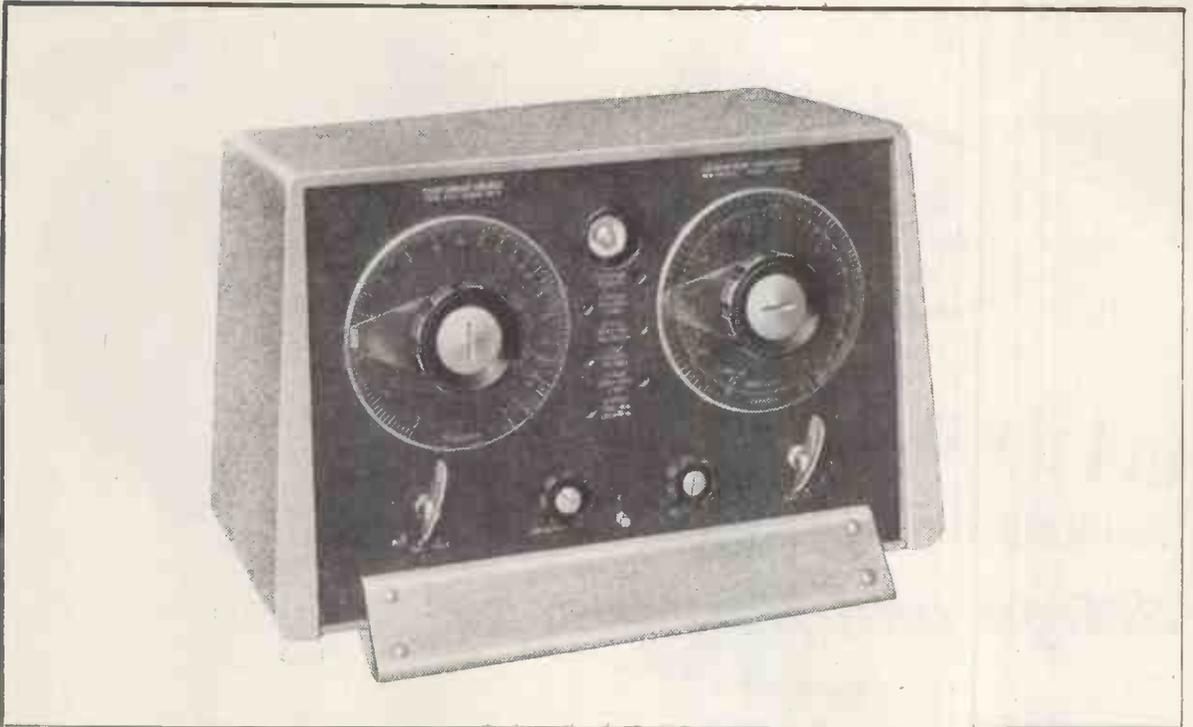
clatter?

To put up with noise and vibration in machinery is as modern as to ride a bone-breaker with solid-rubber tyres. "Clatter" in a factory shatters nerves, paralyses production, raises maintenance costs. Don't stand for it.

RING OR WRITE TO RUBBER BONDERS LIMITED DUNSTABLE, BEDFORDSHIRE

We will send our new Flexilant catalogue. This illustrates all the recent progress in the science of bonding rubber to metal—thus deadening noise, killing vibration, cushioning shock. We're also glad to advise on special problems.





A New Component Bridge

THE WAYNE KERR MODEL B.121

A MODERATELY PRICED self-contained instrument, capable of a wide range of accurate measurements.

In addition to giving direct readings of resistance, capacitance, and inductance, it will measure the impedance between any pair of terminals in a three-terminal network, and it can also be used for in situ measurements of component values.

Two individually calibrated dials give simultaneous readings of parallel combinations of resistive and reactive components, with independent scale multiplying of R and C values. The mains supply constitutes the source, and a selective amplifier with sensitive "magic eye" is used for null indication.

Specification

RESISTANCE RANGE: 3 ohms to 1,000 megohms, using six ranges and 3 multipliers of 0.1, 1 and 10.

CAPACITANCE RANGE: 1.0 pF to 1,000 μ F, using six ranges and 3 multipliers of 0.1, 1 and 10.

INDUCTANCE RANGE: 100 mH to 10,000 H in five ranges.

ACCURACY: 2% on all ranges over the major part of the scale. If higher accuracy is required, the instrument can be supplied hand-calibrated.

POWER SUPPLY: 110/115 V. or 200/250 V. at 50 c/s — 10 W. approx.

DIMENSIONS: 17 $\frac{1}{2}$ " x 10 $\frac{1}{2}$ " x 10" high.

WEIGHT: 15 lb. approximately.



Standard
microphones
 maintain the highest standards in
design and performance
 for every purpose

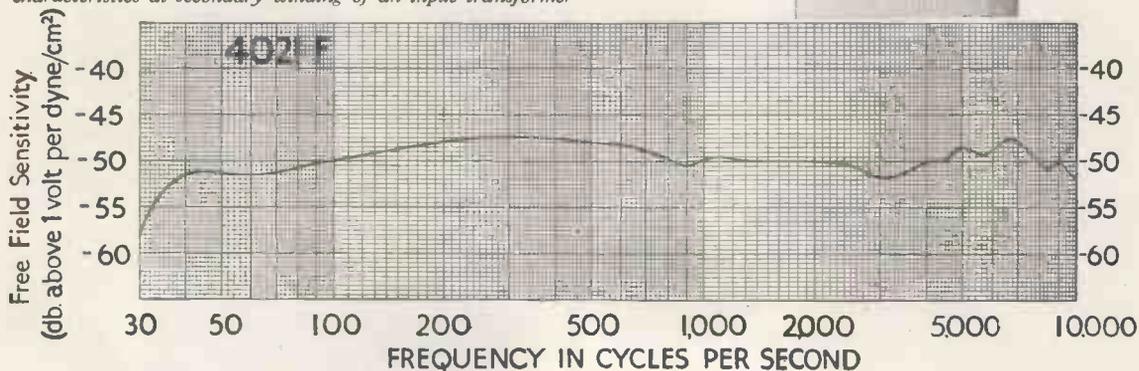
Type 4021

**A GENERAL PURPOSE STUDIO MICROPHONE
 FOR RADIO, TV., SOUND-REINFORCEMENT
 AND RECORDING**

This well-known moving-coil microphone has been the subject of continuous research and improvement since 1937. It continues to satisfy a universal demand for an instrument which combines a very high fidelity of response with a mechanically robust design, at a reasonable cost. Extensively used as a calibrated standard for acoustic measurements, each microphone is individually manufactured to very fine limits and is tested after manufacture to conform with the highest laboratory standards.

Alternative front baffles are available to give omni-directional or directional response. Delivery of the latest improved models is ex stock.

*Approved extract from National Physical Laboratory report.
 Typical 4021-F microphone showing frequency response
 characteristics at secondary winding of an input transformer*



Bulletins and prices of all Standard microphones are available on request to



Standard Telephones and Cables Limited

PUBLIC ADDRESS DEPARTMENT, Connaught House, Aldwych, London W.C.2

PROBLEM-

145 x 2 x 3

SOLUTION-



The **LAB**
TESTED

CONTINUOUS
STORAGE UNIT

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SAVE your slide rule—the real answer is 870—that's the number of different resistors in the 'T' & 'R' range—145 preferred types in two wattages and three tolerances.

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Ref.	Type	Loading	Max. Volts	Range	Dimensions
T	½-watt	½-watt	250	10 ohms	1" x 3/8"
R	½-watt	1-watt	500	to 10 megohms	1" x 1/2"

Tolerance available ±20%, ±10%, ±5%

The Lab Continuous Storage Units are available from your normal source of supply, but more detailed information can be obtained on request.

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C.3	5.4	197	0.64"
C.22	5.5	184	0.44"
C.2	6.3	171	0.44"
C.11	6.3	173	0.36"
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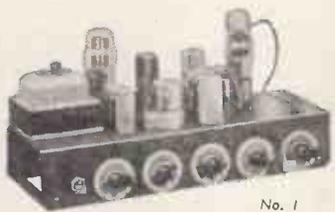
You may have already extended your record reproducer to include the now firmly established L.P. Records. You may be considering doing so. In either case, for real high fidelity at modest cost, it will pay you to consult us. Our aim is not just to sell you equipment but to save you money and to ensure that you get the apparatus most suited to your needs. Discuss

your problem with our Chief Engineer (available daily including Saturdays 11 a.m. to 6 p.m.). Or write enclosing 2d. stamp. This Technical Guidance Service will cost you nothing and save you pounds. **NOTE:** Regarding Pick-up heads to take standard or miniature thorns for 78 r.p.m., these can be supplied with any of the single-record Gram Units or Auto-changers sold by us, if desired.



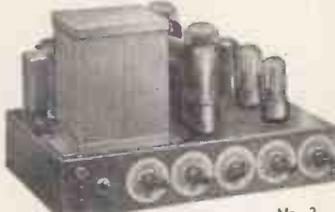
GOODMANS CORNER CABINETS (above) for the AXIOM 150 Mark 2, manufactured by us to Messrs. Goodmans own design. Price: complete kit in plain board with felt, 8 gns. Price ready built, 10 gns. Finished in figured walnut, 16 gns. Other veneers to order. Carriage extra.

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No. 1 "SYMPHONY" AMPLIFIER is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone-control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opposite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is far more important than mere nominal linear response of the amplifier, as the pick-up, speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative-feedback circuit employed. The amplifier can accommodate a wide variety of records from old 78's to new L.P.'s. Input is for all types of pick-up of 0.2v. output or more and there is full provision (and power) for Radio Tuner. It is available to match 2/3 or 15 ohms speakers. Price: 10 gns. (carriage 5/-). Fitted in Portable Steel Cabinet 35/- extra.



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No. 2 "SYMPHONY" AMPLIFIER as No. 1 but with 10-watt Push-Pull triode output and triodes throughout. Woden mains and output transformers and choke. Full provision and power for Tuner. Output tapped 3, 7.5 and 15 ohms. Competes with the most expensive amplifiers on the market yet costs only 15 gns. (carriage 5/-). Fitted in portable Steel Cabinet 2 gns. extra.



"SYMPHONY" AMPLIFIERS with REMOTE CONTROL. Both the above model Amplifiers are available with all controls on a separate Control panel with up to 4 feet flexible cable which simply plugs into the amplifier. Enables the Amplifier proper to be sat in the bottom of a cabinet whilst the controls are mounted conveniently higher up. Extra cost 2 gns.

THE N.R.S. No. 2 PUBLIC ADDRESS AMPLIFIER for 200/250 volts A.C. mains gives output of 15 watts audio. Valve line-up: 6SL7, 6SN7, input and phase splitters, feeding 2 x 6V6 beam power tetrodes in push-pull, 5Z4 rectifier. Twin inputs with separate volume controls enabling gram. and mike or twin turntables to be faded in and out. Tone control is fitted and output is for 3, 7.5 and 15 ohms. This amplifier is built on the same de luxe hammer-finish chassis as the Symphony No. 2 and incorporates the same robust Woden mains transformer and choke, ensuring extreme reliability and absolute confidence in the instrument on the job. We can highly recommend this instrument as gramophone, microphone and radio amplifier for dances, socials, etc. in halls, clubs, institutes, etc. Price in Kit form £12. Fully built and tested 13 gns. Carriage 5/-. Hammer-finish Steel Cabinet with handles, 2 gns. extra.

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GARRARD 3-SPEED AUTO-CHANGERS, Model RC80, plays up to ten records 7in., 10in. or 12in. at 78, 45 and 33 1/3 r.p.m. Stylus pressure on L.P. 10 grammes (adjustable). New ultra-sensitive auto-trip mechanism and heavy loaded turntable to eliminate "wow." Price £14/2/6 or with Garrard Magnetic or Astatic Crystal Turnover Pick-up Head, £16/2/6. With two separate Acos Hi-fi Heads, £18/2/6. With two separate Decca XMS Heads, £19/7/6. Carriage 5/-. Optional Extras: 45 r.p.m. Auto Centre Spindle, 20/9; A.C./D.C. Operation £7/14/-. Fitting in de luxe rexine-covered Portable Cabinet, £5. Pick-up Head to take Fibre Needles, 25/- to 35/-.

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ABOVE GARRARD UNITS are for A.C. Mains but are also available at extra cost as follows: 6v. D.C. 90/-; 12v. D.C. 90/-; 200-250v. A.C./D.C. 153/-.

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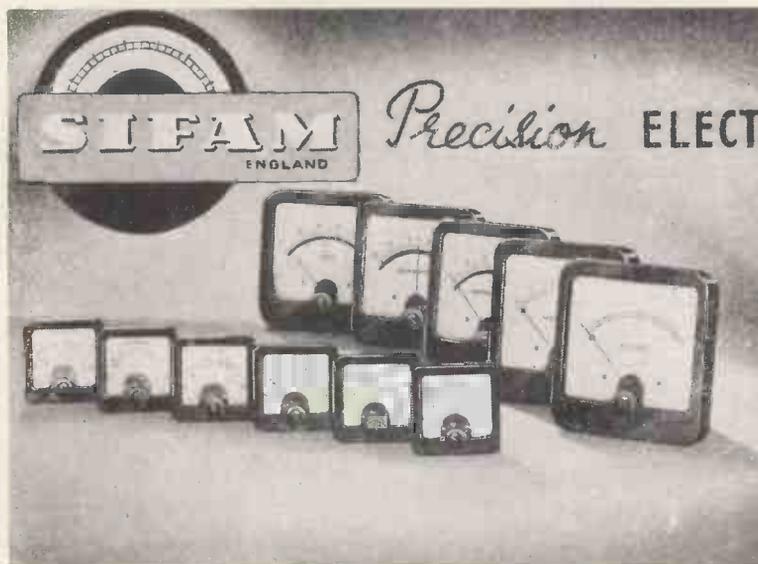
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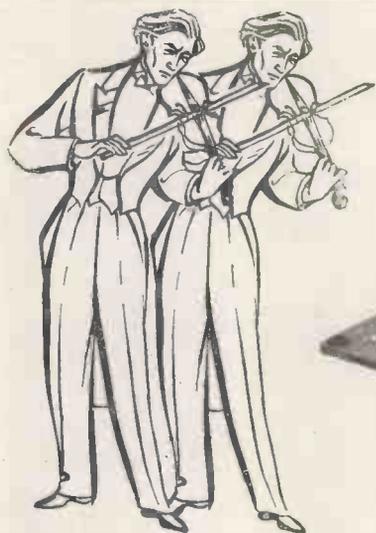
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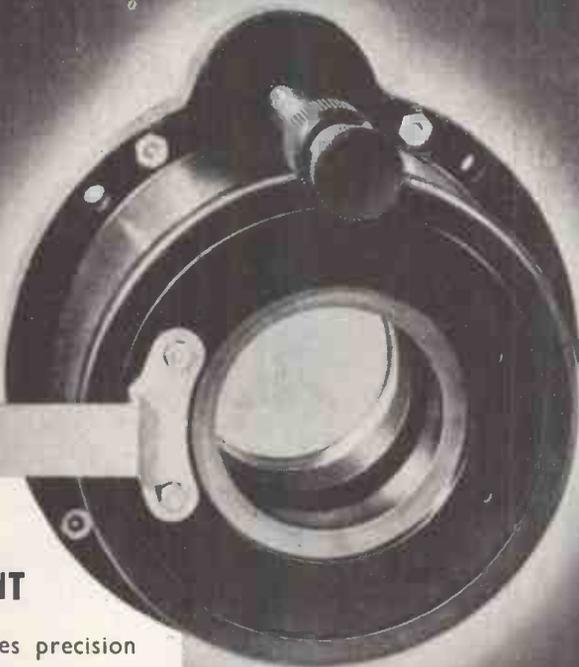
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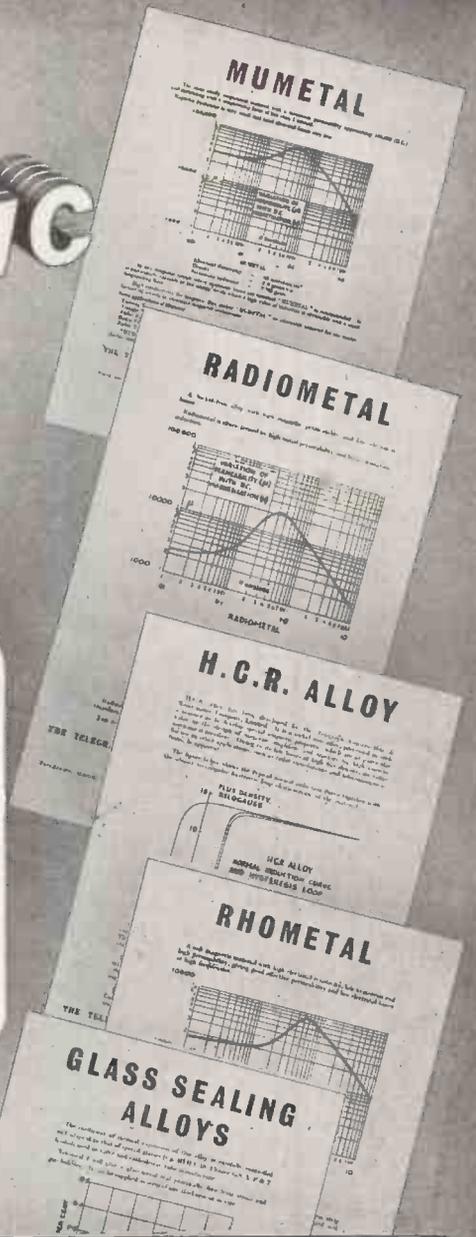
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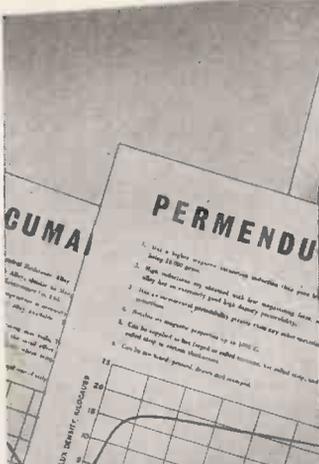
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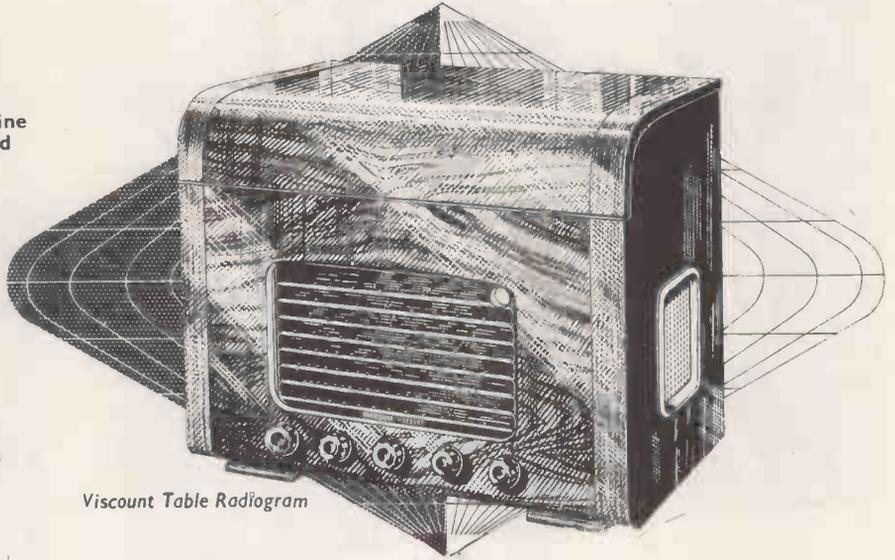
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LETTER FROM *Brazil*

Rio de Janeiro.
24th November 1953.

Dear Mr. Briggs:

About your books; I have all their editions. Their texts are simple, objective, constructive, immune to a common pest which might be called "scientific demagogy." Further, your informal way of exposing ideas, occasionally adorned by a peculiar sense of modesty and humour, are features which make the reading of your texts an attractive occupation. So, add all values duly praised, I believe that the repeated study of the contents of your books, and the execution of lessons therein given, are, to any person interested in matters of sound reproduction, profitable investments of time and mental energy.

About your loudspeakers: The abundant evidences which, within the last five years, I have had participating in merciless comparative tests, technical tests followed by decisive listening tests, have led me to believe that the qualitative performance of loudspeakers must be less the realisation of technical specifications than the fruit of art. Otherwise, how could I thoroughly understand, for instance, the very superior performance of the Wharfedale loudspeaker model Super 12/CS/AL?

Well, whatever the cause may be, an important effect is that your loudspeakers have fascinated me. Consequently, let me confess, Wharfedale units, models W15/CS, Super 12/CS/AL and 8/CS, have overwhelming preponderance, in terms of quantity and quality, in the two separate groups of loudspeakers which are installed in my home. Incidentally, by the end of the year a Wharfedale 5in. tweeter should enrich my equipment.

Thank you, Mr. Briggs, for your accomplishments concerning the betterment of the reproduction of sound.

Yours sincerely,
ED. VIDAL.

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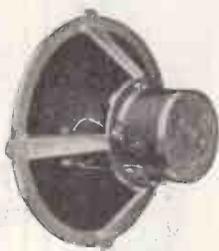
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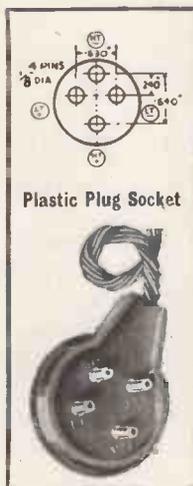
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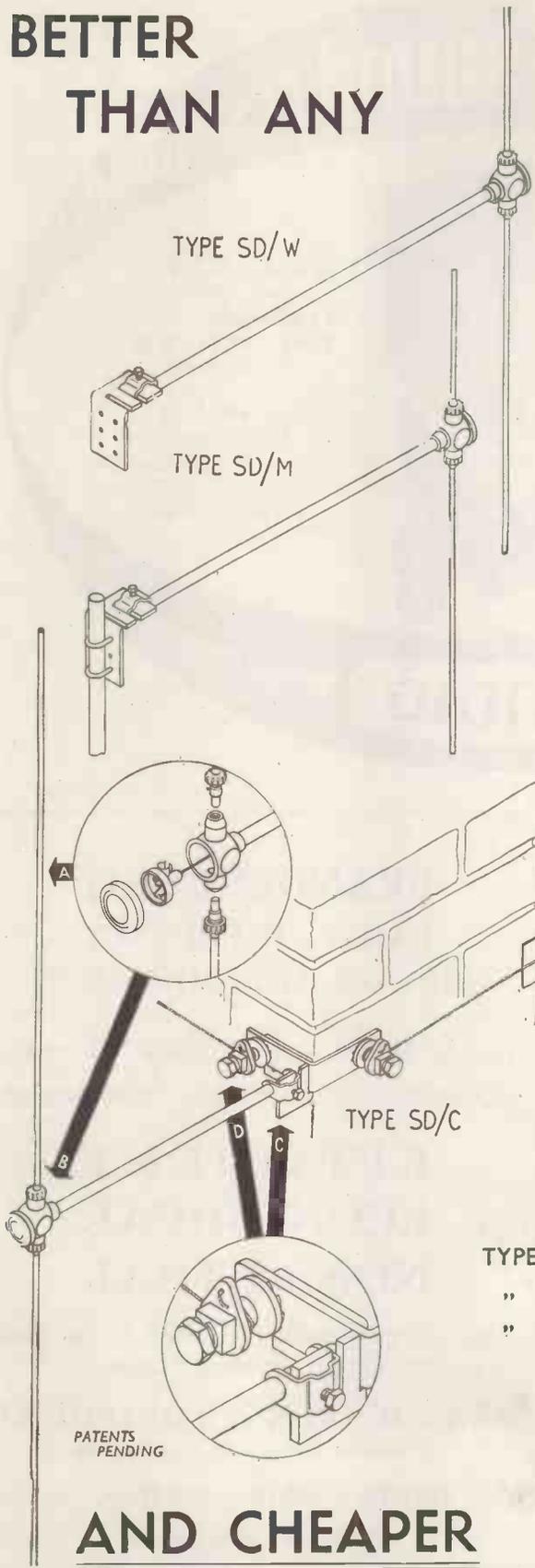


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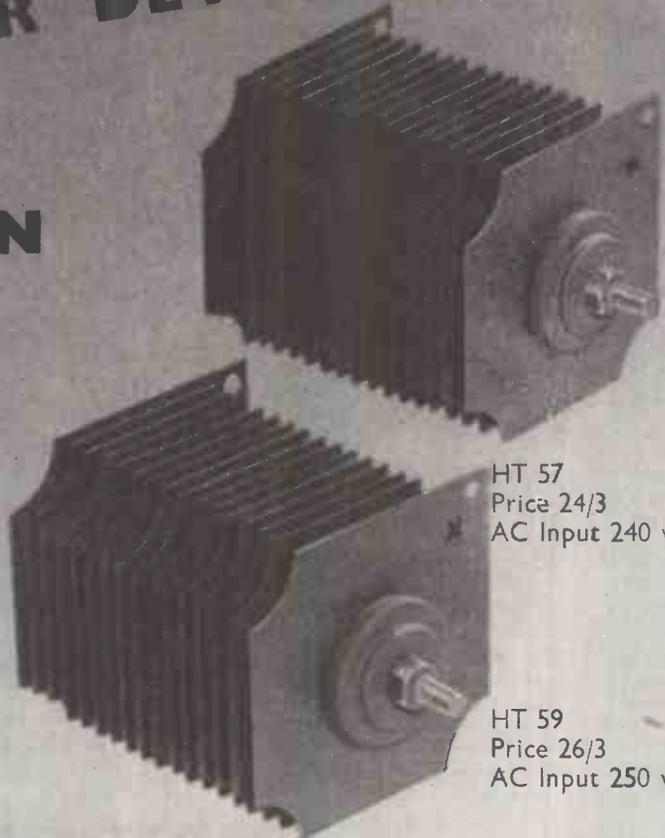
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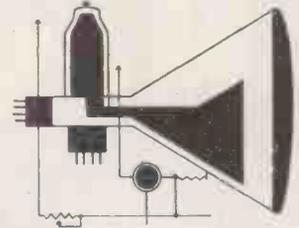
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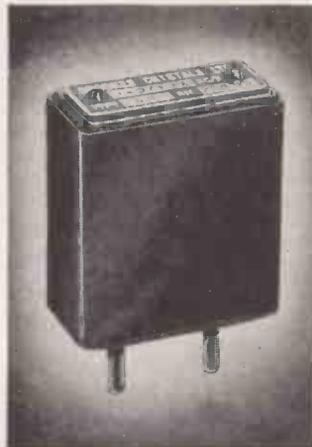
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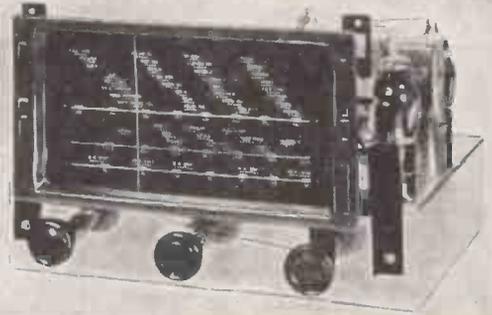
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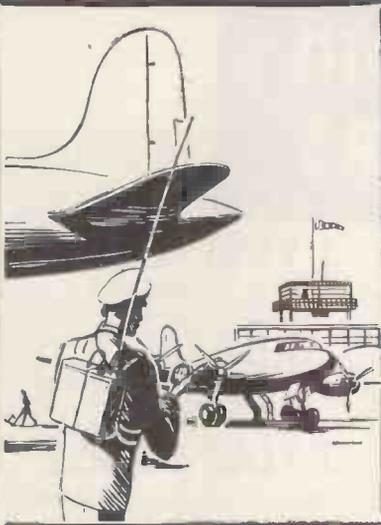
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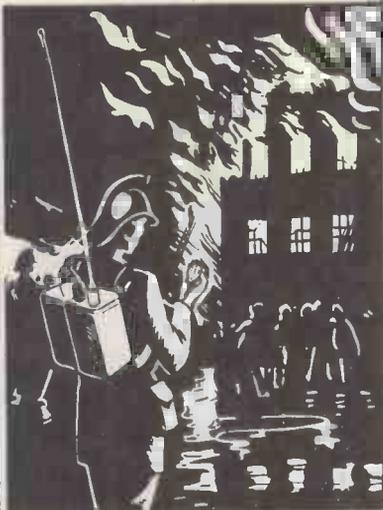
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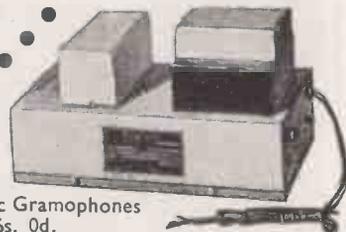
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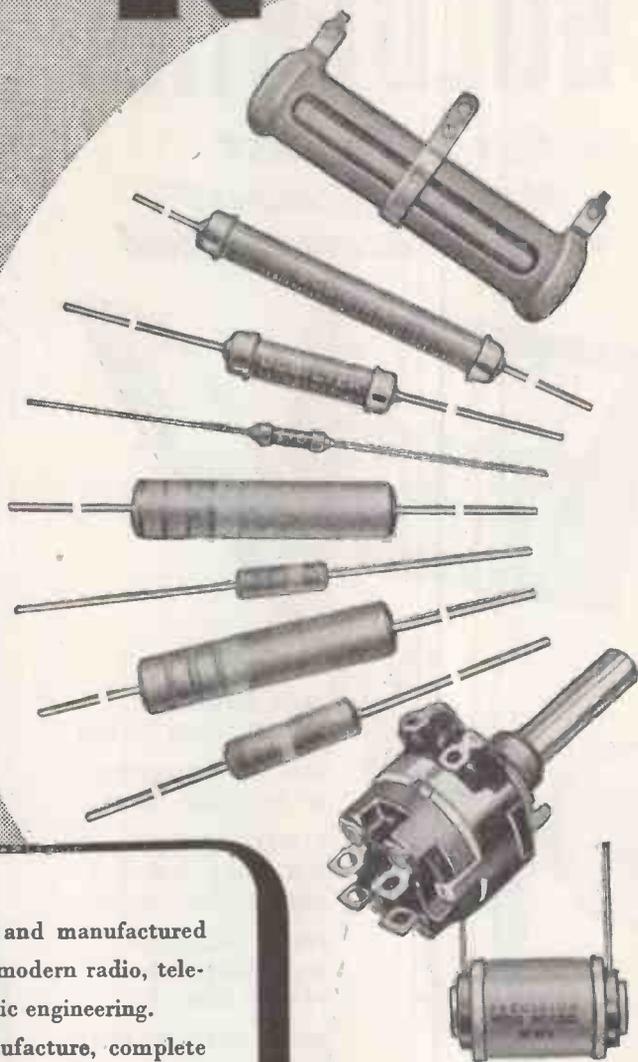
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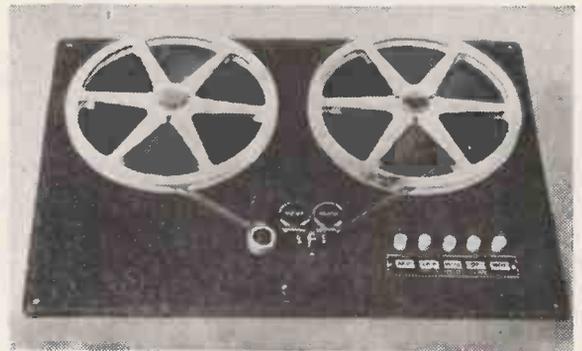
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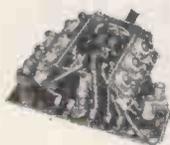
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Please mention "Wireless World."

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The overwhelming reception you get when you fit one of these really powerful units in compact form is more proof that OSMOR "Q" Range Coilpacks provide quality and performance right out of proportion to their modest size and modest cost. They have everything that only the highest degree of long practised technical skill can ensure—extra selectivity, super sensitivity, adaptability. Size only 1½ x 3½ x 2½, with variable iron-dust cores and Polystyrene formers. Built-in trimmers. Tropicalised. Pre-aligned, receiver-tested and guaranteed. Only 5 connections to make. All types for Mains and Battery superhets, and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver, TR.1196, Type 18, Wartime Utility and others. Send today for particulars!

SEPARATE COILS: A full range is available for all popular wavebands and purposes. Fully descriptive leaflet and connection data available. Just note these "plus points":

Only 1in. high. Packed in damp-proof containers. Variable iron-dust cores. Fitted tags for easy connection. Low loss Polystyrene formers.



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A spotlight on another of the "specials" in the OSMOR "Q" Coil Range

45 K/C Tape Recorder Oscillator Coil

TYPE QT8.

A centre tapped wave-wound coil as illustrated for TRUVOX and similar tape-decks. Singlescrew fixing. Fitted tags.

7/6 each



TWO for the Price of ONE

The NEW **OSMOR** CHASSIS CUTTER

An inexpensive but invaluable tool of entirely new design. Cuts two hole sizes with any one reversible punch and die; and can be operated with a spanner or tommy-bar. Blanks easily removed. For use on steel up to 18 s.w.g. Brass and Dural up to 16 s.w.g. Aluminium and Copper up to 14 s.w.g.



P. Pat. 11325/53

Type	Hole Sizes	Illust. price
1	1in. x 1½in.	} Illust. price list on request.
2	1½in. x 1½in.	
3	1½in. x 1½in.	
4	1½in. x 2in.	

Tommy-bars available.

The OSMOR "JIFFY PUNCH"

For cutting smaller holes neatly and quickly with one blow of a light hammer.



P. Pat. 11324/53

Type	Hole Size	Illust. price
A	½in.	} Illust. price list on request.
B	¾in.	
C	1in.	

For use on Steel up to 20 s.w.g. Brass and Dural up to 18 s.w.g. Aluminium and Copper up to 16 s.w.g.

(Dept. W.50) 418, BRIGHTON ROAD, SOUTH CROYDON, SURREY.

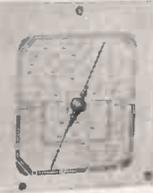
DIALS

Type A. Glass DIAL ASSEMBLY (as illus.) measuring 7in. x 7in. (9½in. x 9½in. overall) mounts in any position on or above the chassis and works with any type of drive. Choice of two 3-colour scales—G1 (L.M.S.) or G2 (M.S.S.). Price complete 24/6. P. & P. 1/6. Pulley assembly for right angle drive if required 1/9. Escutcheon 4/-.



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Overall size 5½in. sq. Printed area 4in. sq., as illustrated. Cream background, 3-colour. Type M1, L.M.S. waves. M2, L. & M. waves. M3, M. & 2/S. waves. Price 3/6 each. Pointer, 1/6. Drum, Drive, Spring and Cord for use with both types of dial, 3/2.



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Send 5d. (stamp) for fully descriptive literature including "The really efficient 5-valve Superhet Circuit and practical Drawings," 6-valve ditto, 3-valve (plus rectifier) T.R.F. circuit, Battery portable superhet circuit, Coil and Coilpack leaflets, Chassis Cutter leaflet, and full radio and component lists, etc., etc.

We keep stocks of many radio components for use in published circuits, including:—

"WIRELESS WORLD" "No Compromise" TRF Tuner. "Midget Mains Receiver." Sensitive 2-Valve Receiver. Television Converter (special coils in cans available), etc., etc.

"PRACTICAL WIRELESS" Coronet Four; Beginners' Superhet; Modern High Power Amplifier 2; Attache Case Portable; R1155 Converter; A.C. Band-Pass 3; Modern I-Valver; 3-speed Autogram.

Dear Reader, We can't mention all our products here but shall be glad to receive your enquiries for Chassis, Tuning Condensers, Switches, Volume Controls and all other Radio Components. If it's top-quality components and a speedy, courteous service you are looking for—try Osmor. We really shall do our best for you.



Keep those small components—resistors, condensers, etc., neatly stored yet visible by using an

OSMOR "JAR-RACK"

(If you're a generous husband you'll buy one or two for your wife's larder, too—she will appreciate the extra space they make.) Holds any 1 lb. jam jars, with or without lids. Easily removed, cannot fall out. Just the thing for the tidy "HAM" or Radio Dealer. Type 1 for wall-fixing, 6/9 each, holds 8 jars (Jars are not supplied but are easily obtained.)

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Aerial plugs in here	TYPE METRES
1	141-250
2	218-283
3	267-341
4	319-405
5	395-492
6	455-567
7	1450-1550
8	410-550 k/c

This is a device on the well-known "wave-trap" principle, which will reject an undesired signal when inserted in the aerial lead.

The Separator may easily be tuned to eliminate any one Station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.

Complete with plug, socket and full instructions—nothing to add.

7/6 POST FREE Satisfaction guaranteed.

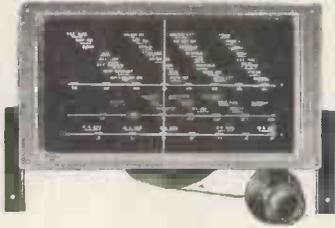
..... 465 k/c. Permeability-tuned with flying leads. Standard size 1½in. x 1½in. x 3½in. For use with OSMOR coilpacks and others, 14/6 pair. PREALIGNED, 1/6 extra.

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Replacement Scales calibrated to Copenhagen Plan now available for :

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Model VM6451



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Designed to provide direct readings for A.C. voltages from 10 millivolts to 2 volts. Three ranges are provided and readings are accurate within 1db from 50 cycles to 150 megacycles. The double triode measuring valve is detachable from the cabinet. This instrument can also be used for modulation carrier detection with the use of headphones. Write for full specification.

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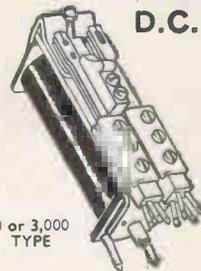
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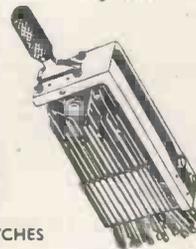
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TYPE

CONTACTS

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600 TYPES: (M), (B) and (C), in Twin-silver and Twin-platinum.



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SWITCHES

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2 C/O, to 8 C/O. Special types made up to order.

MINIATURE ELECTRONIC COMPONENTS



NEW MIDGET TRANSFORMER, TYPE S

This new series of Fortiphone midget transformers, type S, has been specially designed for use with junction-type transistors when the size of the apparatus must be kept to a minimum. These new transformers are so tiny (0.375 x 0.375 x 0.250 in.) as to be smaller than the transistor itself! Most requirements can be met from the range of Fortiphone type S transformers available. On receipt of details we will

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Actual Size

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Designed for use in circuits employing sub-miniature valves or junction-type transistors, Fortiphone type T transformers are larger than Fortiphone type S transformers and are intended for use where smallness is not the first consideration. The connection contacts on these transformers are moulded into the cheek of the bobbin. Fortiphone type T transformers are available in over fifty different specifications. We will recommend suitable

transformers or, if necessary, make a specimen transformer specially suited to your purpose on receipt of details of your requirements. Every transformer is tested before final assembly for short-circuited turns, frequency response, and general efficiency. *Overall dimensions: 0.660 x 0.484 x 0.460 in., or 1.675 x 1.228 x 1.170 cm. Weight: 0.068 oz. or 1.92 grams.*



Actual Size

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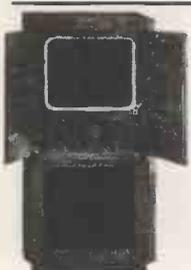
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 With Full Length Doors **£14.0.0**
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 Carriage and Packing 15" extra.

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LTD.

HIGH QUALITY TAPE RECORDING EQUIPMENT

THE MODEL 5D TAPE DESK (to take 10 1/2 in. NAB Reels)
 Programme Time: 62 minutes at 7 1/2 i.p.s.
 124 minutes at 3 1/2 i.p.s.

Panel size: 20 in. x 14 1/2 in.
 Two speeds, 3 1/2 and 7 1/2 i.p.s. Double track heads. Push button control. Fast wind and rewind. Three heavy duty motors. Three separately shielded heads. Complete with NAB reel adaptors
PRICE: (fitted with 6RP heads) £50/-.

ALSO AVAILABLE

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 Programme Time: 55 mins. at 7 1/2 i.p.s.
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PRICE: (fitted with 6RP heads)
 Large Panel (20 in. x 14 1/2 in.), **£47/10/-**.
 Small Panel (13 1/2 in. x 15 1/2 in.), **£45/10/-**.

MODEL 5B TAPE DESK (to take 7 in. reels)
 Programme Time: 31 mins. at 7 1/2 i.p.s.
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PRICE: (fitted with 6RP heads)
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In rexine covered case, fitted with model 5B tape desk, type D.2. C.J.R. amplifier with monitoring. Provision for external loud-speaker.

PRICE: £117/- (without microphone)

High fidelity sound heads. Type 5RP (Record/play), **£3/5/-**. Type 6RP (super fidelity), **£3/15/-**. Type 5E (Erase), **£3/5/-**. Mumetal 5 screening cans, 8/6. Amplifiers, microphones. All types and sizes of magnetic tape.

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Please write to us for details, we shall be very happy to help.

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**FULLY INTERLEAVED
SCREENED AND IMPREGNATED. ALL GUARANTEED.
ALL PRIMARIES ARE 200/250 v. Half Shrouded.**

HSM43 (Midget). Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps.	16/3
HS43 . Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps.	16/6
HS40 . Windings as above. 4 v. at 4 amps., 4 v. at 2 amps.	16/6
Output	
HS2 . 250-0-250 v. 80 m/a.	19/-
HS3 . 350-0-350 v. 80 m/a., 19/-. HS30 . 300-0-300 v. 80 m/a.	19/-
HS2X . 250-0-250 v. 100 m/a., 21/-. HS75 . 275-0-275 v. 100 m/a.	21/-
HS30X . 300-0-300 v. 100 m/a., 21/-. HS3X . 350-0-350 v. 100 m/a.	21/-

Fully Shrouded

FSM63 (Midget). Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps.	26/9
Output	
FS2 . 250-0-250 v. 80 m/a.	21/-
FS30 . 300-0-300 v. 80 m/a., 21/-. FS3 . 350-0-350 v. 80 m/a.	21/-
FS2X . 250-0-250 v. 100 m/a., 23/-. FS75 . 275-0-275 v. 100 m/a.	23/-
FS30X . 300-0-300 v. 100 m/a., 23/-. FS3X . 350-0-350 v. 100 m/a.	23/-
All the above have 6.3 4-0 v. at 4 amps., 5-4-0 v. at 2 amps.	
FS43 . Output 425-0-425 v. 200 m/a., 6.3 v. 4 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded	47/6
FS50 . Output 450-0-450 v. 250 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded	67/6
FS5X . Output 350-0-350 v. 250 m/a., 6.3 v. 6 amps., 4 v. 8 amps., 4 v. 3 amps., 0-2-6.3 v. 2 amps. Fully shrouded	65/-
FS160X . Output 350-0-350 v. 160 m/a., 6.3 v. 6 amps., 6.3 v. 3 amps., 5 v. 3 amps. Fully shrouded	44/-
FS43X . Output 425-0-425 v. 250 m/a., 6.3 v. 6 amps., 6.3 v. 6 amps., 5 v. 3 amps. Fully shrouded	63/6
HS6 . Output 250-0-250 v. 100 m/a., 6.3 v. 6 amps., C.T. 5 v. 3 amps. For receiver RI355. Half shrouded	26/6
HS150 . Output 350-0-350 v. 150 m/a., 6.3 v. 3 amps., C.T. 5 v. 3 amps. Half shrouded	27/9
F36 . Output 250-0-250 v. 100 m/a., 6.3 v. 6 amps., C.T. 5 v. 3 amps. Fully shrouded	29/6
FS120 . Output 350-0-350 v. 120 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 2 amps., C.T. 5 v. 3 amps. Fully shrouded	29/9
FS256 . Output 250-0-250 v. 80 m/a., 6.3 v. at 6 amps., 5 v. at 3 amps. Fully shrouded	28/6
PR1/1 . Output 230 v. at 30 m/a., 6.3 v. at 1.5/2 amps.	21/-
FS150 . 350-0-350 v. 150 m/a., 6.3 v. 4 amps., 5 v. 3 amps.	31/6
FS150X . Output 350-0-350 v. at 150 m/a., 6.3 v. at 2 amps., C.T. 6.3 v. at 2 amps., C.T. 5 v. at 3 amps. Fully shrouded... The above have inputs of 200/250 v.	31/6

OUTPUT TRANSFORMERS

MIDGET OP . 5,000Ω to 3Ω	3/9
8,000Ω to 3Ω	3/9
MOPI . Ratios, 26, 46, 56, 66, 90, 120-150 m/a. max. current, C.T. for Q.P.P. Class B, etc. Secondary 2/4 ohms. Top panel, and clamped, each	5/6
OP10 . 10/15 watts output, 20 ratios on Full and Half Primary	17/9
OP30 . 30 watts output, 20 ratios on Full and Half Primary	25/9
Williamson's O.P. Transformer to Author's specification...	£4/4/-
Chokes for Williamson's Amplifier , 30 H. at 20 m/a.	16/6
10 H. at 150 m/a.	32/-

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All 200/250 v. Input.

F3 . 6.3 v. @ 3 amps.	9/6
F-4 . 4 v. @ 2 amps., 7/6. F-6 . 6.3 v. @ 2 amps.	7/6
F6X . 6.3 v. @ 0.3 amps., 5/6. FI2X . 12 v. @ 1 amp.	8/-
FU6 . 0-2-4-5-6.3 v. @ 2 amps., 10/-. FI2 . 12.6 v. tapped 6.3 v. @ 3 amps.	16/6
F24 . 24 v. tapped 12 v. @ 3 amps.	23/6
F29 . 0-2-4-5-6.3 v. @ 4 amps., 18/9. FUI2 . 0-4-6.3 v. @ 3 amps.	17/6
FU24 . 0-12-24 v. @ 1 amp.	17/6
F5 . 6.3 v. @ 10 amps. or 5 v. @ 10 amps., or 12.6 v. @ 5 amps., or 10 v. @ 5 amps.	34/-
F6/4 . Four windings at 6.3 v. tapped 5 v. @ 5 amps. each, giving by suitable series and parallel connections up to 6.3 v. @ 20 amps.	51/6

Quotations, etc.—stamped addressed envelope, please

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SLIDING DIMMERS for control of lighting from full-bright to blackout at 220/240 v. Fully enclosed and safe, 100 watts, 36/-, 200-watts, 42/6, 300 watts, 47/6 (des. any one 2/-), 500 watts 55/- (des. 3/-).

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1 kW Channelised Transmitter

THE GFT.560 is a 1kW channelised transmitter with a frequency range of 1.5—30 Mc/s. It consists of **three basic cabinets**—r.f. unit, modulator unit, and power supply unit—combinations of which can be used to provide multi-frequency working as well as a number of different types of emission. The wave change facilities of the transmitter are both rapid and reliable—a valuable asset when the operating frequency is changed many times each day.

The GFT.560 is fully tropicalised, and its unit construction facilitates future expansion of the initial installation, should the need arise.

For use in conjunction with the GFT.560 there are ancillary units that enable the transmitter to be remotely controlled over a two wire telephone circuit: operational adjustments are dialled to the transmitter.

The versatility and reliability of this new Mullard transmitter make it particularly suitable for h.f. en-route, ground-to-air services and point-to-point communication networks. A team of Mullard communication engineers is available to advise on the use of the GFT.560 in such applications. They will also assist in planning complete communication systems, if required.

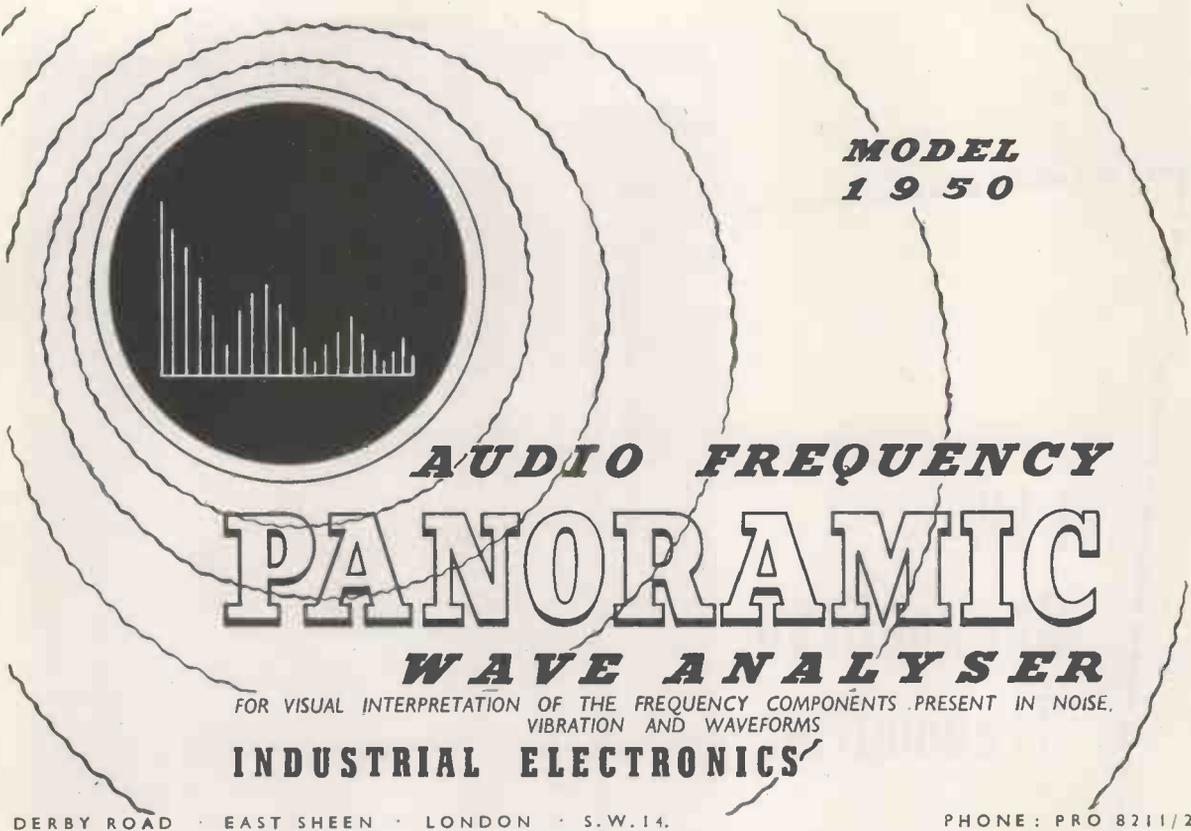
**ABRIDGED
DATA**

Frequency Range 1.5—30 Mc/s
Frequency Stability To Atlantic City, 1947, standards
Power Output 1 kW
Types of Emission c.w., m.c.w., telephony, frequency shift, single and independent sideband. (A1, A2, A3, F1, A3a and A3b)
Output Impedance 600 ohms balanced twin feeder
Power Supply 400V, 50-60 c/s, 3-phase

Mullard



SPECIALISED ELECTRONIC EQUIPMENT



**MODEL
1950**

AUDIO FREQUENCY PANORAMIC WAVE ANALYSER

FOR VISUAL INTERPRETATION OF THE FREQUENCY COMPONENTS PRESENT IN NOISE,
VIBRATION AND WAVEFORMS

INDUSTRIAL ELECTRONICS

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S. G. Brown

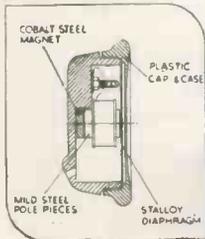
"F" TYPE HEADPHONES

**for LONG LIFE and
TROUBLE-FREE SERVICE**

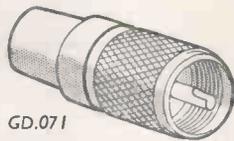
This is a featherweight model of exceptionally strong construction and high sensitivity. It appeals equally to both amateur and professional radio-engineers. It incorporates powerful cobalt steel magnets with flat Stalloy diaphragms.

D.C. Resistance: 4,000 ohms.
Impedance: 14,000 ohms at 1,000 c/s.

For full details of other models in the wide S. G. Brown range please write for Illustrated Brochure "W."

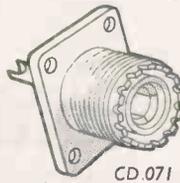
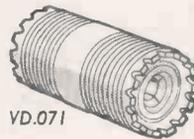
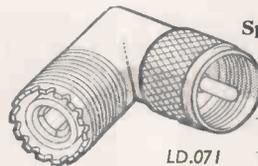


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SHAKESPEARE ST., WATFORD, HERTS.
Telephone: Watford 7241.



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Single and multi-way types.
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U.S. Type Connectors
as illustrated.

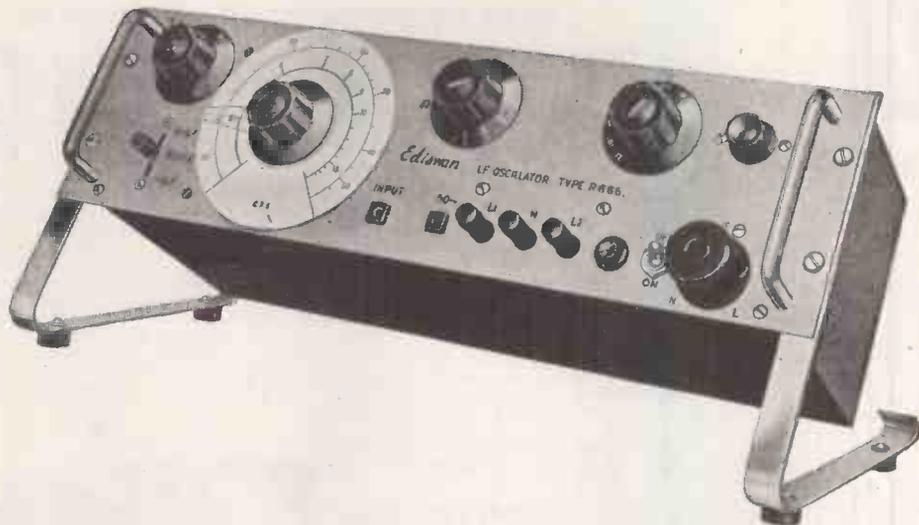


CABLE O.D.	TYPE	CODE NO.
0.41"	Straight plug	GD.071
0.25"	Reducing adaptor	RD.07/05
0.2"	Reducing adaptor	RD.07/03
fits on GD.071, CD.071, VD.071	Elbow plug adaptor	LD.071
fits on GD.071, LD.071	Bulkhead (Junction) adaptor	VD.071
fits on GD.071, LD.071	Chassis receptacle	CD.071

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The Ediswan Low Frequency Oscillator type R.666 provides a dependable low frequency standard for testing, calibration and set up of biological amplifiers and recorders, strain and vibration recorders, and low frequency wave analysers.

Production of this Oscillator has been stepped-up to meet the great demand for it and delivery can now be made with little or no delay. Complete the attached coupon or write for further details.

Brief Specification of Ediswan Low Frequency Oscillator type R.666

TYPE. Resistance capacity, with automatic amplitude control effective over the whole frequency range.

FREQUENCY RANGE. 1.15 c.p.s. to 5,500 c.p.s. **INPUT.** 200—250 volts, 40—60 c.p.s.

OUTPUT. Sine wave 50 volts peak to peak, push-pull, with built-in attenuator.

CONSTRUCTION. Standard 19" rack mounting, but also suitable for bench use. Bench stands available.

NOTES. An incremental switch is fitted. Provision is made for modulation of output.

PRICE £75 nett **STANDS** £1. 1s. nett



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 Please send me full details of the Ediswan Low Frequency Oscillator Type R.666.

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RADIO DIVISION

THE EDISON SWAN ELECTRIC CO. LTD.,
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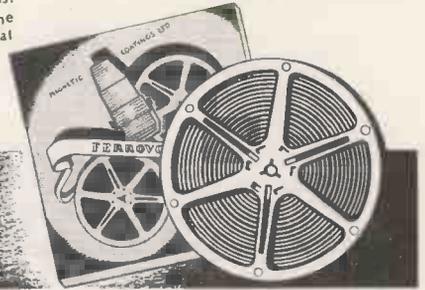
- 1 Does not curl—lies flat on the transducer head, giving better frequency response, and smooth tracking.
- 2 Has the lowest possible surface friction—reducing wear on transducer heads, and guide pillars.
- 3 Has the best possible dispersion of oxide particles, free from coagulation, and flocculation ensuring low noise level.
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- 5 The Lacquer is formulated to attain the maximum adhesion to the base material.

- 6 Gives the highest possible signal-to-noise ratio—excelling in high-frequency response.
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- 10 The Lacquers are pigmented with the highest grade powder. The individual particle size is less than one micron (0.000039 inch).

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- 13 "FERROVOICE" products are subject to continuous development by our technical staff.
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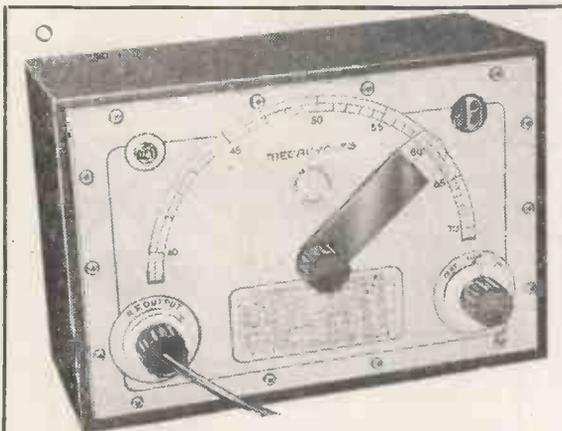


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SEND 1/6 FOR EASY TO FOLLOW POINT-TO-POINT DIAGRAMS AND CIRCUIT DIAGRAM which shows how YOU can build the Receiver illustrated above.



THE COMPLETE KIT to construct a 3-valve plus rectifier T.R.F. Receiver for use on 200/250 v. A.C. mains can be supplied at £5/15/0, plus 2/6 packing and carriage. Each Kit is complete in every detail, nothing has to be made or improvised. Easy to follow, point-to-point diagrams are supplied, making construction very simple. The Dial is illuminated, and the Receiver housed in its Cabinet, size 12in. x 6in. x 6in., presents an attractive appearance. The valve line-up is: 717A—HF. Pentode VR116 — Detector. ATP4 — Output, and Metal Rectifier. Waveband coverage for the medium and long bands. Choice of 3 Cabinets: Bakelite in Walnut or Ivory, or Wooden (Walnut finish).



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Valve line-up: 12T7, 35L6, 148T, 35Z4.
Entirely transportable and unusually sensitive owing to special feed-back circuit employed. Housed in attractive plastic cabinet. Choice of 2 colours—Brown and Cream.
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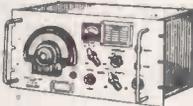


MANUFACTURER'S SURPLUS STOCK

5-VALVE SUPERHET RADIO RECEIVER CHASSIS, built to high standards ensuring quality reception. **SPECIFICATION: 5-VALVE LINE-UP: 78T, 7B7, 7C6, 7C5, 7Y4, 3 WAVEBANDS** Long, medium and short. **CONTROLS:** Tuning, wave change, volume tone control on/off/Gram position on Switch, Pick-up and Extension Speaker Sockets incorporated. For use on 200/250 v. A.C. mains. **DIMENSIONS:** Length 14 1/2 in., height 11 1/2 in., width 6 1/2 in. Distance between controls, left to right from edge of chassis: 1in., 3in., 9 1/2 in., 3in. Plus 5/- pkg./carriage. **£7. 19. 6**
The above Receiver less Speaker and Output Transformer. A suitable 10in. Moving Coil Speaker and Output Transformer can be supplied at 29/- extra.

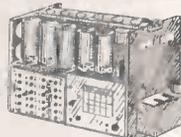
LIMITED QUANTITY 1132A RECEIVER UNITS COMPLETE WITH CIRCUIT

11-valve Superhet Receiver, covering 100 to 124 Mc/s., using four VR53, two VR56 and VR65, VR87, VS54 and VR57 valves. Fitted with Tuning Meter, slow motion Drive, R.F. and L.F. Gain. Control. etc. Circuit: R.F. amp, frequency changer, oscillator and stab., 3-I.F. amps., B.F.O. Det., first audio and output. Brand new, with circuit diagram.
Price **59/6** plus 7/6 carriage.
POWER PACK for above completely wired and tested, will fit on Receiver chassis. Price 50/-, plus 2/6 pkg. and carr.



I124 RECEIVER UNITS

Range 30 to 40 Mc/s. Contains six new Valves 3-9D2, 1-8D2, 1-15D2 (frequency changer), 1-4D1, 24 ceramic trimmers, 8 ceramic valveholders, 6 valve screening cans, 30 resistors, 1-W/W Pot. Meter Mica Tubular and Block Cond. 2 Westector WX6 and 1 Westector WX4, 5-way 4-bank switch with long spindle. I.F. transformers, etc. **17/6** plus 3/6 postage and packing.



I155 RECEIVER UNIT

SLIGHTLY SOILED
In original cases complete with 10 valves. Frequency range 18.5 Mc/s.—75 Kcs. in 5 wave bands. **£7/10/6**. Plus 10/6 packing and carriage.



POWER SUPPLY UNIT

(or above, incorporating output stage. Supplies an output of 250 volts at 90 mA., and which is ample for the R1155 with the output stage. Jones plugs for connecting the Power Pack to the Receiver are included. The 6V6 output stage complete with Output Transformer and 6 1/2in. speaker is built into the unit. Price £5/5/-, plus 5/- packing and carriage.



We have a few Brand new R1155 Receivers in original cases, complete with 10 valves. Frequency range 18.5 Mc/s.—75 Kcs. in 5 wave bands. **PRICE £11/19/6**. Plus 10/6 pkg. and carr.

As a special offer, power supply unit including speaker together with R1155 receiver. **PRICE £16.19.6**. Plus 15/- pkg. & carr.

R1355 RECEIVER AMPLIFIER

with 5 I.F. Stages for T.V. conversion. Contains 7 VR65's. 1—5U4, 1—VU120, 1—EA50. **£11/10/6**. Plus pkg. and carriage 10/-.

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Frequencies covered 30-20 Mc/s. (10-15 metres). Switched tuning, 5 pre-tuned spot freq. 3/VR65 (SP61) 12/6

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12in.	16/11	15in.	27/6

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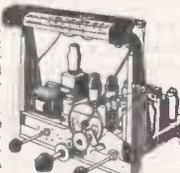
5-VALVE SUPERHET RADIO CHASSIS



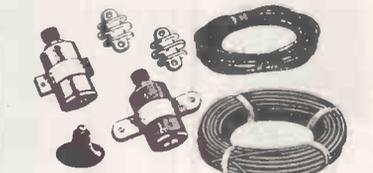
Drilled and cut out for all necessary control mountings and Mains Transformer, fitted with 5 Amphenol Octal Valveholders, Aerial, Earth and Gramophone Sockets. 500 pf Tuning Gang Condenser, full vision drive Tuning Assembly consisting of unbreakable Perspex 3-coloured scale for long, medium and short wavebands. Calibrated in metres, kilocycles and station names, price 39/6.

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Built to exacting specifications and incorporating features ensuring superlative tonal qualities and world-wide reception. Specification: 8 watts push-pull output using 2 Mazda Pen 45 valves. Amplifier negative feedback is applied over all the audio amplifier. Amplifier Mazda Type HA11DD gives signal Detection A.V.C. and Phase Splitting. Two stages of I.F. amplification 465 Kc/s. using Mazda VP41. **FOUR WAVEBANDS—14 M.-24 M., 24 M.-55 M., 190 M.-600 M., 900 M.-2,000 M.** **DIRECT AND VERNIER TUNING.** Gram. position on Switch. Provision for external Loudspeaker. For use on 200/250 A.C. Mains. £13/10/-, plus 21/- pkg. and carr.



Famous Manufacturer's Surplus of ANTI-INTERFERENCE AERIALS offered at a fraction of original cost



The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wave bands. The equipment enables the installation of an 8.3 Mc/s. flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer, Transformer clip, Rubber sucker, 1/4in. x 1/4in. brass screw, 4AB x 1/4in. brass bolt, 4BA nut. Receiver Transformer. Complete with Insulators, clips, etc.; Porcelain Insulators, 2 each, 60ft. Insulated Aerial Wire, 60ft. Screened Co-Axial Down Lead. Installation instruction leaflet included. **LESS CO-AXIAL CABLE & AERIAL WIRE. 15/-**, plus 1/6 pkg. and carr. **COMPLETE 35/-**, plus 1/6 pkg. and carr.

2 STAGE QUALITY AMPLIFIER Complete with 10 in. Energised LOUSPEAKER

4 watts output. A.C. 110/230 mains. **£6. 19. 6** plus 5/- carriage.

DECCA MODEL 33A DUAL SPEED RECORD PLAYER

Includes crystal pick-up with sapphire stylus and a light weight plastic spring balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete with single head (either standard or long playing). **£4.19.6** Extra Head can be supplied for 13/6. Plus pkg. and carr. 5/-.

EX-U.S.A. U.H.F. AERIAL

with untuned detector stage, consisting of V.R.92 valve, etc. Brand new, in carton, 5/-.

MAINS NOISE ELIMINATOR KIT

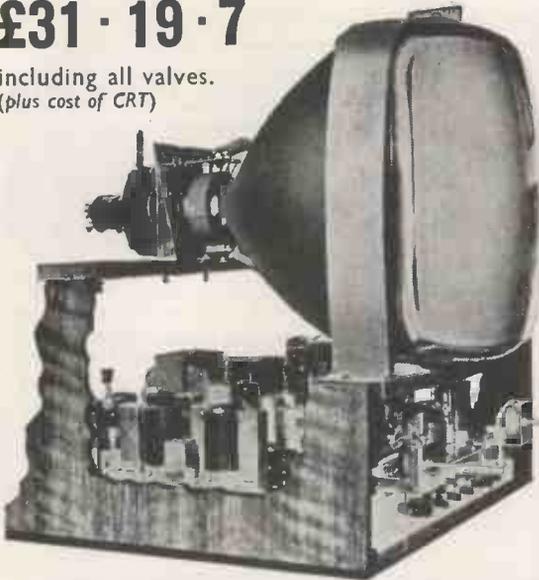
Two specially designed chokes with three smoothing condensers with circuit diagrams. Cuts out all mains noise. Can be assembled inside existing receiver. 5/6 complete.

PREMIER RADIO COMPANY

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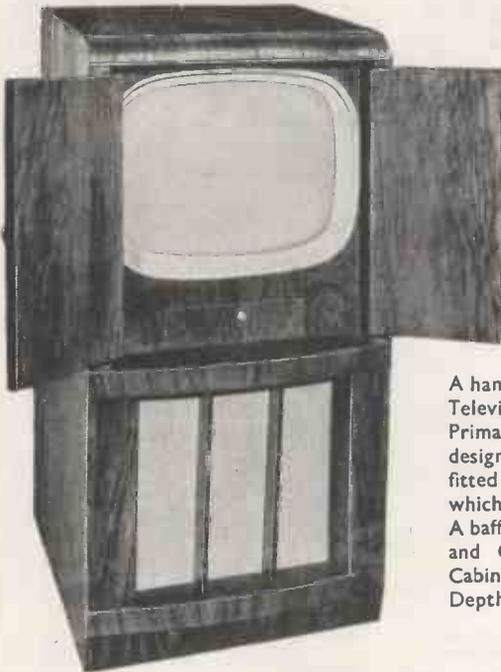
£31 · 19 · 7

including all valves.
(plus cost of CRT)



THE COMPLETE TELEVISOR IS SAFE TO HANDLE, BEING COMPLETELY ISOLATED FROM THE MAINS BY A DOUBLE WOUND MAINS TRANSFORMER. ALL PRESET CONTROLS CAN BE ADJUSTED FROM THE FRONT, MAKING SETTING UP VERY SIMPLE.

The Televisor may be constructed in 5 easy stages: (1) Vision, (2) Time Base, (3) Sound, (4) Power Pack, (5) Final Assembly. Each stage is fully covered in the Instruction Book, which includes layout, circuit diagrams and point-to-point wiring instructions.



PRICE **£13 · 10 · 0**

plus 21/- packing & carriage.

The NEW

PREMIER TELEVISOR

Three years ago we gave you the 6in., 9in. and 12in. Televisors which achieved tremendous popularity. Now after a considerable period of research our Technical Staff have designed a very worthy successor to these original Models.

Brief Technical Details are as follows:

20 valves (plus tube) Superhet Receiver, tunable from 40-68 Mc/s without coil or core changing. Wide Angle scanning Flyback EHT giving 14 kV, Duomag Focalliser permanent magnet focussing with simple picture centring adjustments, suitable for any 17in. or 14in. wide angle Tube, may also be used with a 12in. Tube with very minor modifications.

VISION CIRCUIT. Common RF Amplifier, single valve frequency changer, two IF stages, Video Detector and Noise Limiter followed by special type of Video Output Valve. ALL COILS PRE-TUNED ASSURING ACCURATE ALIGNMENT AND EXCELLENT BANDWIDTH.

SOUND CIRCUIT. Coupling from anode of frequency changer, two IF stages, Double Diode Triode detector and first LF Amplifier, Diode Noise Limiter and Beam type Output Valve, feeding a 10in. Speaker. ALL COILS PRE-TUNED.

TIME BASES. 2 valve sync. Separator, giving very firm lock and excellent interlace.

LINE TIME BASE. Blocking Oscillator using a pentode driving a high efficiency output stage comprising Ferroxcube Cored Output Transformer with Booster Diode.

FRAME TIME BASE. Blocking Oscillator driving a Beam Output Valve coupled through a Transformer to the high efficiency FERROXCUBE Cored Scanning Coils.

POWER PACK. Double wound Mains Transformer supplying all L.T. and H.T. using two full-wave Rectifiers.

The Instruction Book also includes full details for converting existing Premier Magnetic Televisors for use with modern wide angle tubes. All components are individually priced.

Instruction book 3/6, Post Free.

PREMIER TELEVISOR CONSOLE CABINETS

For 14" and 17" Televisors

A handsome Walnut Cabinet that will be a fitting housing for a first-class Televisor.

Primarily designed for our own Televisor, they are quite suitable for most designs published in the various Radio Periodicals. Folding doors are fitted to cover the Cathode Ray Tube when not in use. A flap is provided which gives access to any preset controls on the front edge of the Chassis. A baffle board suitable for a 10in. Loudspeaker and all the necessary Tube and Chassis bearers are included. The overall dimensions of both Cabinets are the same: Height 38½in. Width 19in. Depth Top 19in. Depth Bottom 21in.

TUBE ESCUTCHEONS

17in. White Moulded	21/-	(packing and postage 1/6)
17in. Bronze Moulded, Complete with Protective Glass	48/-	(packing and postage 2/6)
14in. Black Moulded	7/6	(packing and postage 1/-)
Dark Screen Filter suitable for 14in. or 17in. Tubes	19/6	(plus 1/6 packing and postage).

PREMIER RADIO COMPANY

WHY PAY MORE?

WILLIAMSON AMPLIFIER KIT 15gns.
 plus 7/6 post, pkg. & ins.
 This kit is absolutely complete and all components are guaranteed exactly to author's specification.

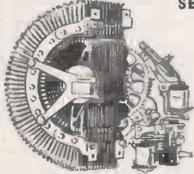
WILLIAMSON OUTPUT TRANSFORMER
 (author's spec.), 3.6 ohms. sec. **£4.4 0**

MAINS TRANSFORMER SP425A (with additional 6.3 v. 3a. and capable of supplying an extra 80 mA. for Pre-amp. or Feeder Unit) **£3.7 6**

PREMIER MAINS TRANSFORMERS
 All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened. All LTs are centre tapped.

SP175B, 175-0-175, 50 mA., 4 v. @ 1 a., 4 v. @ 2-3 a. 4 v. @ 3-6 a.	25/-
SP350A, 250-0-250, 100 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a.	29/-
SP351, 350-0-350, 150 mA., 4 v. @ 1-2 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a.	36/-
SP352, 350-0-350, 150 mA., 5 v. 2-3 a. 6.3 v. 2-3 a. @ 2-3 a. 6.3 v. @ 2-3 a.	36/-
SP375A, 375-0-375, 350 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-3 a.	55/-
SP501, 500-0-500, 150 mA., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 2-2 a. 4 v. @ 3-5 a.	47/-
SP501A, 500-0-500, 150 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 6.3 v. @ 2-3 a.	50/-
SP425A, 425-0-425, 200 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-5 a.	67/6
250-0-250, 80 mA., 6.3 v. @ 4 a. 5 v. @ 2 a.	19/6
350-0-350, 80 mA., 6.3 v. @ 4 a. 6 v. @ 2 a.	19/6
200-230-250, output 3 v.-50 v. @ 2 a.	17/6

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For many uses, including station selection on a Pre-tuned Radio Receiver.
 16 way, 53 Position.
 24 v. motor driven.
Price 69/6
 Plus 2/6 Pkg. & Carr.

PREMIER VARIABLE IMPEDANCE "MATCHMAKER" M.O.I.S. OUTPUT TRANSFORMER

Designed to meet the demand for an efficient variable ratio Output Transformer. 11 ratios from 13:1 to 80:1 all centre tapped and can be used to match any output valves either single- or push-pull. Class "A", "AB1", "AB2" or "B" to any low impedance speech coil or combination thereof. Primary Inductance 60 henries 15 watts audio 100 mA. Price 45/-.

WEYMOUTH MINIATURE I.F. TRANSFORMERS

465 Kc/s., Iron core, permeability tuned, 10/6 pair.

WEYMOUTH MINIATURE COIL PACK
 Covering Med./Long/Short wave bands. Iron cored coils, gram position on switch. Dimens: Height, 1 1/4 in. Length, 3 1/4 in. Width 2 1/4 in. Spindle length 2 in. Price 19/6.

MINIATURE TUNING CONDENSERS
 2 gang .0005 mfd. with trimmers **6/9**

CHARGER TRANSFORMERS
 Input 230 v. A.C. Output 12 v. at 1 amp. Completely shrouded. Price 9/11

BATTERY CHARGERS

200-250 v. A.C. Will charge 2 v., 6 v. and 12 v. Car Battery at 1 amp. Housed in strong metal casing. Finished in Green Hammered enamel. Size: 6 in. long, 3 1/2 in. wide, 3 1/2 in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain ex-Govt. components. Plus 2/6 post and pkg. **39/6**

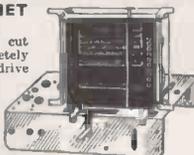


BATTERY CHARGER KITS

All incorporate metal rectifiers. Transformers are suitable for 200/250 v. A.C. cycle mains.
 Cat. No. 2002 Charges 6 volt accumulator at 1 amp. Resistance, supplied to charge 2 v. accumulator. **21/-**
 2004 Charges 2, 6 and 12v. accumulators at 1 amp. **24/6**

7-VALVE SUPERHET CHASSIS

All control mountings cut out, fitted with completely assembled full vision drive scale, long, medium and short waveband and band spread. Heavy flywheel, tuning, 19/6, plus 2/6 pkg. and carr.



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All parts to construct an eliminator to give an output of 120 volts at 20 mA., and 2 volts to charge an accumulator. Uses metal rectifier, 37/6.

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VCR516
 9in. Blue picture. Heater volts 4 Anode 4 Kv. In manufacturer's original carton. **£3/19/6.** Plus 5/- pkg., carr., ins.
VCR517C
 6 1/2 in. picture. This tube is a replacement for the VCR97 and VCR517. Guaranteed full size picture. Price 35/- Plus 2/6 pkg. carr. ins.



ALL BRAND NEW

AUTO TRANSFORMERS 50 WATTS
 Input/Output 0-110-210-220-230-240-250 volts. Plus 1/- P. & P. **7/6**

SPECIAL OFFER THE FAMOUS "CHANCERY" HIGH FIDELITY MICROCELL PICK-UP—TYPE GPX for Standard and Long Playing



The Chancery Light Weight GPX Pick-up which has a sapphire stylus which is precision ground and semi-permanent. With two cartridges 1 L.P. and 1 Standard Price 52/6. Additional L.P. or Standard Cartridges can be supplied from stock at 19/6 each.

QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 26/- plus 1/6 Pkg. and Carr.

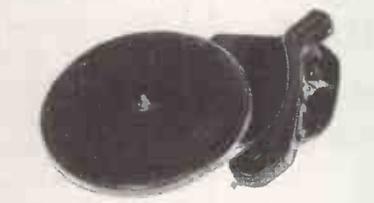
PORTABLE GRAMOPHONE UNIT

Ready to plug into Radio or Amplifier. Fitted with B.B.B. 2-speed motor 33 1/3 and 78 r.p.m. and Chancery high fidelity microcell pick-up type (G.P.X.) with L.P. and Standard Cartridge. Assembled in resin covered cabinet. Height 5 1/2"; Length 15"; Depth 13".



Price £7.7.0
 plus 5/- Pkg. & Carr.
 Cabinets can be obtained separately at 29/6 plus 2/6 Pkg. & Carr. Carrying handle and clips are supplied free.

SPECIAL OFFER—AT ALMOST HALF PRICE PLESSEY GRAMOPHONE UNITS



The Motor, Tone arm, and Magnetic Pick-up is in one Unit, with Automatic stop and start. For use on 200/250 v. A.C. mains 50 cycles. Limited quantity only. **£3/19/6.** plus 2/6 packing and carriage.

GARRARD Rim Drive 78 r.p.m., complete £5.19.6
 with magnetic pick-up and turntable
 Packing and carriage on the above units 2/6

THE COLLARO RC3/521 3-SPEED AUTOMATIC RECORD CHANGER



Magnetic Studio head transformer. Included. Motor suitable for 100/125v. or 200/250 v. Play either 7" or 10" or 7" and 12" not mixed.
Price £9.19.6
 Plus 5/- Pkg. & Carr.

"MASTERADIO" VIBRATOR PACK

6 v. input, 180 v. 35 mA. output, complete with valve rectifier and leads. **39/6.** Plus 5/- pkg., carr.

ACCUMULATORS
 Lead Acid Celluloid Non-Spill, 2 v., 7 amps. **8/6**
 2 volt 10 amp (by famous maker) **4/11**

RECTIFIERS

E.H.T. Penoil Type S.T.C.	
Type K3/25	650 v. 1 mA. 4/7
" K3/40	3.2 kv. 1 mA. 6/-
" K3/45	3.6 kv. 1 mA. 8/2
" K3/50	4 kv. 1 mA. 8/8
" N3/160	12 kv. 1 mA. 21/6
H.T. Type S.T.C.	
Type RM1	125 v. 60 mA. 4/-
" RM2	125 v. 100 mA. 4/6
" RM3	125 v. 125 mA. 5/6
" RM4	250 v. 250 mA. 18/-
L.T. Type Full Wave	
6 v. 1 amp.	4/-
12 v. 1 amp.	8/-
12 v. 2 amp.	10/9
12 v. 4 amp.	15/-

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5 1/2 in. pentode, 4 volt Heater. This Electrostatic Tube is recommended as eminently suitable for Television. 15/- plus 2/6 Pkg., carr. and ins. Data sheets supplied.

SUPER QUALITY TELEVISION MAGNIFYING LENS

5in. lens suitable for 6in.	18/6
6in. lens	25/-
10in. lens	22/10/-
12in. lens	23/10/-

ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium, with four sides

7 x 5 1/2 x 2 1/2 in. ..	4/-
7 x 3 1/2 x 2 1/2 in. ..	3/9
9 1/2 x 4 1/2 x 2 1/2 in. ..	4/3
10 x 8 x 2 1/2 in.	5/6
12 x 8 x 2 1/2 in.	7/-
14 x 8 x 2 1/2 in.	7/6
10 x 9 x 3 1/2 in.	7/-
12 x 10 x 3 1/2 in.	7/9
14 x 10 x 3 1/2 in.	7/11
16 x 10 x 3 1/2 in.	8/3
16 x 8 x 2 1/2 in.	5/-



ALUMINIUM PANELS 18 s.w.g.

7 x 6 in.	1/3	7 x 4 in.	1/-
9 1/2 x 6 in.	1/8	9 1/2 x 4 in.	1/5
10 x 9 in.	2/2	10 x 7 in.	1/11
12 x 9 in.	2/5	12 x 7 in.	2/5
14 x 9 in.	3/2	14 x 7 in.	2/11
16 x 9 in.	3/6	16 x 7 in.	3/5
20 x 9 in.	4/8	20 x 7 in.	4/5
22 x 9 in.	5/2	22 x 7 in.	4/11

LOUDSPEAKERS

ELAC—2 1/2 in. dia., Moving Coll, 15 ohms imp.	15/-
PLESSEY—3 in. dia., Moving Coll, 3 ohms imp.	9/11
ELAC—3 1/2 in. dia., Moving Coll, 3 ohms imp.	15/-
ELAC—5 in. dia., Moving Coll, 3 ohms imp.	15/6
ELAC—8 in. dia., Moving Coll, 3 ohms imp.	19/6
PLESSEY—8 in. dia., Mains Energised, 3 ohms imp. (600 ohms field), with Pentode Transformer	22/6
PLESSEY—8 in. dia. Mains Energised, 3 ohms imp. (600 ohms field)	19/6
PLESSEY—10 in. dia. Moving Coll, 3 ohms imp.	23/6
GOODMANS—12 in. dia., Moving Coll, 15 ohms	28/8
Plus 5/- packing and carriage.	
VITAVOX—K12/20 12 in. dia., Moving Coll, 15 ohms imp.	21/11
Plus 5/- packing and carriage.	

SPECIAL OFFER A 12in. TRUVOX P.M. SPEAKER

(2-3 ohm Voice Coil) For only **47/6**
 These are brand new in Maker's Cartons Plus 2/6 Pkg. and Carr.

METERS

Large stocks available, a few of which are enumerated below:—

Full Scale Deflection	Scale Length	External Dimensions	Movement	
		in.		
25 A	1 1/2	2 1/2 round	R.F. Thermo	7/6
3.5 A	1 1/2	2 1/2 x 2 1/2	R.F. Thermo	7/6
4 A	1 1/2	2 1/2 x 2 1/2	R.F. Thermo	7/6
20 A	1 1/2	2 1/2 round	M/C	8/6
40 A	1 1/2	2 1/2 round	M/C	8/6
1.5 mA	1 1/2	2 1/2 round		12/6
5 mA	2	3 1/2 round		7/6
6 mA	2	3 1/2 round		18/9
50 mA	1 1/2	2 1/2 x 2 1/2	M/C	7/6
20 V	2	2 1/2 x 2 1/2	M/C	8/6
40 V	1 1/2	2 1/2 x 2 1/2	M/C	8/6

MOVING COIL METER

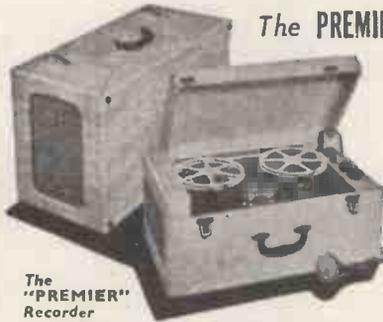
A super quality Moving Coil Meter basic movement 2 mA scale dimensions 2 1/2 in. Overall dimensions 2 1/2 in. dia. 1 1/2 in. deep. Bakelite Case projecting type. At present scaled 1 amp. R.F. By removing thermo couple, reversing scale and recalibrating the meter, a high grade test instrument with any range above the basic F.S.D. may be built up. **Price 4/9**

Germanium Crystal Diodes. G.E.C. wire ended, 2/6 24/- doz.

PREMIER RADIO COMPANY

The PREMIER De Luxe **PORTABLE** MAGNETIC TAPE RECORDING KIT PRICE £37·4·0

(Plus 15/- Pkg., Carr. & Ins.)



The "PREMIER" Recorder

This Recording Outfit has been designed for use with M.C.2-III "SCOTCH BOY" Magnetic Tape. With this new and improved high-quality tape a frequency of 50 c.p.s. to 9,000 c.p.s. at tape speed of 7 1/2 in./sec. can be readily achieved. Additional reels of 1,200ft. can be supplied at 35/-

INSTRUCTIONAL BOOKLET . . . 2/6
This is credited if a complete kit of the Tape Recorder is ordered.

As is usual in all PREMIER KITS every single item down to the last nut and bolt is supplied. The Chassis is punched and layout diagrams and theoretical circuits are included. When completed the PREMIER PORTABLE TAPE RECORDER compares MORE than favourably with any other make at double the price.

SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW
AMPLIFIER (including 8in. Speaker) ... £11 0 0 plus 5/- pkg./carr.
LANE TAPE TABLE & REWIND SPOOL £14 15 0 plus 7/6 pkg./carr.
PORTABLE CABINET (rexine covered) £4 19 6 plus 5/- pkg./carr.
MICROPHONE £2 19 6 plus 1/- pkg./carr.
REEL OF NEW M.C.-2-III "SCOTCH BOY" TAPE (1,200ft.) £1 15 0 plus 1/- pkg./carr.

To those unable to build this PORTABLE TAPE RECORDER we can supply it completely wired, tested and ready to plug in at 39GNS Plus 1 gn. pkg./carr.

CRYSTAL MICROPHONE

An entirely insulated crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance. No background noise, really natural tone. The ideal Mike for tape, wire and sound projectors. Price 22/6

MICROPHONE STAND BASE
Heavy Moulded Black Base fitted with Standard thread adaptor. Dimensions: 7 1/2 in. across, 2 1/2 in. deep. Weight: 1 1/2 lb. Post paid 3/11.



SPECIAL OFFER

CRYSTAL HAND MICROPHONE



High Impedance. Excellent frequency response, light weight. Gives very high quality results when used with tape recorder, amplifies for any type of P.A. equipment. Complete with screen lead and plug Plus 1/6 Pkg. & Carr. Price 29/6.

MICROPHONES

LUSTRAPHONE—Moving Coil; High Impedance. Stand Type: £5/15/6—Hand Mike £6/6/0.

RONETTE—Crystal Mike; Incorp. the Filter Cell Insert; High Imped. Ball Type: £3/19/6.

CRYSTAL MICROPHONE—Rothermel 2AD56. Especially recommended. £2/19/6. Table stands for all the above 10/6 and 17/6.

THE GOLDRING MAGNA CARTRIDGE



- A magnetic Turnover Cartridge with high output and cantilever styli.
- Entirely new principle. (Pat. applied for.)
- Output comparable to crystal pickups.
- Cantilever styli give minimum record wear and eliminate needle-talk.
- Styli easily replaceable.
- Smooth extended frequency response on both standard and L.P. records.
- The ideal replacement Cartridge for 3-speed record changers and units.

Of special interest to the designer of new equipment.

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MODEL B (up to 7" spool capacity) £9. 10. 0.

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RC94 Scanner	£100
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723A/B Valve	£3

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TRANSMITTERS. CPN2, APN3, ART13, BC1149, TDQ, TDE.

TRANSCEIVERS. ARCI, ARC3, SCR-522, TCS, BC800 RT1/APN2.

INDICATORS. ID6B/APN4, ID17/APN3, ID18/CPN2, BC1151, BC1152, BC1159, MC412, I-81A, I-82A.

TEST SETS. Any unit with prefix "TS." IE19, BC638, I-208.

MODULATORS. BC1091, BC1142, CM3.

SYNCHRONISER. BC1148.

POWER UNITS. RA34, RA42, RA59, TA2, RA88, RA90, MG149, PE98, PE158, DM28.

TUNING UNITS. TN17, TN18, TN19, TN54, TU57, TU58, TU59.

CONTROL GEAR. BC1150, BC1145, JB91, JB95, JB98, JB102, PN31, PN32.

ANTENNA GEAR. BC223A, RC94, AS27, AT4, AN104.

MOUNTINGS. FT237, FT247A.

And almost every American made unit even if not mentioned above.

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THE *FIRST* TO
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Beam Tetrode

Sub-Miniature Output Valve
with still lower filament current

TYPICAL OPERATION

Filament Voltage	1.25	1.25 V.
Filament Current	10	10 mA.
H.T. Voltage	22.5	30 V.
Control Grid Voltage	0	-1.2 V.
Power Output	1.8	3.3 mW.

The maximum cross-section is only 8 mm. x 6 mm. with a maximum glass length of 35 mm.

A small flat sub-miniature output tetrode with still lower filament current and improved performance at reduced battery voltages.

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EDDYSTONE

MODEL '840'

AC/DC COMMUNICATIONS RECEIVER



The New Model "840", illustrated above, possesses full Communication facilities and operates from either A.C. or D.C. mains 100/110 and 220/250 volts.

- Seven valve superheterodyne with R.F. stage.
- Frequency coverage 30 Mc/s. to 480 kc/s.
- Gear driven tuning with 140/1 reduction.
- Mechanical bandspread. Accurate re-setting.
- B.F.O. and noise limiter.
- Internal loud-speaker. Headphones jack.
- Robust diecast construction. Rustproofed steel case.
- Suitable for tropical service.
- Weight 30 lbs. Size 16 $\frac{3}{4}$ " x 10 $\frac{1}{2}$ " x 8 $\frac{3}{4}$ " high.

List Price (in U.K.) £45

Exempt from Purchase Tax

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IF YOUR PROBLEM IS COIL IMPREGNATION

The BLICKVAC HIGH VACUUM IMPREGNATOR meets the rapidly growing demand for high-vacuum impregnation.



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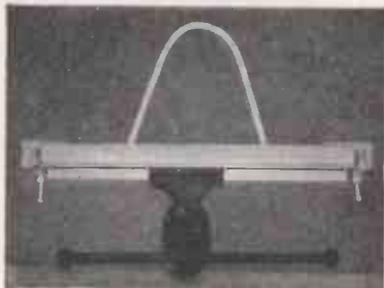
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Associated with Blick Time Recorders Ltd., Blick Engineering Ltd.

PARKER'S SHEET METAL FOLDING MACHINE



Heavy Vice Model. Capacity 18 gauge M.S. x 2ft. wide. Loose Attachments for Radio Chassis making Weight 22 lb. Price 50/- Attachments 1/6 per ft. Carriage 4/-, with attachments 5/6.

Also Parker's Square Type Drill Vice. Machined table 7in. x 6in. x 1/2in. Jaws of Bright Steel. Admits stock of 4in. Complete with stand. Heavily constructed. Wt. 13 1/2 lb. Price 37/8. Carriage 2/6.

Machines guaranteed. Send for details.

A. B. PARKER WHEATCROFT WORKS, WELLINGTON STREET, BATLEY, YORKSHIRE. Tel.: Batley 426

MINIATURE MAGNETIC LIGHTWEIGHT EARPHONES



The AMPLIVOX E.4, E.5 and E.6 provide a range of highly sensitive lightweight miniature receivers. Ideal for many applications, the inserts have been incorporated in lightweight headsets, stethoscope devices and small microphones.

The E.6 is the smallest of the range, the diameter is 0.835", depth 0.332" and weight 1/4 oz. D.C. resistance E.4 & E.5 2-2,000 Ω. F.4 1-600 Ω.

AMPLIVOX LTD.
2 Bentinck Street, London, W.1.



Loud-speaker Manufacturers to the radio industry since 1930

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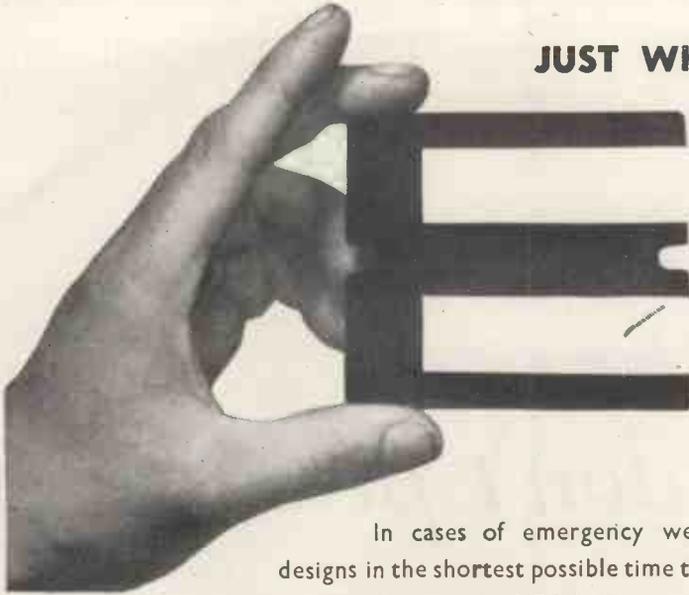
... to know all the set-manufacturer's problems, and still less how they should be solved. Our job is looking after that final, critical link in the chain of reproduction—the loud-speaker. And there we do know what we are talking about.

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INSULATED SLEEVING

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CLASSIC EXAMPLES of

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COMPLETE INSTRUMENTS	PRICE		DEPOSIT	
	£	s. d.	£	s. d.
580/1 Ferragraph Model 2a (as available)	79	10 0	27	0 0
580/2 G.B. Standard	99	10 0	33	5 0
580/A Vortexion with Wearite Deck	84	0 0	28	0 0
581/2 Grundig 2-speed	84	0 0	28	0 0
581/8 R.M.C. with new Lane Tape Desk	47	10 0	16	0 0
TAPE DESKS				
585 Lane Mark IV	17	10 0	6	0 0
586 Truvor, Mark III*	23	2 0	8	2 0
587/1 Wearite, Type 2A*	35	0 0	12	0 0
587/2 Wearite, Type 2B*	40	0 0	14	0 0
588/1 Bradmatic, Type 1 and 5RP*	41	0 0	14	0 0
588/2 Bradmatic, Type 3c*	45	10 0	15	10 0
588/3 Bradmatic, Type 5/6RP*	42	0 0	14	0 0
588/4 Bradmatic, Type 5CL*	47	10 0	18	10 0
588/5 Bradmatic, Type 5D*	50	0 0	17	0 0
*Equipped for half-tape recording.				
MICROPHONES				
553 Reslo VMC (Moving-coil)	6	0 0		
554 Reslo R.V. Ribbon	9	0 0		
557 Gramplan Moving-coil	5	17 6		
560 Cosmocoord Mic/30 Desk Model Crystal	2	10 0		
561 Cosmocoord Mic/22-1 Acos Crystal	4	4 0		
563 Cosmocoord Mic/16-2 Acos Crystal	12	12 0		
565 Lustraphone C.H.-51 Hand Model, Moving-coil	5	15 6		
566 Lustraphone L.X.35 Crystal Model	2	10 0		
Stands of all types available.				
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592/1 Lane Amplifier Kit, K-A-1/R.P.	13	10 0	4	10 0
592/2 Lane Amplifier Assembled	15	10 0	5	5 0
593/1 Elpico Junior Amplifier	16	16 0	6	0 0
593/2 Elpico Senior Amplifier	24	0 0	8	0 0
594 Bradmatic O.I. with Push/Pull O/P	62	0 0	21	0 0
595 C.J.E.C.P./1 with P/P O/P	24	12 0	8	5 0
595/1 C.J.E. Professional Type P.A.I.	94	0 0	32	0 0
MOTORS				
520 Collaro Clock and Anti-clockwise	1	18 6		
521 B.S.E. Model S.R.2	1	5 0		
522 B.S.E. Model S.R.1	1	12 0		
523 B.S.E. Model F.P.10	1	18 0		
T.R. TAPES				
569 Emitape H60/6, 600ft.	1	1 0		
570 Emitape H60/12, 1,200ft.	1	15 0		
570 Emitape H66/12, 1,200ft.	1	15 0		
572 G.E.C. Plastic, 1,200ft.	1	10 0		
573 Gevaert, 1,200ft.	2	0 0		
574 Agfa 1,200ft.	1	17 6		
576 Magnetophon, 1,200ft.	2	0 0		
576 Ferrotape (Wearite), 1,200ft.	2	5 0		
577 Ferrotape (Wearite), 1,750ft., 84in.	3	3 0		

The outright purchase of equipment can be a heavy item, but that is no reason why you should not straight away have the best of gear available by Classic H.P. Here are a few examples showing deposits in relation to the full cash purchase price.

DISK EQUIPMENT



MOTORS AND PICK-UPS	PRICE		DEPOSIT	
	£	s. d.	£	s. d.
CONNOISSEUR				
400 3-speed motor	21	17 3	7	10 0
400/1 3-speed motor with pick-up and one head	27	16 6	9	5 0
GARRARD				
401 Autochanger RC 80 less pick-up heads	15	1 6	5	0 0
401/1E Autochanger RC.75A with 2 Decca XMS heads	18	17 8	6	5 0
COLLABO				
402 Autochanger Model 3RC.531, 3-speed less pick-up head	12	3 1	4	5 0
402/6 A.C. Motor 5/534, 3-speed	6	5 4	2	5 0
DECCA				
403 GU.40 3-speed motor with crystal turnover pick-up	9	10 0	3	5 0
403/3 Decca transcription motor, 3-speed, Decca XMS pick-up and 2 heads	23	18 2	8	0 0
B.S.E.				
405 M.U.10 3-speed motor	3	18 7	1	5 0
405/2 GU.4 3-speed motor with turnover crystal pick-up	9	9 0	3	5 0
PLESSEY				
406 Plessey 3-speed Autochanger unit, with pick-up. Special price, limited number	10	10 0	3	10 0
E.M.I.				
407 E.M.I., 3-speed, type 2125	17	2 6	5	15 0
AMPLIFIERS, TONE-CONTROLS ETC.				
100 Leak, T.12 Standard	28	7 0	9	10 0
101 Quad, with control unit	35	0 0	11	15 0
103 Goodsell M.A.15	19	10 0	6	10 0
104 Rogers Baby de Luxe	14	0 0	4	15 0
150 Leak "Vari-slope"	12	12 0	4	5 0
151 Goodsell Type U/TC	8	15 0	3	0 0
151/1 Goodsell Type P/U/TC	14	14 0	5	0 0
151/2 Goodsell Type P/PA	18	0 0	6	0 0
152 Rogers Junior de Luxe, Mk. II	9	0 0	3	0 0
153 Lowther Master Control Unit	20	0 0	6	15 0
LOUDSPEAKERS				
WHARFEDALE				
601/2 W.12	9	5 0	3	5 0
601/3 W.12/CS	9	15 0	3	5 0
601/4 Super 12in./CS/AL	16	0 0	5	10 0
GOODMANS				
603/1 Axiom 150/2	10	5 9	3	10 0
603/2 Andiom 80 15in.	22	10 0	7	10 0
603 Andiom 60	8	12 6	3	0 0
TANNOY				
606 Tannoy 12in. Dual Concentric, with built-in crossover network	27	10 0	9	5 0
LOWTHER VOIGT				
607 Lowther Voigt PM/2 Drive unit	35	0 0	12	0 0
VOIGT				
608 Voigt P.M. Pressure Unit	42	0 0	14	0 0

The items shown here represent but a small proportion of our regular stock, which includes radio-feeder units, complete radio units etc.

And our vast and varied range of apparatus and equipment, possibly the largest in the country, is backed by the famous Classic pre-sales test scheme, whereby every piece of apparatus is thoroughly tested before despatch and guaranteed by our own highly skilled technicians, thus enabling us to give a firm guarantee.

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- **TWIN TRACK:** Up to 2 hrs. recording.
- **SEPARATE BASS AND TREBLE CONTROLS.**
- **4 WATTS OUTPUT:** Neg. F/B.
- **INTERNAL MIKE RECORDING SYSTEM.**

The "Impresario" can also be used as a high quality radio, gramophone or microphone amplifier.

PRICE **49 $\frac{1}{2}$** GNS.
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The "Impresario" is the first trans-portable tape recorder in Great Britain to provide power supply and internal space for a radio tuner unit with optional listening and/or recording.

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May be fitted in a few minutes.

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600 RELAYS

to specification. Tropicalising, impregnating and Services jungle finish if required. Delivery 3-4 weeks.

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AND CONSTRUCTORS
NUMBER ELEVEN

VALVES FOR TAPE RECORDERS

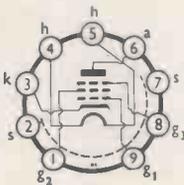
Service in tape recorder amplifiers makes stringent demands on the valves used, particularly in the early stages.

Operation in high gain circuits with a considerable degree of bass boost, and in a confined space in close proximity to a loudspeaker, places a premium on freedom from microphony and hum.

The typical Osram valve line-up shown has proved entirely satisfactory in practice for tape recorder applications. The use of the Z729 low noise pentode, allied with a suitable circuit layout, ensures the virtual elimination of induced hum.

INPUT STAGE Z729

low noise pentode

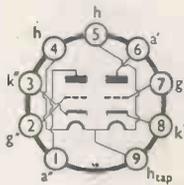


- V_h 6.3V
- I_h 0.2A
- V_a 250V
- V_{g2} 140V
- g_m 1.85m/AV
- V_{hum} 1.5 μ V
- $R_{g1-k} = 470k\Omega$

Base B9A

Tone correction and intermediate stages B309

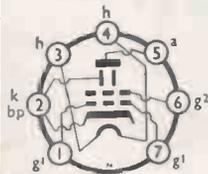
double triode



- V_h 6.3V
- I_h 0.6A
- V_a 250V
- g_m 5.5 mA/V
- r_a 10 k Ω

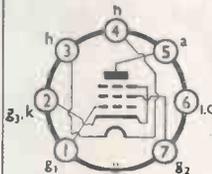
Base B9A

Output and bias oscillator N727/6AQ5 or N78



- V_h 6.3V
- I_h 0.45A
- V_a 250V
- V_{g2} 250V
- I_k 50mA
- V_{g1} -12.5V
- P_{out} 4.5W

Base B7G

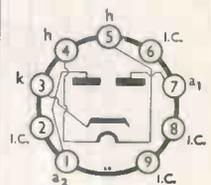


- V_h 6.3V
- I_h 0.64A
- V_a 250V
- V_{g2} 250V
- I_k 40 mA
- V_{g1} -5V
- P_{out} 4W

Base B7G

Rectifier U709

full-wave rectifier



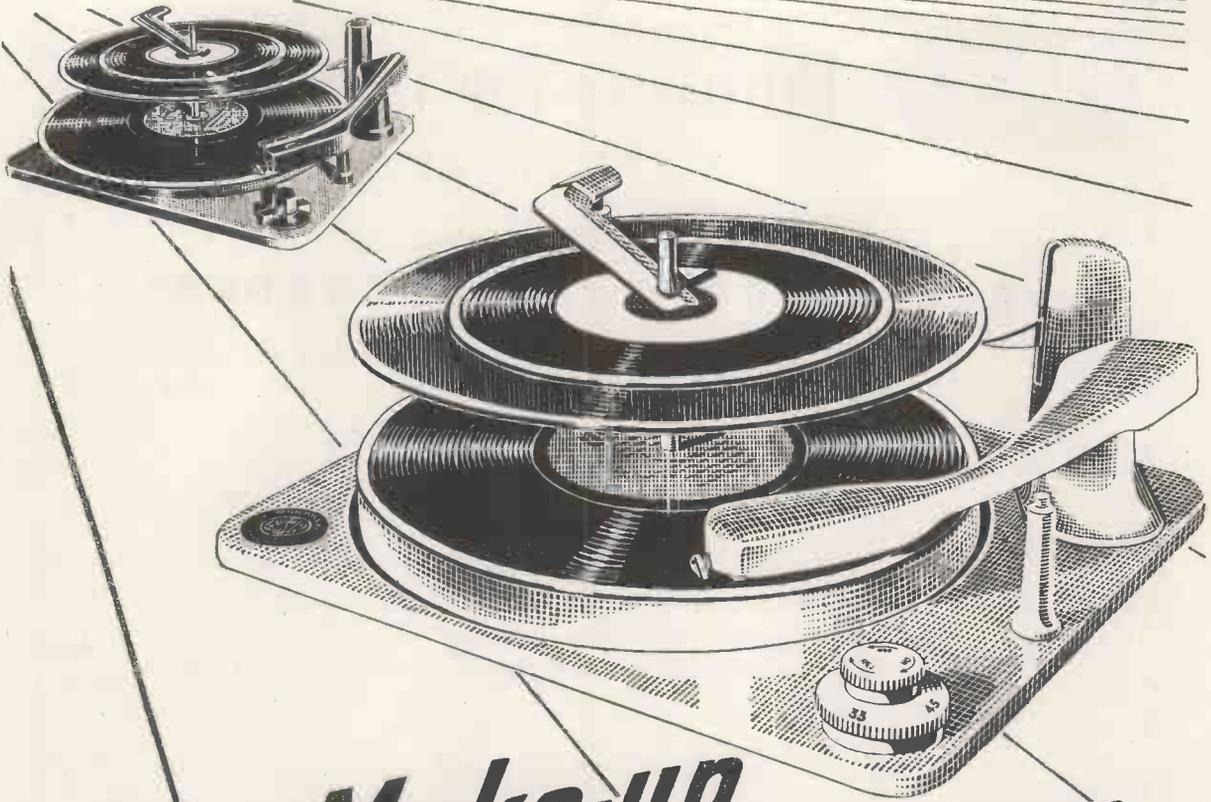
- V_h 6.3V
- I_h 0.95A
- V_{h-k} 450V (max.)
- V_{in} 350 rms (max.)

I_{out} 150 mA
Base B9A

The heater-cathode rating of the U709 permits operation from a common 6.3V heater winding

For further information and full technical data write to:
The Osram Valve and Electronics Dept.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2



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AND ELECTRONICS

43rd YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.

Editor: H. F. SMITH

FEBRUARY 1954

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VALVES, TUBES & CIRCUITS

14. FULL-WAVE RECTIFIER TYPE EZ80

The new Mullard full-wave rectifier, type EZ80, having a maximum output current of 90 mA, is suitable for the power supplies of most small and medium power amplifiers designed for operation from a.c. mains. It is a miniature all-glass valve having a single-ended construction and a B9A (noval) base. With a heater rating of 6.3V, 0.6A, the maximum peak heater-to-cathode voltage of 500 volts is sufficient to permit the heater of the EZ80 to be supplied from the same 6.3-volt winding on the transformer as the other valves in the amplifier.

CHOICE OF RESERVOIR AND SMOOTHING CAPACITORS. When designing an amplifier it is desirable to know the amount of a.c. ripple which may be superimposed on the direct voltage supplied to the valves. For a particular input voltage and output current the values of ripple and direct voltages depend upon the reservoir capacitance and upon the type of smoothing network. Generally the power supply includes a reservoir capacitor (C1), either an inductance (L) having a resistance (R) or a resistance (R) alone, and a smoothing capacitor (C2). The following table shows typical values of ripple and direct voltages across C1 and across C2 for several standard values of components. The input voltage is 2 x 250V r.m.s. and total output currents of 90 and 60 mA are considered.

In general, the value of the ripple voltage across C2 is inversely proportional to the values of both C2 and C1 whereas the ripple across C1 is only inversely proportional to the value of C1 and not dependant upon L, R or C2. To ensure a low ripple voltage at C2 it is necessary to make both C1 and C2 as large as possible. If further smoothing is desired, as with the supplies to a pre-amplifier stage, it is usual to incorporate this in a form of decoupling in order to isolate this stage.

If large values of capacitance are used it is possible to economise in the design of the amplifier by replacing the smoothing choke by a resistor with little change in ripple voltage. The output voltage from C2 will then be reduced by an amount depending upon the load current and the value of the resistor. In this case the voltages required for the anodes of the output valves may be taken from C1. With a single valve output stage, the ripple across C1 must then be as low as possible. In push-pull stages, if the two output valves are reasonably similar, quite large amounts of ripple can be tolerated as they will be balanced out.

From the table it is seen that the conventional network of C1 = 8μF, L = 10H, C2 = 16μF may be replaced by C1 = 50μF, R = 500 Ω, C2 = 50μF with only a slight increase in ripple across C2 from 210 mV to 225 mV and a reduction in the ripple across C1 from 21V to 3.5V. The output voltage across C2 is reduced from 251V to 220V but the anodes of the output stage may be connected to C1, across which is a voltage of 265V.

$V_a \text{ (r.m.s.)} = 2 \times 250\text{V}, I_{out} = 90\text{mA.}$

C1 (μF)	C2 (μF)	L (H)	R (Ω)	Ripple Voltage		Direct Voltage	
				across C1 (V _{r.m.s.})	across C2 (mV _{r.m.s.})	across C1 (V)	across C2 (V)
8	8	10	100	21	450	260	251
8	16	10	100	21	210	260	251
16	16	10	100	10.5	110	263	254
50	50	0	500	3.5	225	265	220
50	50	0	1000	3.5	110	265	175

$V_a \text{ (r.m.s.)} = 2 \times 250\text{V}, I_{out} = 60\text{mA.}$

C1 (μF)	C2 (μF)	L (H)	R (Ω)	Ripple Voltage		Direct Voltage	
				across C1 (V _{r.m.s.})	across C2 (mV _{r.m.s.})	across C1 (V)	across C2 (V)
8	8	10	100	15	315	283	277
8	16	10	100	15	145	283	277
16	16	10	100	7.5	75	285	279
50	50	0	500	2.5	160	287	257
50	50	0	1000	2.5	80	287	227

VALVE DATA

HEATER	V_h	6.3	V
	I_h	0.6	A

LIMITING VALUES

	$V_a \text{ (r.m.s.) max.}$	2 x 350	V
	$I_{out} \text{ max.}$	90	mA
	C max.	50	μF
	$V_{h-k(pk)} \text{ max.}$	500	V

BASE

B9A

DIMENSIONS

Max. seated height	61	mm.
Max. overall length	67	mm.
Max. bulb diameter	22.2	mm.

TYPICAL OPERATING CONDITIONS

$V_a \text{ (r.m.s.)}$	2 x 250	2 x 275	2 x 300	2 x 350	V
C	50	50	50	50	μF
* $R_{lim} \text{ min.}$	125	175	215	300	Ω
I_{out}	90	90	90	90	mA
V_{out}	265	285	310	360	V

*Per anode.



Reprints of this advertisement, together with additional data, may be obtained free of charge, from the address below

MULLARD LTD., Technical Publications Department, Century House, Shaftesbury Avenue, W.C.2.

MVM 260

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This valve and its direct equivalents have been used for sound and vision detection and noise limiting in the majority of T.V. Receivers manufactured since the war and is extensively employed in this season's models.

Because of its improved performance the Brimar 6AL5 is also used widely in Industrial Electronic Equipment, Computers, Navigational Aids, Test Equipment, etc.

Use the **BRIMAR 6AL5**
 the improved replacement
 —at **NO EXTRA COST**

BRIMAR	FERRANTI	MAZDA	MARCONI OSRAM	MULLARD
6AL5	DD6	6D2	D77 DI52	EB9I



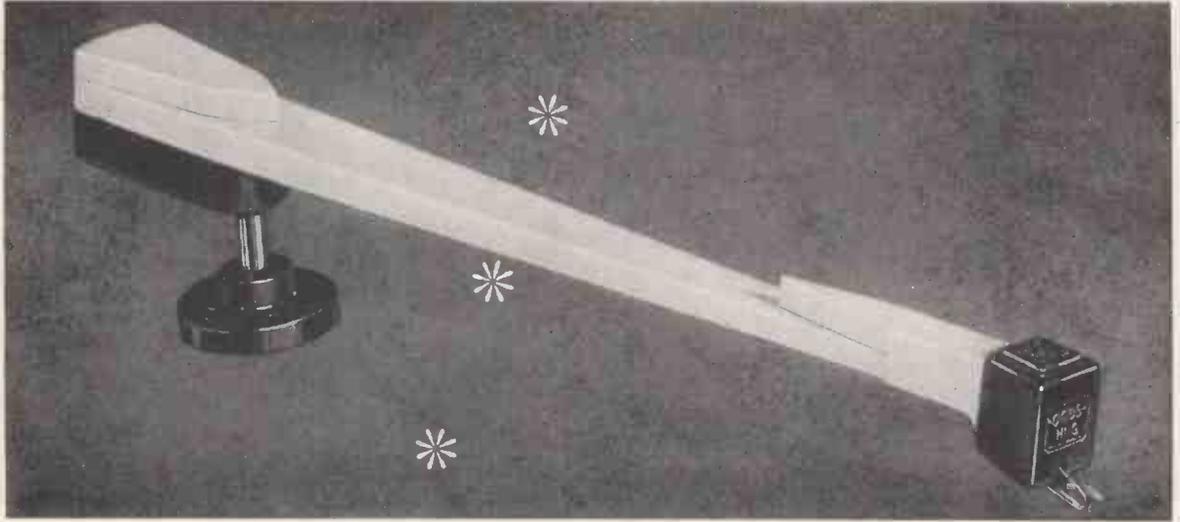
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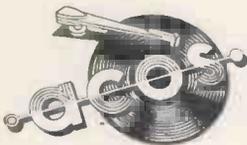


ABOUT ~~acos~~ HGP 40 AND GP 20 PICK-UPS

* We will be frank with you. When we evolved the now famous Hi-g pick-up tracking principle, we felt that it called for the introduction of an entirely new pick-up, complete with arm and new style heads. We called this pick-up the HGP 40.

* The interest in the HGP 40 has been tremendous, but it is already clear that there are thousands of owners of that most popular of all crystal pick-ups—the GP 20—who wish to bring it up to date by changing the existing head (GP 19 or GP 19LP) for an HGP 40 head (standard or LP). It cannot be done.

* However, we bow to public demand. We are discontinuing the HGP 40 as such. Instead, we are now producing the HGP 39-1 (STD or LP) pick-up head to fit the GP 20 arm. Its response will be substantially the same as the HGP 40 and the sapphire stylus is easily replaceable. Its price is £1 12 0, plus 10/3 Purchase Tax.



always well ahead

Acos devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

TO SUM UP:—

HGP 40 Pick-up is discontinued.
HGP 39-1 (STD or LP) Heads are available to modernise the GP 20.
GP 20 fitted with HGP 39-1 head will in future be known as the GP 20|Hi-G.

THE "BELLING-LEE" PAGE

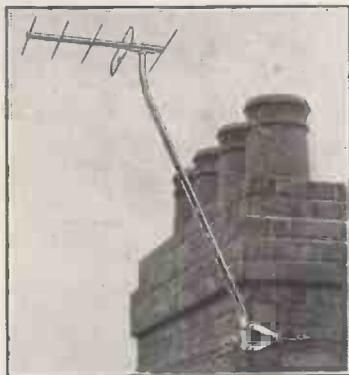
Providing technical information, service and advice in relation to our products and the suppression of electrical interference

Television Developments

Television may or may not develop along the lines with which you agree, but nobody can say that it stands still.

The first alternative programme will be the transmission of "Stills" by the Television Society's experimental transmitter. The aerial was designed by D. N. Corfield, manufactured by "Belling-Lee" and presented to the Society by the company. The range of the transmitter is semi-visual and about 15 miles, covering Central, South and West London. The necessary receiving aerials are available to those who prefer to buy a factory made job rather than make their own.

The Isle of Man Douglas transmitter has brought Christmas cheer to thousands, and one is tempted to enquire as to whether suppressors will be considered a "must" in



next year's Tourist Trophy races on the Island as they are at Goodwood.

A small island is an ideal place on which to launch a suppression campaign, as it is reasonably practical for the organisers to keep a grip on the situation.

We would like to make it very clear that so far as aerials for the official alternative transmissions are concerned, it is our policy to develop these so that they may be added to an existing aerial in such a way that its good features are retained. Where the normal B.B.C. Television programme is obtainable on an indoor aerial and an outdoor aerial is necessary for the alternative programme, complete installations will be made available. Dimensionally, these new aerials are much smaller, consequently offering less windage, and it will be our aim to design fixings and attachments in such a way as to keep prices at a minimum.

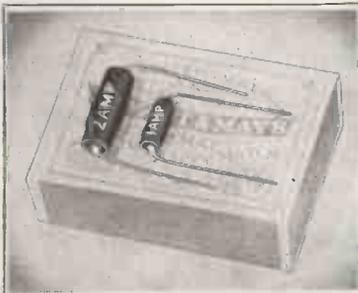
One very important point must be made here. It will be obvious

that in designing these additional arrays to be attached to or incorporated in existing aerials, care has been taken to ensure that the addition does not in any way adversely affect the performance or mechanical strength of the aerial to which it is intended to be attached.

It is possible that some viewers will build their own supplementary arrays or attach arrays not manufactured by Belling and Lee Ltd., but such additions if attached to an existing aerial manufactured by Belling and Lee Ltd., will invalidate any guarantee or insurance by Belling and Lee Ltd., which may be in force at the time.

In addition, Belling and Lee Ltd., can accept no responsibility whatever if a supplementary array manufactured by them is attached to an aerial not of their manufacture. Supplementary arrays complete with masts and lashings will be available where a viewer wishes to use one manufactured by Belling and Lee Ltd., although his original aerial may be of another make.

The method of connecting such aerials to receivers or converters has not yet been decided but we are at present discussing this point at Industry level as a very urgent question.



Except for the fact that the alternative stations will probably transmit on band 3, at the time of going to press, no official information is available regarding siting of stations relative to existing B.B.C. transmitters, nor polarisation nor contemplated radiated power.

Suppression of Household Appliances

The ever increasing number of television receivers coming into use emphasises the need for the suppression of household appliances employing fractional horse power motors. It is a fact that the eye is less tolerant than the ear and has a very strong dislike to flashes and distorted pictures.

Suppression of some of the larger pieces of domestic apparatus should be approached with care, as sewing machines, washing machines, refrigerators, etc., may be subject to Hire Purchase agreements which may prohibit their being opened up. The same kind of thing may have to be considered when dealing with appliances where the guarantee might be affected.

Fortunately much may be achieved in many cases without opening up, even in locations famed for bad reception conditions. For example, during a conversation with Mr. Coupland, a service engineer working with Messrs. J. E. Dawson, Bridge Street, Boston, Lincs., he confirmed that sewing machines, etc., are satisfactorily suppressed without tampering with the "innards" by the use of 2 "Belling-Lee" type L1310 inductors (see illustration) inserted in the mains lead at the motor. These were, in fact, within 2/3 inches of the brushes.

In general, fairly large capacitors are required to suppress interferences on medium and long waves. In the case of a hairdryer or a similar class of appliance, it is often impractical to have these large suppressors either within the appliance housing, or hanging in the lead close to it. In such cases a plug suppressor "Belling-Lee" type L1308 will probably solve the difficulty. Where both television and medium and long waves have to be considered, and particularly in the case of a "portable" appliance, the flex lead suppressor "Belling-Lee" type L799 close to the appliance will take care of T.V. suppression, and the plug suppressor L1308 will protect you on the medium and long waves.

P.S. ✓

All efficient new cars have a suppressor fitted as standard.

Bring your car up to date for 2/6d.

Fit a "Sparkmaster" for controlled spark, easier cold starting, reduced pinking and longer plug life.

Cars so fitted do not interfere with T.V. reception.

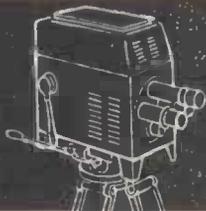
Fit a "Belling-Lee" "Sparkmaster" today.

Written 24th December, 1953

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BROADCASTING

Marconi made radio broadcasting possible. Today 75% of the countries in the world rely on Marconi broadcasting transmitters.

**TELEVISION**

Marconi Television Equipment is installed in every one of the B.B.C.'s Television Stations and has been ordered by countries in North and South America, Europe and Asia.

**MOBILE RADIO**

Marconi Mobile Radio is used by Public Utilities and Armed Forces, including Police and local Defence Forces all over the world.

MARCONI

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System Planners and
Manufacturers of Aeronautical,
Broadcasting, Communications
and Maritime Radio
Equipment, Television, Radar
and Navigational Aids
on land, sea and in the air.**

AERONAUTICAL

Forty - four Airlines and twenty-two Air Forces fit Marconi air radio equipment. Marconi airport installations are in use in many parts of the world.

**COMMUNICATIONS**

More than 80 countries now have Marconi-equipped telegraph and communications services, many of which, completed twenty years ago, still give trouble-free operation.

**MARITIME**

All radio approach and marker Beacons around the British coasts have been designed and manufactured by Marconi's. Marconi's experience of seagoing radio and radar is unrivalled.



POLYTAGS...lead-through and stand-off insulators

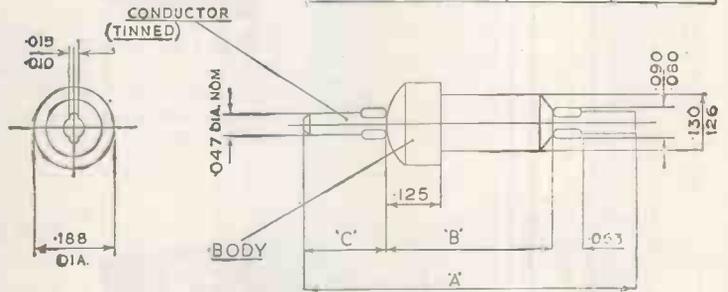
Polytetrafluoroethylene (P.T.F.E.) is an outstanding insulator. It is tough, durable and will not crack or arc. Its dielectric properties are substantially constant over a frequency range of 60 c.p.s. to at least 300 Mc.p.s. and are unaffected by temperature changes between minus 100°C. and plus 288°C. It has zero moisture absorption and is water repellent. It is, therefore, a most suitable material for stand-off and feed-through insulator terminals and has been chosen by Ediswan for this purpose. Ediswan Polytags are available in five types as illustrated below.

PT 1 & 2. Lead-through

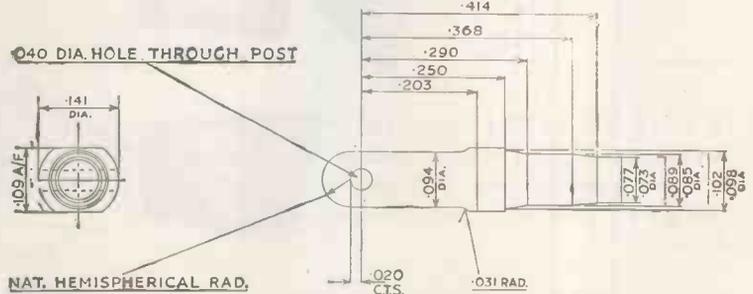


	A	B	C
PT 1	.750	.375	.188
PT 2	.875	.500	.188
PT 3	.563	.375	—
PT 4	.688	.500	—

PT 3 & 4. Stand-off



PT 5. Component mounting



Fixing: Polytags are primarily designed for fixing with a 5 B.A. nut—PT 1—4 or an 8 B.A. nut PT 5. They are self-tapping.

We are equipped to produce components fabricated or moulded in P.T.F.E. to individual specifications and enquiries will be welcomed.

EDISWAN



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Head Office: 155 Charing Cross Road, London, W.C.2. Member of the A.E.I. Group of Companies

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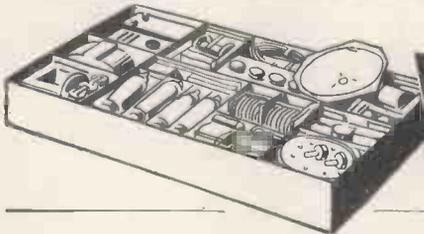
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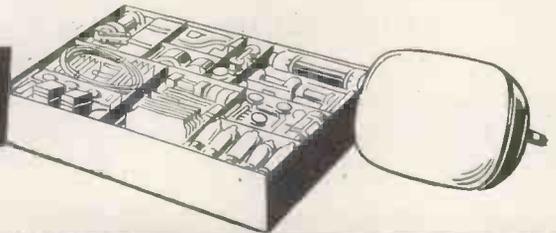
1

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COSSOR *presents...*



The new Cossor Double Beam Oscilloscope

MODEL 1052

Two similar amplifier channels with an approximate gain of 2000 and an upper frequency response of 3 megacycles are features of this new Cossor Double Beam general purpose oscilloscope. The repetitive or triggered time base has a sweep duration from 200 milliseconds to 5 microseconds.

The instrument will operate from power supplies of any of the various frequencies and voltages encountered in the Armed Services or from standard civil supply mains. The top and side panels are quickly detachable to allow inspection and a removable plate at the rear of the instrument allows access to tube plates, anode and modulator.



and Voltage Calibrator

MODEL 1433

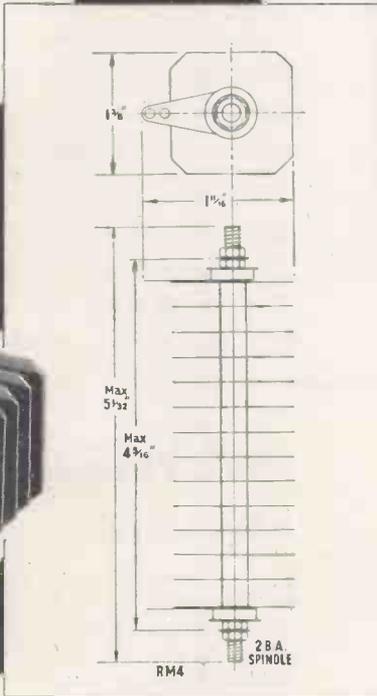
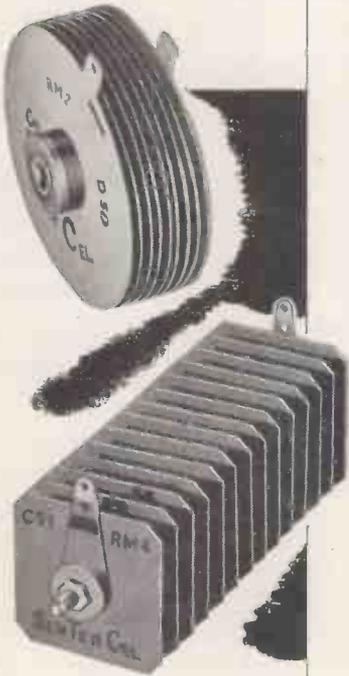
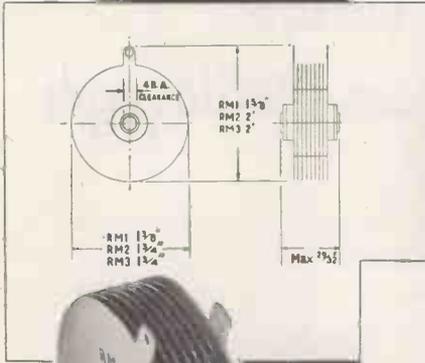
Primarily designed to be used with the new Cossor oscilloscope the Cossor Voltage Calibrator model 1433 provides an accurate means of calibration of input voltages to the plates or amplifiers of any oscilloscope. Calibrating voltages are read directly from a wide scale meter without any computation being necessary. Measurements can be made to an accuracy of $\pm 5\%$ and the instrument can be used in any application where a source of accurately-known voltage is required.

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Maximum ambient temperature	35°C 55°C	35°C 55°C	35°C 55°C	35°C 55°C	35°C 40°C 55°C
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Maximum input voltage (r.m.s.)	125V	125V	125V	125V	250V
Maximum peak inverse voltage	350V	350V	350V	350V	700V
Max. instantaneous peak current	Unlimited	Unlimited	*Unlimited	Unlimited	Unlimited
Weight	0.82 oz.	1 oz.	1.4 oz.	2 oz.	4.5 oz.



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VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8½ in. x 22½ in. x 15½ in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. reels with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE** £18 0 0.

3-WAY MIXER AND PEAK PROGRAMME METER

FOR RECORDING AND LARGE SOUND INSTALLATIONS, ETC.

One milliwatt output on 600 ohm line (.775V) for an input of 30 micro-volts on 7.5-30 ohm balanced input.

Output balanced or unbalanced by internal switch. The meter reading is obtained by a valve voltmeter with 1 second time constant, which reads programme level, and responds to transient peaks.

Calibration in 2 db steps, to plus 12 db and minus 20 db referred to zero level. Special low field internal power pack supplies 8 valves including stabilising and selenium rectifier, consumption 23 watts.



Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3

Telegrams: "Vortexion, Wimble, London."

Crystal Palace Transmitters

**Britain to have most powerful transmissions with
Marconi-equipped station**

By 1956 BBC television transmissions will be the most powerful in the world.

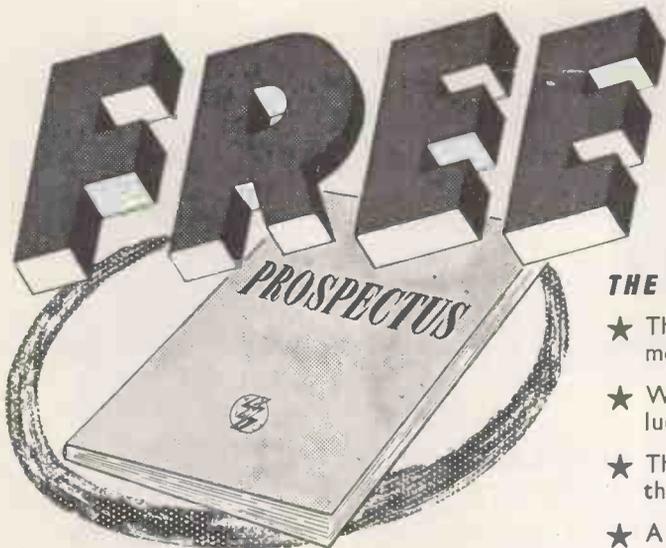
For the new Crystal Palace station which will replace Alexandra Palace, the Corporation has ordered Marconi sound and vision transmitters. They will be used with a high gain aerial system which will radiate 200/250kW—twice the power of existing Regional transmitters.

Two 15kW vision transmitters, the first two in the world to work in parallel, will ensure the highest reliability of service. They will use a new type of tetrode valve of small size, a Marconi development permitting valuable space savings in transmitter design. Two 4½kW sound transmitters will also operate in parallel.

Marconi high or medium power transmitters and high power aerials are installed in every one of the BBC's television transmitter stations, while Marconi television equipment has been ordered by countries in North and South America, Europe and Asia.

MARCONI

complete television transmitting equipment



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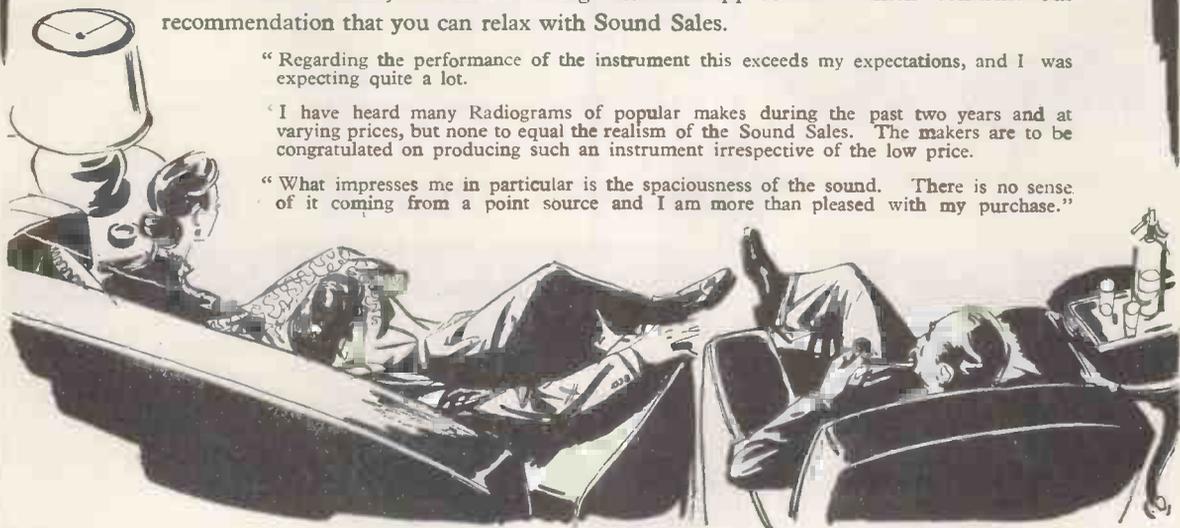
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We are indebted to A. F. Bushell, Esq., who obtained one of our D.X. Plus Four Radiograms via Messrs. Webb's Radio, for the following letter of appreciation which confirms our recommendation that you can relax with Sound Sales.

"Regarding the performance of the instrument this exceeds my expectations, and I was expecting quite a lot.

"I have heard many Radiograms of popular makes during the past two years and at varying prices, but none to equal the realism of the Sound Sales. The makers are to be congratulated on producing such an instrument irrespective of the low price.

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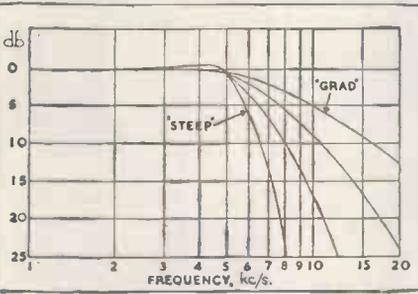
LEAK equipment is unique—

It is acceptable to professional communications engineers for recording and broadcasting. The B.B.C. use several hundreds of the TL/12 Amplifier, and 1,000 are used by other Broadcasting Corporations.



The Vari-Slope

Representing a unique feedback circuit development, the "Vari-Slope" pre-amplifier gives audibly better reproduction. This advance consists of variable slope "electronic" low-pass filters operating on negative voltage feedback principles. No Inductors ("Chokes") are used, and their disadvantages are completely eliminated. The turnover frequencies are 5kc/s, 7kc/s, and 9kc/s, and the slopes of attenuation are continuously variable over the range 5db to 50db per octave.



Frequency amplitude curves for the "TREBLE-3" position (5 kc/s turn-over). Curves of the same slopes are obtained on the other two positions turning over at 7Kc/s and 9Kc/s ("—2" and "—1" positions).

The filters consist essentially of Twin-T resistor-capacity networks inserted in the return circuit of a single-loop feedback amplifier. The more obvious advantages of this electronic feedback method over conventional choke filters include:—

- (a) Improved transient response characteristics (due to absence of chokes having self-capacitance) and the consequent reduction of "ringing."
- (b) Extremely low harmonic and inter-modulation distortion due to negative voltage feedback action.
- (c) No discontinuities in the rates of slope when the slope control is operated, and no change in signal level at frequencies below turnover (Both these faults occur in variable-slope choke filters due to the slope control altering the terminating impedance and the insertion loss.)
- (d) No chokes to cause magnetic hum pickup.
- (e) Smaller size, lighter weight, greater uniformity in production.

Point-One TL/12 Triple Loop Feedback Amplifier

Used with the "Vari-Slope" pre-amplifier and the best available complementary equipment, the TL/12 power amplifier gives to the music-lover a quality of reproduction unsurpassed by any equipment at any price.

For laboratory use as a stabilised-gain audio frequency power amplifier. For the highest possible standard of disc recording. For the highest possible quality of reproduction from Pickup, Radio, Microphone, Film and Magnetic Tape. For use as a driver amplifier in the speech modulator chain of broadcast transmitters.

27 Gns.

The "Point-One" TL/12 Amplifier is built to a tropical specification and used throughout the world, including:

- The British Broadcasting Corporation.
- The South African Broadcasting Corporation.
- The Swedish Broadcasting Corporation.
- The Swiss Broadcasting Corporation.
- The Italian Broadcasting Corporation.

LIST PRICE IN BRITAIN **12 Gns.**



£5. 10s.

Write for fully descriptive literature.

Steep-Cutting Filter

For use with the TL/12 power amplifier and pre-amplifiers preceding the Vari-Slope. This filter unit is of particular interest to the record enthusiast.

H. J. LEAK & CO., LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

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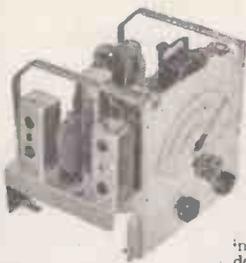
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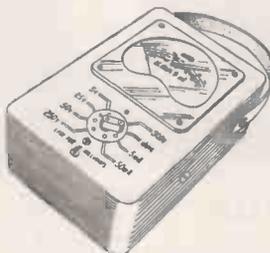


Extremely well built on chassis size approx. 9 1/2 x 7 1/4 x 8 1/2 using only first-class components, fully aligned and tested, 110-240 volt A.C. mains operation. Large clear edge-lit dial. Three wave bands covering Long, Medium and Short waves. Complete with five Mullard valves, frequency changer, double diode triode, pentode output and full wave rectifier. Complete with Rola loudspeaker ready to operate. Special cash-with-order price this month, £8/17/6, carriage and insurance 7/6. Hire purchase terms £3 deposit, balance over 12 months.

Cabinets for this chassis available next month.

MULTI-METER KIT

The Multi-meter illustrated measures D.C. volts, D.C. m/amps and ohms. It has a sensitivity of 200 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick-on range indicator and full instructions for making are available as a kit, price 15/- plus 9d. post and packing.



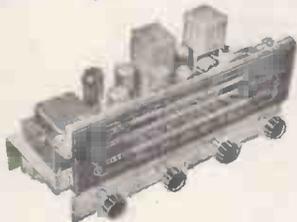
HUGE NEW PURCHASE

We have purchased another large quantity of the Collaro Auto Record Changer, type R.C. 3/521, three speed suitable for all types of records and with the latest type crystal pick ups. Buy one this month as you will not be able to again at this special price of 11 gns. plus 7/6 carriage and insurance. H.P. Terms £4



deposit and balance over 12 months.

THE "WINDSOR" 5-VALVE SUPERHET



This is a 5-valve A.C. superhet covering the usual long, medium and short wave bands. It has a particularly fine clear dial with an extra long pointer travel. The latest type local valves are used and the chassis is complete and ready to operate. Chassis size 15in. x 6in. x 6in. Price £9/19/6 complete with 8in. or 6in. speaker. Carriage and insurance 10/- H.P. terms £3/7/- deposit.

TABLE RADIO CABINET

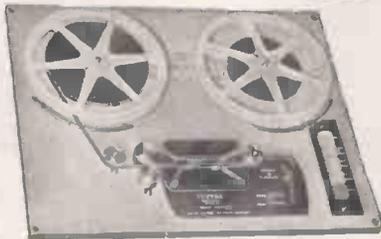
Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15 1/2 x 14 x 6 1/2in.—walnut veneered and satin finished. 37/6, carriage and packing 3/6. Note. This cabinet is the correct one for the chassis above with 6 1/2in. speaker.



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Yours for £7/14/- Now available ex-stock, this fine tape deck has many superior features some of which are as follows:

1. Powered by 3 shaded-pole A.C. motors.
2. "Drop-in" Tape loading.
3. Push-button control, electrically and mechanically interlocked.
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BE PREPARED

For a cold winter by making our low-cost Electric Blanket. 27 yards of special heater wire and blueprint 20/- Blueprint only, 1/6. Alternatively make a Bed-Warmer. Constructional data 1/6.

Blanket. 27 yards of special heater wire and blueprint 20/- Blueprint only, 1/6. Alternatively make a Bed-Warmer. Constructional data 1/6.



CONNECTING WIRE SNIP

P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/- each. Colours available: Black, Brown, Red, Orange, Pink, Yellow, White, Transparent. 4 coils for 10/-.

SOMWEAVE



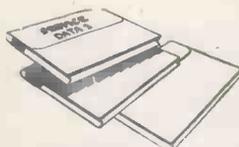
This really lovely loud-speaker fabric we offer at approximately a third of today's cost. It is 42in. wide and our price is 2/- per yard or panels 12in. x 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

x 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

PLUGS FOR MODERN VALVE HOLDERS



Each is fitted with a rubber shroud. For B7G button base and type 2 for B9A. Price 1/4 each, discounts for quantities.



SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities, and which every service engineer is ultimately bound to meet. The following makes are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster-Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pyc, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder.

Our folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry" etc., which have been imported into this country. Names include Sparton, Emmerson, Admiral, Crossley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1. Post free.

ELECTRICAL BARGAINS

In addition to our large range of radio accessories we also carry a good stock of electrical wiring accessories; details of a few of these can be found below:—

T.R.S. CABLES, 250 v. CLASS

1/.044 Twin flat	9d.
3/.029 Twin flat	1/-
3/.029 Twin with earth	1/3
3/.020 3 Core flat	1/6
3/.036 Twin flat	1/4
3/.036 Twin with earth	1/7
3/.036 3 Core flat	2/-
7/.029 Twin flat	1/6
7/.029 Twin with earth	1/11
7/.036 Twin flat	2/9
7/.036 Twin with earth	3/3
7/.064 Twin flat	4/9

LEAD-COVERED CABLES 250 v. CLASS

3/.029 3 Core	2/3
3/.036 3 Core	2/8
7/.044 Twin	3/3
3/.036 Twin	2/-
7/.029 Twin	2/9
7/.064 Twin	5/-

CLIX 15 AMP. FOOT PLUG



Made to B.S.S. specification, shuttered in moulded Bakelite case, 8/6 each.

IRON-CLAD SWITCH FUSES

Best makers, M.E.M., etc., 15 amp., 10/6, plus 1/6 post. 30 amp., 16/6, plus 2/6 post. 15 amp., used but in good condition, 8/6. 10 amp. porcelain (Mömdix), 6/-.



5 AMP. SURFACE SWITCHES—HICRAFT



Oblong Brown Plastic 1-way 1/3 each. Oblong White Plastic 1-way. 1/3 each.

Oblong Brown 2-way.. 1/6 each
Oblong White 2-way.. 1/6 "
Round Brown 1-way.. 1/3 "
Round White 1-way.. 1/3 "
Round Brown 2-way.. 1/6 "
Round White 2-way.. 1/6 "

.....
15 per cent. discount if
bought in dozens.
.....

10 AMP. SWITCH

Rotary pattern with chrome cover and on/off indicator. 2/3.



SOCKETS HICRAFT

Flush type for skirtings, 5 amp. 3-pin shuttered, 1/3 each; ditto with switch, 2/3 each.



CEILING SWITCHES—HICRAFT



With cord and acorn. Brown or White, 1-way, 3/9 each; 2-way, 4/3 each.

LAMP HOLDERS

Bakelite, 1/- each or 10/6 doz. Bakelite skirted Batten holder. 1/6 or 15/- doz. Bakelite type threaded, for 1/2in. with HO skirt, 1/6.

ELECTRONIC PRECISION EQUIPMENT LTD.



ENAMELLED WIRE

(On wooden reels)

S.W.G.	2 oz. Reel	4 oz. Reel
16	1/4	2/-
18	1/4	2/2
20	1/5	2/4
22	1/6	2/6
24	1/7	2/8
26	1/8	2/10
27	1/9	3/-
28	1/8	2/10
30	1/9	3/-
31	1/10	3/1
32	1/10	3/2
33	1/11	3/3
34	1/11	3/4
36	2/-	3/6
38	2/2	3/10
40	2/4	4/2

TINNED COPPER WIRE

16	1/4	2/-
18	1/4	2/2
20	1/5	2/4
22	1/6	2/6

DOUBLE SILK COVERED WIRE

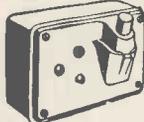
16	1/3	1/10
18	1/3	1/11
19	1/5	2/3
20	1/6	2/6
22	1/8	2/10
23	1/9	3/-
24	1/9	3/-
26	1/11	3/4
27	2/-	3/6
28	2/1	3/8
29	2/2	3/10
30	2/3	4/-
31	2/4	4/2
32	2/6	4/6
33	2/9	5/-
34	2/10	5/2
35	3/-	5/6
36	3/2	5/10
38	3/6	6/6
39	3/9	—
40	4/-	7/6
41	2/3	—
42	2/6	—



SHEET PAXOLIN

Invaluable for when you are experimenting. Size 6in. x 6in., 1/-.
Size 12in. x 8in., 2/-.
Size 12in. x 12in., 3/6.
Size 24in. x 12in., 6/-.

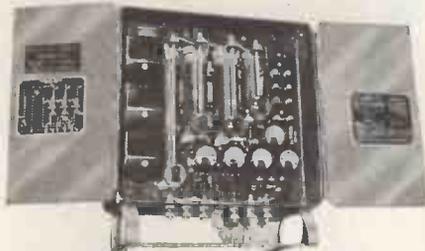
CLIX 15-AMP. FOOT SWITCH PLUG



Made to B.S.S. specification, shuttered in moulded bakelite, case, 8/6 each.

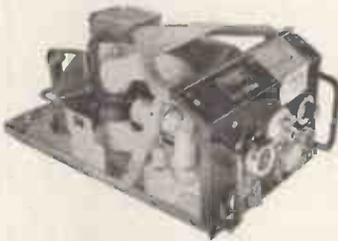


This other one is our portable Tape Recorder Cabinet. A Superior cabinet covered with best quality rexine and complete with carrying handle and fasteners. Price is £3, carriage and packing 10/- extra.



CHARGING SWITCHBOARD

Feed this Switchboard through a Mains Transformer and Rectifier giving 24 volt D.C. up to 50 amps. and you have an excellent multi-circuit charger for simultaneously charging several batteries at different currents. This is an ex. Government switchboard rated at 550 watts 18 volts fitted into steel cases with doors. It contains three reversed current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are brand new, in original cases. Price £4/10/-, carriage 10/-.
We can supply a 12 volt, 50 amp. Mains Transformer at £4/5/-, plus 5/- carriage.



COMPLETE 10 C.M. TRANSMITTER RECEIVERS

Type numbers available include T.R. 3548, T.R.3191, T.R.3151. All are priced at £15 each, and contain blower motor, I.F. Unit, suppressor unit etc.



MAGNETRON MAGNET

The correct one for using with the above magnetrons can be used for many other purposes, one such purpose being the making of a magnetic chuck. Price 30/- each, carriage 7/6.



MAGNETRONS

Precision made for RADAR type Nos. CV. 186 and CV.64. Unused, guaranteed. Any not functioning correctly will be replaced. Price £7/10/- Post and insurance 10/-.

THIS MONTH'S SNIP

This month our special snip is quite a small item but undoubtedly of use to every radio electrical experimenter. It is a wire-wound variable slider resistance which can be locked at any point along its length. The Type Number is CLR.810. Its value is 1,000 ohms but other gaugs of wire can be wound on it to make a variable resistor to your special requirements. Price only 1/6, or 6 for 8/-.



SURPLUS BARGAIN CABINETS

For Tape Recorders, Televisors, Radios, Radiograms, etc., are always on show at our branches, Fleet Street, Finsbury Park or Ruislip Manor. The one illustrated we call The Regina. This is a television Consol cabinet, cut out for a 12in. tube, but not drilled. It has an adjustable platform. It is extremely well-finished, walnut veneer and satin polish. Ideal for many constructor sets, View Master, Teleking, etc. Price £7/17/6, carriage 10/-.

GREATLY REDUCED CATHODE RAY TUBES

VCR97. Brand new and unused, ideal for 'scope, etc. Price 12/6. Carriage and insurance 5/- extra.



VCR517. 6jin. guaranteed full picture. 29/6 plus 5/- carriage and insurance.

VCR139A. 37/6 plus 2/6 carriage, etc.

VCR138. 3 1/2in. electrostatic short persistence, suitable for T.V. and ideal for 'scope work, 37/6 plus 3/6 carriage, etc.

VCR112. 5in. electrostatic, persistence not known, 15/- each plus 5/- carriage, etc.

CV996. 6in. electrostatic, persistence not known, 15/- each plus 5/- carriage, etc.

CV1140, CV1590, CV1546. All 12in. magnetic long persistence £4/10/- plus 10/- carriage.



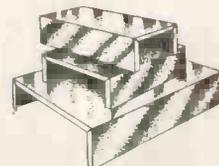
CHASSIS ASSEMBLY

3 colour, 3 waveband scale covering standard Long, Medium, and short wavebands, scale pan, chassis punched for standard 5 valve superhet, pulley driving head, springs, etc., to suit. Scale size 14 1/2in. x 3 1/2in. Chassis size, 15in. x 5in. x 2in. deep. Price 15/-, plus 1/6 post.
Note: This is the one that fits our £7/10/- Radiogram cabinet and our 37/6 table cabinet.



22/6 FLUORESCENT LIGHTING

Complete kit comprises Hi-craft 40 watt control unit starter lamp holders, clips and wiring diagram. Price, less tube, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 P.P. Tubes 7/6 each, carr. free, minimum quantity 6.



BLANK CHASSIS 18 S.W.G. Aluminium

7 x 3 1/2 x 2	3/9
9 1/2 x 4 1/2 x 2 1/2	5/-
10 x 8 x 2 1/2	5/6
10 x 5 1/2 x 2 1/2	5/-
10 x 9 x 3	7/-
12 x 9 x 2 1/2	7/-
14 x 9 x 2 1/2	7/6
14 x 10 x 3	7/9
16 x 10 x 3	8/3
16 x 8 x 3	7/9
11 1/2 x 10 x 3	7/6
16 x 12 x 3	8/8
19 1/2 x 9 x 2 1/2	8/3
20 x 10 x 3	10/-
21 1/2 x 9 1/2 x 2 1/2	10/6

ELECTRONIC PRECISION EQUIPMENT LTD.

NEW ITEMS THIS MONTH

WELDING CABLE

This Cable is adequately insulated, and so is quite suitable for any job where high current is required, e.g. motor-starter wiring, plating, welding, etc.

- 250 amp. 5/- per yd.
- 75 amp. 3/- "
- 25 amp. 1/6 "

NON-STRETCHABLE CABLES

These Cables are extra heavily rubber covered and have string plaited with the conductors, which makes them tremendously strong and ideal for portable appliances where normal cables would stretch and break. These are twin cables.

- 70/.0076 (10 amp.) 2/- per yd.
- 110/.0076 (15 amp.) 2/6 "

LACQUERED AUTO CABLE

20 amp. twin flat 44/.012, 1/- per yd.

SCREENED CABLES

4-core 23/.0076 V.I.R. taped plated metal overall, 3/- per yd. Single-core 9/1.022 V.I.R. taped plated metal overall, 1/6 per yd.

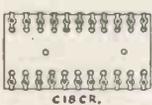
EARTH WIRE

7/1.029 enamelled copper, 50ft. coils, 3/-.

CONNECTING WIRE

Push back, assorted colours, 10ft. coils, 6d. per coil, 5/- per doz. P.V.C. insulated, single, 23 gauge, tinned copper, 50ft. coils, 1/9 per coil; assorted colours, 4 coils, 6/6.

GROUP BOARDS



9-way on PAX Panel, size 3 1/2 x 2 1/2 in. approximately, 9d. each, 8/- a doz.

13-way on PAX Panel, size 5 1/2 x 2 1/2 in. approximately, with two mounting brackets, 1/3 each, 12/- a doz.

TAG STRIPS

7-way plus 2 combined mounting brackets and earthing tags. 6d. each, 5/6 a doz. 9-way plus 2 combined mounting brackets and earthing tags. 9d. each, 8/6 a doz. 13-way plus 2 combined mounting brackets and earthing tags. 1/- each, 11/- a doz.



Voltage Selection Panels with Shorting Plug, 1/- each.

PLUGS AND SOCKETS

12-way, 1/6 the pair Octal Plug, fits standard Octal valve-holder, 1/-.



METAL-CASED CONDENSERS

64 mfd. 450 volt working 600 mA. ripple, can size 4 1/4 x 1 1/2, 4/9 a doz. 1 mfd. 350 volt, size 1 1/2 x 1 1/2 tubular, 8d. each, 7/- a doz.

MINIATURE WIRE-WOUND POT

Colvern 200 ohms, 1/3 each, 12/- a doz.

CONDENSER FIXING CLIPS

1 1/4 in., 4d. each, 3/9 a doz.

12in. P.M. SPEAKER, TRUVOX

£3. Post and packing 3/6.

A 70 Gn. RADIOGRAM FOR ONLY 40 Gns. OR £14. 0. 0. DEPOSIT



This Cabinet has all the properties which combine to make it a beautiful piece of furniture and yet a most up-to-date radio-gram. Externally, it is beautifully figured walnut; internally, it is white sycamore. The radio section is raised to a comfortable operating level and beyond the auto changer is a compartment for storing your most popular records. We are most proud to offer this cabinet, and feel sure that every purchaser will be equally proud to own one. It can be supplied complete as a working radiogram, the price being £42, carriage and insurance £1. Alternatively, the cabinet may be purchased separately, price £18/18/-. Or with record changer, but uncut radio board, price £30. The radio chassis incorporated in the complete model is our popular 5-valve A.C. mains Superhet, covering 3-way bands (long, medium and short) and with volume and tone controls, multi-colour edge-lit dial, etc. The record changer incorporated in all models is the latest Collaro 3-speed model (type No. RC531) with the famous Collaro "Studio" pick-up.

A FEW MORE AVAILABLE



The Cabinet illustrated alongside has proved one of our best bargains, and all of the original batch we purchased was sold during November and December. Nevertheless, we have been able to obtain a further quantity, but regret that the price is just a little higher, though still well below cost. The Cabinet is suitable for television using tube sizes varying from 12in. to 17in., its overall dimensions being 3ft. 5in. high, 1ft. 4in. deep, 1ft. 10in. wide. It is complete with plywood back and "Bowler Hat." Originally made for a very expensive television and really good quality. Unrepeatable. Offered at £7/5/-, carriage, packing, etc., 12/6. Note: These are cut for 12in. tubes, but the holes for the controls are not drilled.

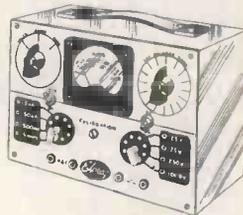
THE 17 RANGE ELECTRONIC TEST METER

10 megohms input impedance on voltage ranges.

This is the first instrument of the new "Elpreq" range of test equipment. It is undoubtedly an essential piece of equipment for professional and amateur alike. It has all the qualities of a modern 20,000 ohms per voltmeter, with none of its fragility. It is quite as easy to handle as an ordinary instrument, yet it is a valve voltmeter which will enable you to measure directly, grid, A.V.C. and resonant voltages and to perform checking operations which extend its usefulness far above that of any ordinary multimeter. By an ingenious piece of circuitry, exceptional accuracy is obtainable. The ranges include:—

- D.C. Voltage 4 Ranges
- D.C. Current 4 Ranges
- A.C. Voltage 4 Ranges
- A.C. Current 4 Ranges

Resistance Ranges. For those interested in television, an optional E.H.T. probe extending the meter's range to 10KV is also available. The instrument is completely self-contained and can be totally enclosed in an attractive metal case with carrying handle. Price of completely self-contained instrument, less case, 57/6. E.H.T. Probe 10/6. Case as illustration will be available shortly.



MISCELLANEOUS ITEMS

PROJECTION T.V. SCREEN

Made from plastic and precision-milled on both sides to give a reflectionless surface. The cost of these from the manufacturers was 30/- each, but through a company going into liquidation we are able to offer these at 17/6 each. Size is 17x14in. but easily cut to suit cabinet opening. A limited quantity only, of course, is available.

PLASTIC TELEVISION MASK

This is a Mask and Implosion Guard combined, made for 12in. tube from moulded Perspex and internally sprayed bronze. It is the type of mask which fixes on the inside of the cabinet and is thus suitable for the amateur-cut hole. It is the latest type of mask as fitted to most modern televisions. Brand new and perfect at less than manufacturer's price, viz., 15/-, plus 1/6 carriage and insurance.

BALL BEARING TURNTABLE

As fitted to portable radios. The diameter approximately 4 1/2 in. Price 2/6 each.

NEEDLE CUPS

For gramophones made from Bakelite. Diameter approximately 1 1/4 in. Price 6d. each, or 4/6 a dozen.

BLACK SEALING WAX

For filling grubbing screw holes in Bakelite, knobs, sealing instruments, etc.: 1/2 lb. sticks, 1/6 each, or 15/- a dozen.

BLOCK CONDENSERS

.5 mfd., 1,000 volts, 2/6. .5 mfd., 750 volts, 2/- . 2 mfd., 400 volts, 2/6. 2 mfd., 350 volts, 2/-.

CLEAR PLASTIC PANELS

Suitable as windows in radio sets and instruments, size 4, 2 1/2 d. each; 5, 6d. each; 5/- a dozen.

CROCODILE CLIPS

Large size for battery charges. 9d. each, 7/6 a dozen.

SCREENED SYSTOFLEX

5 mm., 1/- per yard length; 10/- a dozen yards.

DOMED FEET

Nickel plated, knock-in type for wooden cabinets. 6d. each, 5/- a dozen.

NIPHAM PLUG

2-pin type, No. XB.10260, 2/3.

MAZAK PLUGS AND SOCKETS

2-pin plug type, No. 10H/1411, and socket to match, type No. 10H/397, 3/6 the pair. 19-pin plug type, No. 10H/418, 2/6.

BAKELITE PLUG AND SOCKET

3-pin heavy duty type, No. ZA/6557, with a socket to match. Type No. ZA/5585, 3/- a pair.

SYSTOFLEX, ETC.

Insulated sleeving for all purposes. 24 1-yard lengths, mixed sizes 2-10 mm. Some varnished cotton (Systoflex), some P.V.C. for E.H.T. work. Approximate cost value 15/-, offered as a parcel 7/6, or half the quantity, 4/-.

“Superior 15”

SOME QUESTIONS ANSWERED



QUESTION

*Can I expect sound and pictures equal to factory made sets?
Is it robust and likely to go for long periods without trouble?
Why is it so much cheaper than any other big picture television?
Does it look like a home-made set?*

*How about soldering? Is it difficult like repairing a kettle or saucepan?
Is aligning the set difficult?*

Will the Elpreq “Superior 15” receive all B.B.C. stations?

What happens if I cannot get my television to work once I have it finished?

ANSWER

The picture compared favourably with any set at the Radio Show.

Yes, because all parts are standard size and proved types.

The reason is because you assemble it yourself and thus save labour and other costs.

No, because it isn't really home made, it is simply assembled from factory made parts, just as are all so-called “factory made” T.V. models.

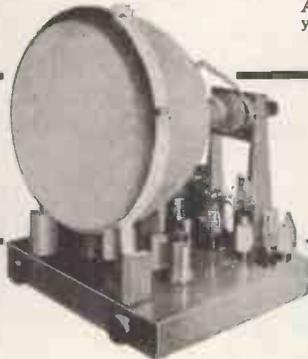
Soldering radio parts is simplicity itself.

No, the coils are all specially designed which “pre-aligns” them and you have only to follow the simple directions to ensure receiving the perfect picture. No instruments are necessary.

Yes, and all constructors will be notified of the modifications that will be necessary when Commercial T.V. starts.

You send for a service form which you complete and then our engineer will indicate your trouble. Alternatively, for a nominal charge, we will take your chassis and make it perfect.

UP TO THE MINUTE
BIG PICTURE T.V.



ONLY £37.10
OR £12.10 deposit

—MORE QUESTIONS ANSWERED

QUESTION

What is the cost?

Are Hire Purchase terms available

Are there any guarantees?

Are cabinets available?

How much is the data and can I have it on approval?

How can I order

ANSWER

All components, valves and Cossor 15in. cathode ray tube cost £37-10-0.

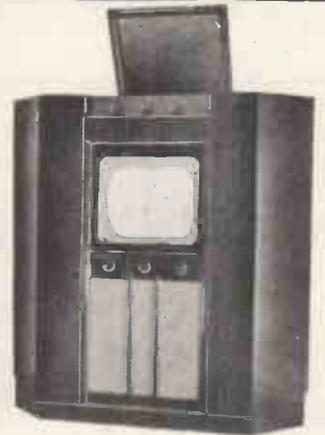
Yes, the deposit is £12-10-0, the balance is spread over 12 months.

You are covered by two guarantees, one covers the components and the other ensures that you will get perfect results.

The illustrations show the cabinets which are available. The Console costs £11-10-0 and the Super corner model £18-0-0. H.P. terms again are available.

The data costs 7/6, but providing you keep it clean and in good condition you can return it within 7 days if you think you cannot make the television (7/- will be refunded to you).

An order form is enclosed with the 7/6 data, which you can complete and post to us.



—As Demonstrated at the National Radio Show

ELECTRONIC PRECISION EQUIPMENT LTD.

Post orders should be addressed to :—

ELPREQ HOUSE (Ref 2.), HIGH STREET,
WEALDSTONE, MIDDX.

Personal shoppers however must continue to call at :—

42-46, WINDMILL HILL, RUISLIP, MIDDX.
Phone : RUISLIP 5780. Half-day, Wednesday.

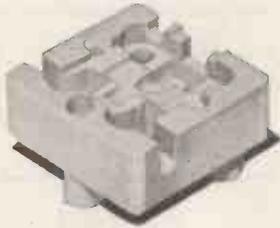
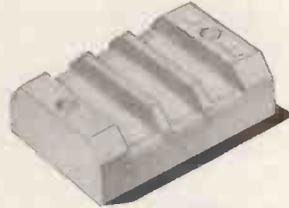
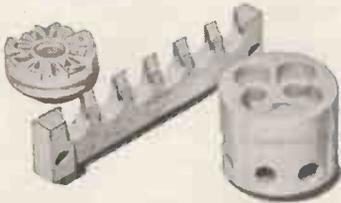
152-153, FLEET STREET, E.C.4.
Phone : CENTRAL 2833. Half-day Saturday.

29, STROUD GREEN RD., FINSBURY PARK.
Half-day, Thursday.



Bullers CERAMICS FOR INDUSTRY

High quality material and dimensional-precision are attributes of Bullers die-pressed products. Prompt delivery at competitive prices.



We specialise in the manufacture of

PORCELAIN
for general insulation

REFRACTORIES
for high temperature insulation

FREQUELEX
for high-frequency insulation

PERMALEX & TEMPLEX
for capacitors

BULLERS LIMITED

Porcelain Works:
MILTON,
STOKE-ON-TRENT
Stoke-on-Trent 5164

Sales Office:
6, LAURENCE POUNTNEY HILL,
LONDON, E.C.4
MANsion House 9971

Iron Works:
TIPTON,
STAFFORDSHIRE
Tipton 1691

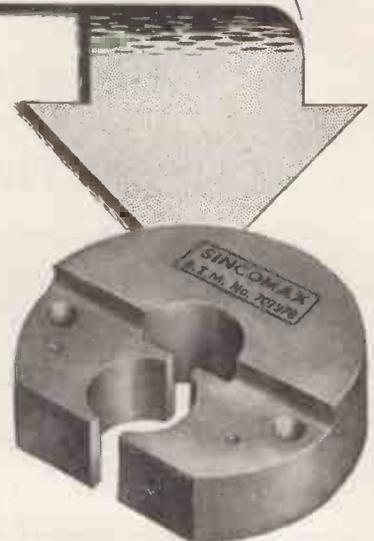
ELIOS

MUREX 'SINCOMAX' MAGNETS

ARE USED IN
E.I.C. INSTRUMENTS



The high magnetic stability and strength of 'Sincomax' magnets makes a robust job even of a sensitive Microammeter. In this application as in many others Murex Sintered Magnets continue to give accurate and reliable service.



Photograph by courtesy of E.I.C. (Hillington) Ltd., Glasgow

MUREX LIMITED (Powder Metallurgy Division)

RAINHAM • ESSEX • Rainham, Essex 3322

London Sales Office: Central House, Upper Woburn Place, W.C.1. Euston 8265



C.R.T. Display Units

With the basic essentials for visual presentation and designed to provide in simple and convenient form the best means of demonstrating signals from your existing equipment, they will also form display units for the Unitel System of instruments.

Model 1001 incorporates a 5in. diameter cathode ray tube with the following features: ● Post Deflection Acceleration at 4000 v. ● Fine Focus, High Intensity and Sensitivity. ● Self contained operating potentials from 200 to 250 v. A.C. Mains. ● Graticule with variable illumination. ● Full screening against external fields.

Ideal for monitoring production tests.

NAGARD
LTD

18, Avenue Road, Belmont, Surrey. VIGilant 0345.

Specialists in Oscilloscopes and D.C. Amplifiers

Your problems are our interest—Write for details.

L·R·S

EASY TERMS

Estd. 1925

LEAK QUALITY EQUIPMENT
for the Connoisseur
POINT-ONE TL/12 12-WATT
Triple Loop Feedback Amplifier



For the highest possible quality of reproduction from Pick-up, Radio, Microphone. Film and Magnetic Tape this amplifier has won world-wide recognition. As used by the B.B.C. and many overseas Broadcasting Corporations.

Cash Price £28 7 0.

THE NEW VARI-SLOPE PRE-AMPLIFIER

Gives audibly better reproduction. No chokes to cause magnetic hum pick-up. Extremely low harmonic and intermodulation distortion. Cash Price £12/12/0



For fuller details see maker's advertisement on p. 85

TERMS for these TWO UNITS

£9 deposit with order and 18 monthly instalments of 40/-.

Passenger carriage 10/- extra, payable with deposit.

LEAK V.S. TUNER AND DYNAMIC P.U. also supplied on similar terms All the above available separately

Armstrong Chassis

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Connoisseur 3-speed **GRAM UNITS** and **LIGHTWEIGHT PICK-UPS** to match, can be supplied from stock.

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BAIRD Soundmaster	£68	5	0
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Portable	£74	10	0
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GRUNDIG L.G.S. 1,200ft.	£2	0	0
SOUNDMIRROR Paper Tape 1,200ft....	£1	5	0
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Spare Spools 1,200ft.	4	3	
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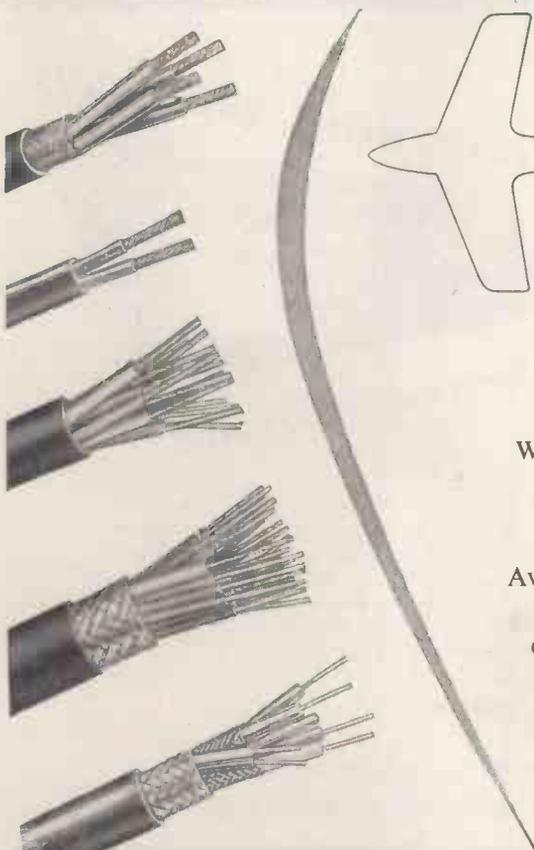
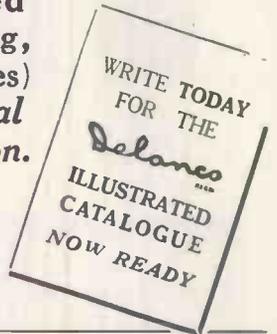
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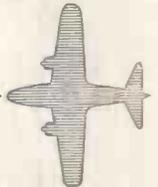
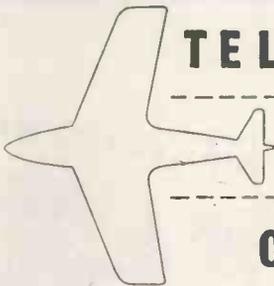
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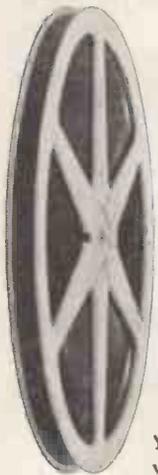


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RADIO EXPORT

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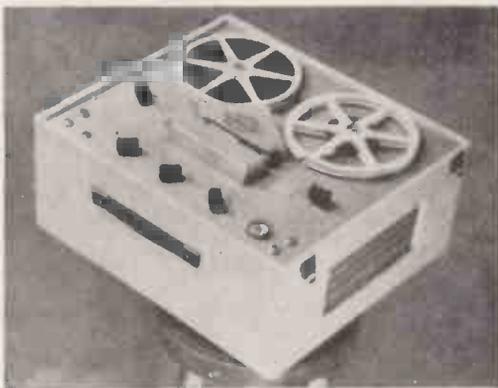
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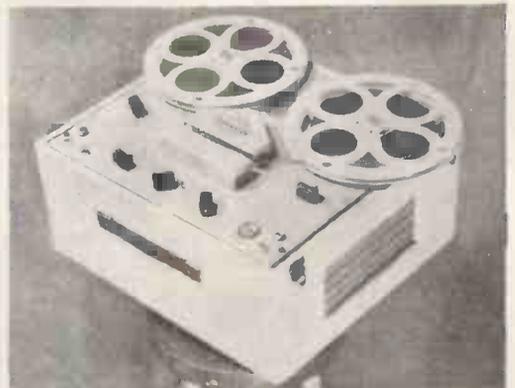
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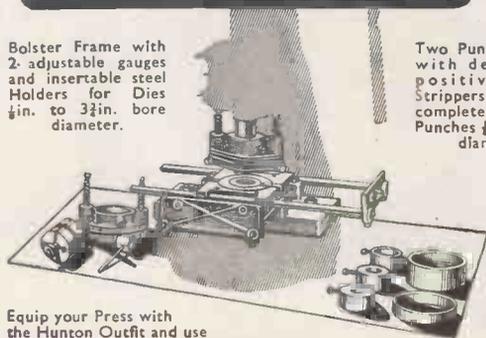
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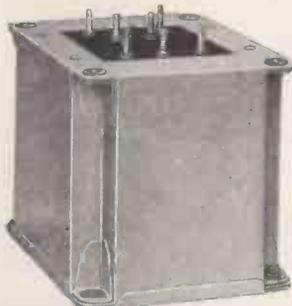


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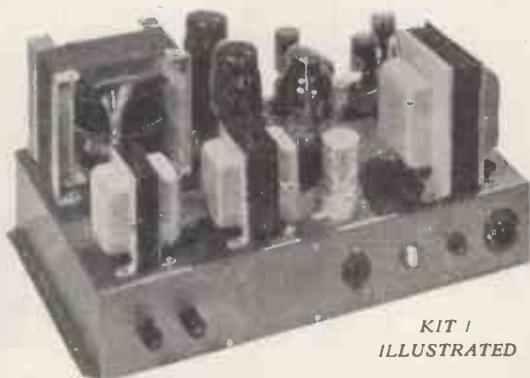
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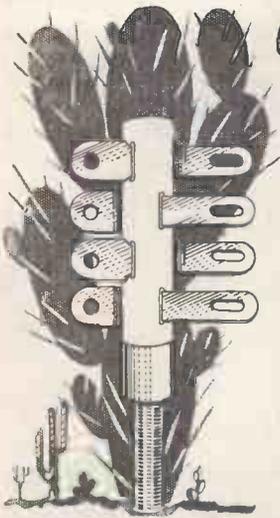


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Moulded Crystal Holder
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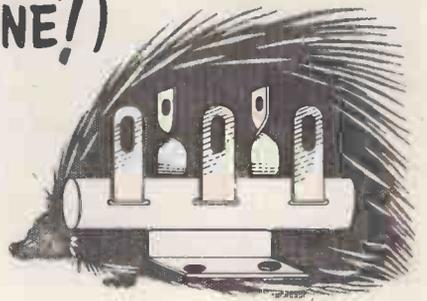
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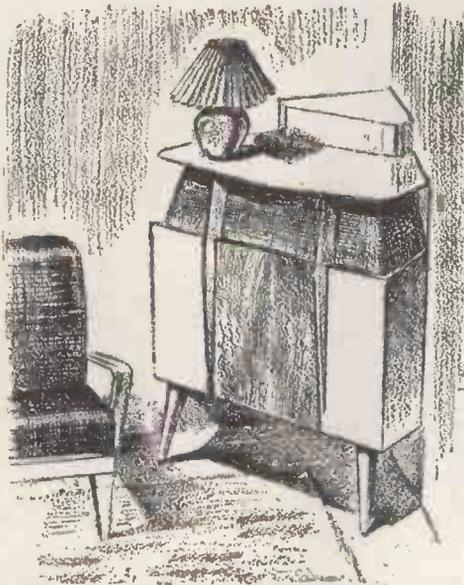


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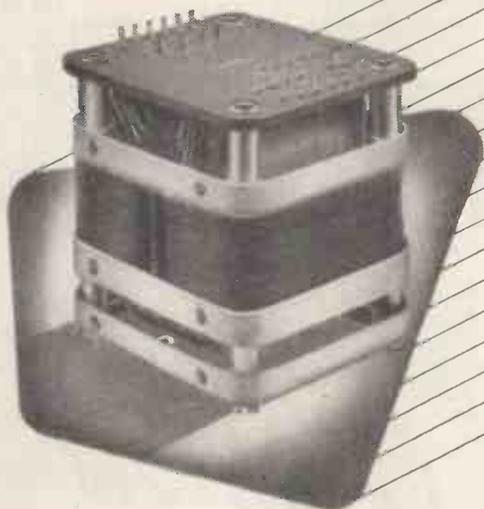


S.L.92

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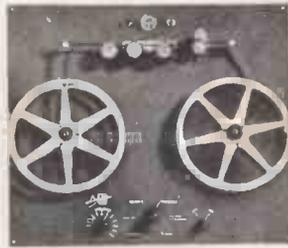
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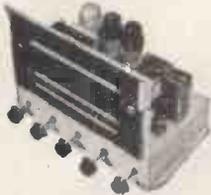
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The above photograph shows the receiver closed, in this position it may be securely locked. On the right the receiver is shown opened for viewing. Note the remote control panel on the right hand side of cabinet.

Prices, £187 in stained and polished cabinet or £198 in attractively veneered cabinet. (Both Prices tax free.)

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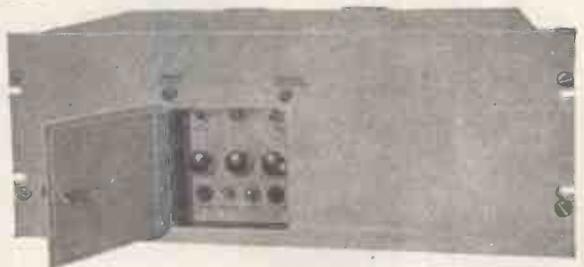
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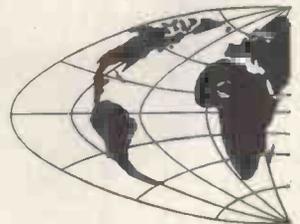
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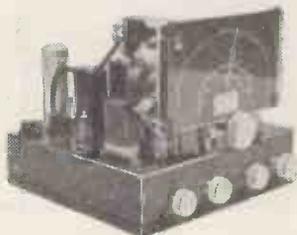
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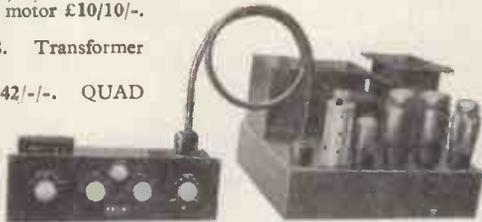
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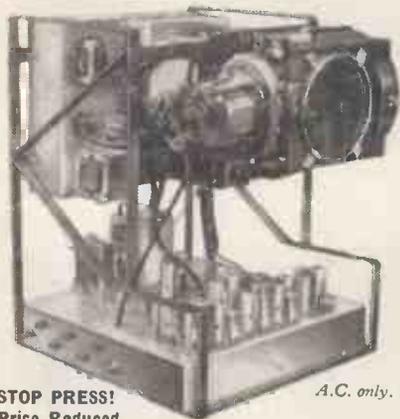
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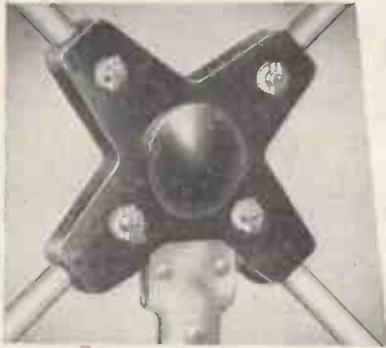
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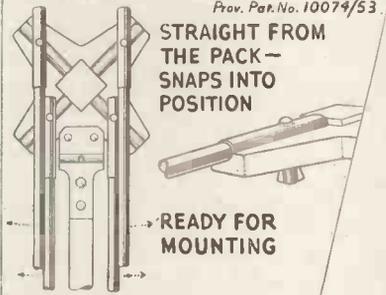
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57 OR ON HIRE PURCHASE
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De Luxe T.V. Enlargers. 12in.	£3 15 0	£1 5 0	9 2	—
Bremi Microphone 7D.	£3 15 0	£1 5 0	9 2	—
Tamsa R/P & Erase Head	£4 10 0	£1 10 0	10 9	—
Amplion Testmeter. 10 ranges A.C.-D.C.	£5 0 0	£1 13 4	12 3	—
Bremi Microphones IIA.	£5 5 0	£1 15 0	12 10	—
Three 1,200ft. reels Scotch Boy Tape	£5 5 0	£1 15 0	12 10	—
Black & Decker ½in. Universal Drill	£6 5 0	£2 1 8	14 11	7 8
Collaro AC514	£6 5 11	£2 2 0	15 1	7 10
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Goodmans Axiom 101. 8in. L/Spkr.	£6 12 1	£2 4 1	15 9	8 1
Garland Amplifier AC11A	£6 12 6	£2 4 2	15 9	8 1
Collaro AC47	£6 13 4	£2 4 6	15 11	8 2
Wharfedale Golden CBS. 10in. Speaker	£8 6 7	£2 15 7	19 11	10 2
Goodmans Audiom 60 Speaker	£8 12 6	£2 17 6	£1 0 8	10 7
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Connoisseur Pick Up, 2 heads	£9 5 6	£3 1 10	£1 2 2	11 4
Leak Pre-amplifier	£9 9 0	£3 3 0	£1 2 7	11 7
Wharfedale W12/cs. 12in.	£9 15 0	£3 5 0	£1 3 4	11 11
Goodmans Axiom 150, Mk II	£10 5 6	£3 8 6	£1 4 7	12 7
Leak "Varislope" Pre-amplifier	£12 12 0	£4 4 0	£1 10 2	15 6
Garrard 3-speed Auto-changer. R.C.75A	£15 8 1	£5 2 8	£1 16 10	18 10
Garland Amplifier AC IV	£15 15 0	£5 5 0	£1 17 8	19 3
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Garrard 3-speed Auto-change. R.C.80	£17 1 3	£5 13 9	£2 0 10	£1 0 11
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"HERALD" TAPE RECORDER. 8in. Speaker, 2 Inputs with mixing controls, Lane Tape Table, Single tape speed twin track recording. Fast rewind and forward speeds. 48 Gns. or on H.P. Send 2½d. stamp for brochure.

MAGNETIC TAPE. Now available, the new Scotch Boy High Coercivity Tape MC2-III, with higher output and signal-to-noise ratio. Price 35/- per 1,200ft. reel. Still available: Scotch Boy MCI-III: 1,200ft. 35/-; 600ft., 21/-; 300ft., 12/3. Spare 7in. spools, 4/3. Ferrotype, the new kraft-based medium coercivity tape: 1,200ft., 22/6. Spare 7in. spools, 4/6. Magnetophon Tape: £2 per 1,200ft. reel.

BRENETTE MICROPHONES. Large sales of these popular microphones have enabled us to make substantial reductions in the prices. The following range is available: Type 9ND: Multi-directional ball-type, in black and chrome, £2/2/-, post 2/-. Type 7D: Directional type, for instrumental or vocal use; black and chrome, £3/15/-, post 2/6. Type IIA: A wide-frequency-response microphone, in brown cast case with chrome grille, £5/5/-, post 2/6. Type 13U: A highly sensitive studio microphone with outstanding frequency characteristics. Flexible mounting enables it to be used directionally or not as required. Black and chrome finish, £6/6/-, post 3/6.

ALL GOODS NEW AND UNUSED (except where otherwise stated).

PLEASE ADD POST OR CARRIAGE ON ALL ITEMS. KINDLY PRINT NAME AND ADDRESS. POST ORDERS TO OUR DEPTFORD ADDRESS, EARLY CLOSING THURSDAY. OPEN ALL DAY SATURDAY.

SHOP HOURS: Mon: Tues: Wed: and Sat: 9 a.m.—6 p.m. Thurs: 9 a.m.—1 p.m. Fri: 9 a.m.—7 p.m.

GARLAND BROS. LTD.

CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8.
 5 OBELISK PARADE, LEWISHAM, S.E.13.

TEL: TIDEWAY 4412/3
 TEL: LEE GREEN 4038



GARRARD RECORD PLAYERS
For 6 and 12 v. operation, complete with magnetic pick-up and volume control. In metal cabinet size: 17in. x 14in. x 11in. Very limited quantity.
LASKY'S PRICE £5.19.6
Carriage 10/- extra.

1/2 H.P. ELECTRIC MOTORS
By Famous British Manufacturer. 230/250v. 50 c.p.s. Single phase. 1425 r.p.m. Self starting, standard spindle. Dims: 8 x 6 1/2 x 6in.
LASKY'S PRICE 99/6
Brand New and Unused. Carr. 7/6.

HEARING AIDS
By well-known Manufacturer. In metal case, size: 2 1/2in. x 4 1/2in. x 1in. Complete with batteries and 3 sub-miniature valves, earpiece and cord. Only two controls; volume and on/off. Fitted with internal crystal microphone. MADE TO SELL FOR 22 GNS.
LASKY'S PRICE 99/6
Postage 3/6 extra.
Ready for use. Perfect working order. Slightly soiled but new and unused.

TANNOY PRESSURE UNITS
10 watts. 7.5 ohms impedance. Last few only. **PRICE 59/6**
Carriage 4/6 extra.

R.F. OSC. E.H.T. KIT
Consisting of R.F. oscillator E.H.T. coil with EY51 heater winding, EY51 rectifier, 6V6 valve and base. All necessary condensers and resistances, including .0005mfd. 12.5Kv. smoothing condensers.
LASKY'S PRICE 53/6



Fully Assembled Power Pack and Output Stage, for R1155 Receiver For use on 200-250 volts A.C. mains.
LASKY'S PRICE 79/6
Carriage 5/- extra.

MUIRHEAD SLOW MOTION DRIVES 8/6

CRYSTAL DIODES
Germanium 1/6 each, post free.

12 VOLT D.C. MOTOR GENERATORS
Output 300 volts at 150 m/A. D.C. 7,500 r.p.m. Size: 2 1/2in. diam. 6in. long.
LASKY'S PRICE 17/6

I.F. TRANSFORMERS
465 Kc/s Iron dust cores in cans, midget type. Size 1 1/2in. x 1in. x 2 1/2in. By Plessey. Price 8/6 per pair.
WEARITE TYPE 550. 445-520 Kc/s. 8/6 per pair.
WEARITE TYPE 500. 450-470 Kc/s. 8/6 per pair.

BAFFLE RADIO CABINETS



Pleasing design, complete with knobs, drilled chassis, dial, drum drive and back. Finish in satin mahogany veneer, natural colour polish. Outside dimensions: 17 1/2in. wide 11 1/2in. high, 5in. deep.

HUGE PURCHASE OF STAINLESS STEEL RECORDING WIRE. ON STANDARD REELS. (By B. & H.)

15 mins.	7/6
30 mins.	12/6
60 mins.	25/-

PORTABLE TAPE RECORDER
Brand new and unused. Perfect working order. Twin track recording, with fast rewind. Valve line up: 2-6V6, 2-6J7, 0Z4 and 6J5. In attractive carrying case, with hinged lid, handle and locks. Size: 17 x 12 x 7in. Supplied with hand microphone, spool of tape and empty take up spool. For 200-250 volt A.C. mains. Circuit available.
LASKY'S PRICE £34.19.6
Carriage 15/- extra.

SOLO SOLDERING IRONS
220-250 volts
Latest model instrument iron 19/8
Standard model 19/-

ALL WAVE RADIO INTERFERENCE SUPPRESSOR UNITS, 5/6 each.

GRAM MOTORS
Shaded Pole

METAL RECTIFIERS
6 and 12 volt F.W. Bridge.

0.6a.	4/6
2a.	9/-
3a.	9/11
4a.	12/-
6a.	17/6

6 volt Centre Tapped Bridge.

0.75a.	3/9
1a.	3/11

R.1155 RECEIVERS

BRAND NEW AERIAL TESTED BEFORE DESPATCH
These well-known ex-Air Ministry Receivers need no further introduction. Supplied complete with 10 valves, and full circuit data.
LASKY'S PRICE £11.19.6
USED MODELS £7.19.6
A Few Only. Model R1155.N. Covering the shipping band of 1.5-3.0 Mc/s. Price £17.
Carriage 12/6 per unit extra, including 10/- returnable on packing case. 10s. 0d. rebate will be given on power packs for the R.1155 when purchased with the receiver.

TOGGLE SWITCHES. BULGIN

S.P.S.T.	1/6
D.P.S.T.	2/6
D.P. Change over	3/6

TRIPLEX DARK SCREEN FILTERS

14 x 12 1/2 x 1 1/2in.	7/6
15 1/2 x 13 1/2 x 1 1/2in.	9/6

Postage and packing 5/- per piece extra. (This charge is necessary owing to extra packing required.)

BRANDENBERG R.F. E.H.T. UNITS
Complete with valves.

6-9 Kv.	£6 6 0
13-16 Kv.	£9 9 0

THE SOUNDMASTER

You can now build your own HIGH FIDELITY TAPE RECORDER (both tape desk and amplifier) AT HOME. Uses precision machined parts and standard radio components. Easily wired and assembled without previous experience.
SEND NOW for 26 page booklet giving full data to build in 6 easy stages, with full size wiring diagrams. All the latest developments in home recording. Lifelike reproduction of voice, music and events. 3 speeds, twin track recording at 3 1/2in., 7 1/2in. and 15 1/2in. per second. Fast forward and fast rewind using 3 motors.

POST FREE 6/6
BY THE CREATORS OF THE VIEWMASTER
All components in stock. Write for list. Wearite, Bulgin, T.C.C., Collaro, etc.

PRESS BUTTON COIL PACKS
5 Preset stations—3 M.W. and 2 L.W. For use in superhet circuit, with 460 Kc/s. I.F. Size: 3 1/2in. x 5 1/2in. 2 1/2in. Deep. By Famous Manufacturer, complete with circuit, and knobs.
LASKY'S PRICE 21/-
Postage 2/6.

CONDENSERS. Electrolytics.

Case	Tabular
16 mfd. 500 v.w.	3/6
24 mfd. 450 v.w.	3/11
32 mfd. 500 v.w.	5/11
60 mfd. 350 v.w.	4/11
64 mfd. 450 v.w.	3/6
8+8 mfd. 450 v.w.	3/11
8+16 mfd. 450 v.w.	3/11
8+32 mfd. 475 v.w.	3/11
16+8 mfd. 500 v.w.	4/6
16+16 mfd. 500 v.w.	4/6
16+32 mfd. 450 v.w.	4/6
20+20 mfd. 275 v.w.	2/-
32+32 mfd. 500 v.w.	4/11
32+32 mfd. 350 v.w.	3/11
60+100 mfd. 350 v.w.	7/6
250 mfd. 350 v.w.	4/11
8000 mfd. 3 v.w.	6/11

MANY OTHER TYPES IN STOCK

SPECIAL T.V. CONDENSERS

32 + 100 mfd. 450 v.w. 7/6	.04 mfd. 12.5 Kv.	7/6
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Bias

10 mfd. 25 v.w.	1/3
12 mfd. 50 v.w.	1/3
25 mfd. 25 v.w.	1/6
25 mfd. 50 v.w.	1/6
50 mfd. 12 v.w.	1/3
50 mfd. 25 v.w.	1/6
50 mfd. 50 v.w.	1/9
75 mfd. 12 v.w.	1/9
100 mfd. 25 v.w.	2/-
100 mfd. 50 v.w.	2/6

Tubular Waxed
500 v.w., .01, .02, .05, .001, .002, .005, etc. From 6d. each, 5/- doz. .1 mfd. 9d. each.

Miniature Mica
100, 200, 300, 500 PF., 5d. each, 4/- doz.

Supplied in maker's original wood transit case. Frequency coverage 100-124 Mc/s. 11 valves: 1 VR65, 1 VR66, 4 VR53, 2 VR54, 1 6J5, 1 V570, 1 VR57. Large tuning scale with slow motion drive. 0.5 mA tuning meter. R.F. and L.F. gain controls, jack sockets for line and phone. Totally enclosed in metal case, grey enamelled with plated handles. Size: 18 x 10 x 11in. Supplied with all valves, also circuit and calibration chart.

GRADE 1. Brand New 79/6. GRADE 2. Soiled 49/6. GRADE 3. Secondhand 39/6. Carriage 10/- per unit extra.

TWO-GANG TUNING CONDENSERS .0005MFD.

No. 1. Miniature. With trimmers. Size: 2 1/2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE, 7/6**

No. 2. Midget. With trimmers. Size: 2 1/2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 8/6.**

No. 3. Midget. Less trimmers. Size: 2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 6/6.**

No. 4. Standard type. Size: 2 1/2in. x 2 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 6/6.**

THREE GANG .0005mfd. Less trimmers. Size: 3 1/2 x 2 1/2 x 1 1/2in. LASKY'S PRICE 7/6.



SENTERCEL RECTIFIERS

RM1	3/10
RM2	4/3
RM3	6/-
RM4	18/-

WESTINGHOUSE RECTIFIERS
250 v. R.M.S.
14A976. 80 m/a 8/6.
14A86. 200 m/a 20/4.
14A100. 270 v. R.M.S. 200 m/a 21/6.

CONDENSERS. Electrolytics.

Case	Tabular
1 mfd. 900 v.w.	1/-
1 mfd. 250 v.w.	9d.
2 mfd. 150 v.w.	1/-
2 mfd. 350 v.w.	1/8
4 mfd. 350 v.w.	1/8
4 mfd. 450 v.w.	1/8
4 mfd. 150 v.w.	1/6
8 mfd. 350 v.w.	2/-
8 mfd. 450 v.w.	1/9
15 mfd. 200 v.w.	2/-
16 mfd. 350 v.w.	2/3
16 mfd. 450 v.w.	2/9
16 mfd. 500 v.w.	3/3
32 mfd. 350 v.w.	3/6
32 mfd. 450 v.w.	4/8
50 mfd. 350 v.w.	4/8
250 mfd. 12 v.w.	2/-
8+8 mfd. 350 v.w.	3/-
8+8 mfd. 450 v.w.	3/11
12+12 mfd. 350 v.w.	2/6

T.C.C. VISCONOL HIGH VOLTAGE CONDENSERS (Cathodray)

.001 mfd. 12.5 kv.	7/6
.001 mfd. 15 kv.	10/-
.001 mfd. 25 kv.	18/-
.0005 mfd. 25 kv.	18/-
.0005 mfd. 12.5 kv.	10/-

Plastic case, single bolt fixing. Other h.v. types. .1 mfd. 7 Kv. 15/- .04 mfd. 12.5 Kv. 7/6

We have a large range of ceramic tube condensers now available.

R.1132.A RECEIVERS



Supplied in maker's original wood transit case. Frequency coverage 100-124 Mc/s. 11 valves: 1 VR65, 1 VR66, 4 VR53, 2 VR54, 1 6J5, 1 V570, 1 VR57. Large tuning scale with slow motion drive. 0.5 mA tuning meter. R.F. and L.F. gain controls, jack sockets for line and phone. Totally enclosed in metal case, grey enamelled with plated handles. Size: 18 x 10 x 11in. Supplied with all valves, also circuit and calibration chart.

GRADE 1. Brand New 79/6. GRADE 2. Soiled 49/6. GRADE 3. Secondhand 39/6. Carriage 10/- per unit extra.

TWO-GANG TUNING CONDENSERS .0005MFD.

No. 1. Miniature. With trimmers. Size: 2 1/2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE, 7/6**

No. 2. Midget. With trimmers. Size: 2 1/2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 8/6.**

No. 3. Midget. Less trimmers. Size: 2in. x 1 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 6/6.**

No. 4. Standard type. Size: 2 1/2in. x 2 1/2in. x 1 1/2in. spindle. **LASKY'S PRICE 6/6.**

THREE GANG .0005mfd. Less trimmers. Size: 3 1/2 x 2 1/2 x 1 1/2in. LASKY'S PRICE 7/6.

A LASKY'S RADIO ADVERTISEMENT. SEE OVER.



LINE TRANSFORMERS FOR "ETRONIC" T.V. RECEIVERS

No. 1. For models 1536 and 1637. Complete with EY51 rectifier, 39/6.
No. 2. 7Kv. type, 35/-.

POT/METERS. All values. Wire Wound from 3/6. Depending on wattage and length of spindle. Carbon. Less switch 2/11 each With s.p. switch 4/3 each With d.p. switch 5/6 each

VCR97 C.R. TUBES, new unused. 35/- Carriage 5/-.

Screen Enlarger for VCR97. Filter or clear, 17/6. Postage 2/6.

C.R.T. Neck Protectors, 2/6.

10 K.V. METROSIL E.H.T. REGULATORS. By Metrovick. Pencil type, 5/- each.

TELEVISION SELENIUM RECTIFIERS

The very latest "Sentercell" S.T.C. range:
K3/40, 3.2 kv. 7/6
K3/45, 3.6 kv. 8/2
K3/50, 4.0 kv. 8/8
K3/100, 8.0 kv. 14/8
K3/160, 12.8 kv. 21/6

DARK SCREEN PERSPEX FILTERS

18in. x 14 1/2in. 25/-
14 1/2in. x 12 1/2in. 19/6
13 1/2in. x 11in. 14/11

PERSPEX. 13 1/2in. x 10 1/2in. x 1/4in. Neutral shade, slightly marked, 4/11 per piece.

TEST PRODS

Fully fused, with retractable points, 4/11 per pair (1 red, 1 black).

9in. TABLE T.V. CABINETS



Medium shade mahogany finish. Complete with back, safety glass, speaker-fret. Internal dimensions: 19 1/2in. high, 16in. wide, 14in. deep.

LASKY'S PRICE Soiled 25/-

Carriage 7/6 each extra

Adaptor frame available for 6in. C.R. tubes. The aperture can easily be enlarged to take 12in. or 14in. tubes.

SPECIAL C.R.T. OFFER

Brand new and unused 12in. ion trap cathode ray tubes. 6.3 volt heater, 7-9 Kv. E.H.T. 35 mm. neck. Black and white picture. By famous manufacturer.

PERFECT £12/19/6
Carriage and insurance 15/- per tube extra.

MANUFACTURERS' SURPLUS T.V. COMPONENTS

Wide Angle Scanning Coils. Low imp. line and frame pair 19/6
Scanning Coils. 35 mm. Low imp. line and frame 12/6
Frame multi ratio output trans. 10/6
Focus Coil. 35 mm. electro magnetic 12/6
Line or Frame B.O. transformer. Auto. 4/6
Wide Angle Frame B.O. trans. 10/6
P.M. Focus Magnets. With vernier. 35 mm. Tetrode 15/-
Triode 17/6
Less vernier 12/6
Wide Angle P.M. Focus Unit. For all 38 mm. tubes. With vernier and picture shift. Ferroxdure 25/-
PLESSEY
Scan coils per pair 25/-
Width Control 6/6

Co-Axial Cable. 70-80 ohms impedance. Single core, 8/- doz. yards. Twin core, 12/- doz. yards. Twin feeder, 6/- doz. yards. **Co-Axial Connectors.** For standard 1/4in. cable, 1/6.

C.R.T. MASKS Brand New LATEST ASPECT RATIO

9in. 7/-
10in. 7/6
12in. 15/-
12in. Flat Face 15/-
12in. Old ratio 9/6
14in. Rectangular 21/-
15in. Cream rubber 17/6
15in. With fitted safety glass 22/6
16in. Plastic, white 17/6
16in. Double D 31/6
17in. Rectangular 21/-

PLASTIC ESCUTCHEON SAFETY MASKS

Incorporating dark screen filter.
12in. Round Face 15/-
12in. Double D 17/6
16in. for metal tubes 32/6

SOILED. NEW ASPECT RATIO

9in. 5/-
12in. 7/6
12in. with fitted armour plate glass, cream 11/6
12in. do. Black 8/6

ARMOUR PLATE GLASS

16in. Actual size 17 1/2 x 15 1/2 x 1/4 inch 7/11
15in. Actual size 16 1/2 x 13 1/2 x 1/4in. 6/11
12in. Actual size 13 1/2 x 10 1/2 x 1/4in. 4/-
9in. Actual size 9in. x 8in x 1/4in. 3/-

DE LUXE T.V. CABINETS

NEW 1954

12 INCH MODEL

(Mark II)



This cabinet is now supplied complete with mask, glass, castors, shelf, bearers, c.r.t. neck end protector, back, speaker fret and baffle board. Finished in beautiful figured medium, light or dark walnut veneer, with high polish. Suitable for most home constructor T.V. receivers, including the "Viewmaster," "Practical Television," "Tele King," "Magnivision," "Wireless World," etc. Can be supplied with cut-out for 16in. c.r. tube at no extra cost.

WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL

Adaptor frames for fitting 9in. or 10in. c.r. tubes can be supplied if required.

LASKY'S PRICE
Carriage 12/6 extra.

£8.10.0

An allowance of 4s. 6d. will be made if the mask is not required. Mask and glass extra when cabinet is ordered with cut out for 14, 16, or 17in. C.R.T.'s. Inside Dimensions: Depth 16 1/2in.; width 17 1/2in.; height 28in. Overall height 32in. and width 18 1/2in.

THE VIEWMASTER

Construction envelope 7/6. **POST FREE.**
Wide angle conversion 3/6 **POST FREE.**
All components in stock. Write for price list.

COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS

MODEL 3RC/521.

Brand new and unused in maker's original carton. Pleasing cream or fawn finish. Complete with hi-fidelity studio crystal turnover head. Type GP. 29.



LASKY'S PRICE
£9.19.6
Carriage Free

NOW IN STOCK. 3-Speed Mixer Changer model 3RC/522. Price on request.

TYPE AT/9 T.V. MAINS AUTO TRANSFORMER
200, 220, 250 and 375 volt tappings. 250 mA. Also 5 v. 3 a.; 6.3 v. 7 a., and 6.3 v. 3 a. secondaries. Price 25/-

ION TRAPS
All types. Price 3/-.. State tube type number when ordering.

INTERCOM UNITS

4-station operation. For use on A.C./D.C. mains 200-250 volts. Supplied complete, with 3 new valves, ready for immediate installation. Fitted in attractive plastic cabinet. Suitable for use as baby alarm. **MASTER UNIT £5/19/6.** Carr. 5/- extra. **Extension Units.** Price 21/- each complete. Carriage 2/- each extra.

LASKY'S LINE TRANSFORMER

RF.EHT for line fly-back. 6-8Kv. with EY51 heater winding. Suitable for home construction T/V 19/6 each.

POSTAGE STAMP TRIMMERS

Paxolin. Up to 100pf. 6d. each. 5/- per doz. Ceramic. Up to 100pf. 9d. each. 7/6 per doz.

Duodecal (B12A) bases. VCR139 c.r.t. bases. 1/- each. 10/6 dozen.

ELAC DUOMAG FOCALISERS. For wide angle c.r. tubes. Low, medium and high flux. 37/6 each.

THE TELE-KING

A practical 5-channel
SUPERHET TELEVISION RECEIVER

Using the new 16 and 17 inch cathode ray tubes and wide angle components for the home constructor.

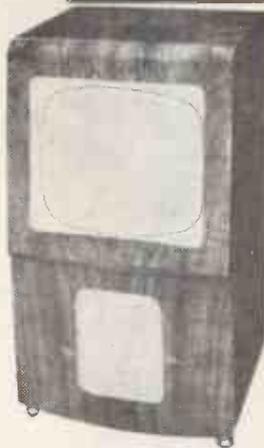
Complete instructions, wiring diagrams and 32-page descriptive booklet.

6/- POST FREE

**ALL COMPONENTS IN STOCK
WRITE FOR LIST**



Alexandra Palace,
Sutton Coldfield,
Holme Moss,
Wenvoe,
Pontop Pike,
Belfast,
Kirk o'Shotts.



NOTICE TO ALL PURCHASERS OF THE ENGLISH ELECTRIC 16 inch C.R.T. TYPE T.901
The first and only reconditioning service. By English Electric. A reconditioned 16in. metal tube costs £12 and carries maker's full guarantee. Write for further details.

ALLEN WIDE ANGLE COMPONENTS

- D.C. 300 latest type Ferroxcube Coils 39/6
- GL. 16 Coil 7/6
- GL. 18 Coil 7/6
- Focus Coil 31/-
- FO.305 trans. 21/-
- Frame B.O. transformer 15/-
- Line E.H.T. transformer 40/-

CHASSIS

Power pack Sound-vision and Scan chassis.
PRICE 11/- each.
All other metal work available from stock.

RESISTANCES. 72 Resistances, all exactly as specified, 18/-.

CABINET
Walnut veneer, £8/10/-, plus carriage 12/6 extra. As illustrated here.

- WIDE ANGLE CATHODE RAY TUBES**
- 14in. MW36-22 £19 9 3
 - 14in. C14B £20 10 1
 - 16in. MW41-1 £22 4 10
 - 16in. T901 £22 4 10
 - 17in. MW43-64 £23 12 8
 - 17in. C17BM £24 13 0
- Carriage and insurance extra.

OUTPUT TRANSFORMERS

- 40 mA Multi ratio 4/11
- 80 mA Multi ratio 14/11
- 80 mA Pentode 12/6
- 60 mA Plessey, 6,000 ohms.. 5/11
- Standard Pentode 4/11
- Pentode 3/6
- Midget Pentode 3/6
- Miniature Pentode, 3S4, 1S4 3/6
- PX4 Intervalve 8/6
- 5:1 Intervalve 5/11

R.F. E.H.T. OSCILLATOR COILS. 6-18 Kv. output. Heater winding for EY51. Circuit and full data supplied.

LASKY'S PRICE 25/-.

P.M. LOUDSPEAKERS

- All with 3 ohm speech coil
- 2 1/2in. 15/- 4in. 9/6 6 1/2in. 15/-
 - 3in. 14/6 5in. 14/6 8in. 15/-
 - 10in. 17/6

NEW AVAILABLE 12-inch Goodmans heavy duty speaker. Capacity 15 watts, 15 ohms speech coil impedance.

LASKY'S PRICE £5/19/6.
Car 3/6 ex. All loudspeakers offered are first grade and of highest quality construction. Many other types in stock. Send us your reqts. Special offer. 12in. Truvox, 3 ohms. **LASKY'S PRICE 49/6.**

SPEAKER FRET

- Expanded Metal. Silver Finish.
- 12in. x 12in. 3/11
- 12in. x 18in. 5/11
- Plastic White, 12in. x 5in. ... 2/-
- Wire. Bronze, 11in. x 8in. ... 2/-

SMOOTHING CHOKES

- 20 mA. 40 H 3/6
- 40 mA. 8 H 3/6
- 40 mA. 10 H 4/3
- 100 mA. 10-20 H 7/3
- 250 mA. 10 H 18/6

MAINS TRANSFORMERS

All 200-250 v. 50 c.p.s. primary. Finest quality, fully guaranteed. M.B.A./3. 350-0-350 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price 18/-.

MBA/6. 325-0-325 v. 100 mA. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price 22/6.

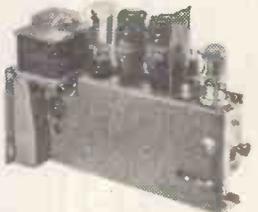
MBA/7. 250-0-250 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. Price 18/-.

MBA/8. 235-0-235 v. 60 mA., and 6.3 v. 3 a. Price 12/6.

AT/3. Auto transformer. 0-10-120, 200-230-240 volts 100 watt. Price 17/6.

J/RA/3 AMPLIFIER

6 VALVES. 12-15 WATTS OUTPUT. Originally made for talkie film projectors. In carrying case. Chassis size: 14 1/2 x 10 x 4 ins. For use on 200-250 volts A.C. mains. Grey crackle finish. Fitted with volume and tone controls. Resistance capacity coupled circuit. Output 2 K T66 in push-pull.



High quality components used throughout. In black rexine covered wood case, size 15 1/2 x 13 1/2 x 9 1/2 ins. giving plenty of room for speaker, etc. Circuit diagram available. Complete with 6 valves, fully assembled and wired.

LASKY'S £9.19.6 COMPLETE
Carriage 15/- extra.

LASKY'S T.V. CONSTRUCTORS' PARCELS

No. 1. All brand new components by Igranic. Comprises E.H.T. flyback line transformer, 7-10Kv. with Ferroxcube core and rectifier heater winding; scanning coils; frame output transformer; Elac focus unit with vernier adjuster, U37 E.H.T. rectifier and brand new 12-inch cathode ray tube with ion trap, mask and glass. **LASKY'S PRICE FOR THE COMPLETE PARCEL, £15/19/6.** Carriage and insurance 15/- extra.

No. 2. The Constructors' Parcel as above, but less the cathode ray tube and ion trap. **LASKY'S PRICE 79/6.** Carr. 3/6 extra.

No. 3. Condenser Parcel. 1 of each:—.04mfd. 12.5Kv.; 32 +32mfd. 350 v.w.; 32+100mfd. 450 v.w. AND 24 1,000pf. ceramic tubes; 6 .1mfd. 500 v.w.; .01mfd. 500 v.w. ALSO 12 assorted "pf" condensers of your own choice. **PRICE 45/- POST FREE.**



No. 4. Complete set of metal-work, as illustrated here. Unassembled. Comprising main chassis, tube supports and valve-holders. (Less sound-vision chassis.) **PRICE 25/-.** Carriage 3/6 extra.

No. 5. RESISTANCES. Watt. 85 resistances your choice. **PRICE 18/-.** POST FREE.

No. 6. One of each of the following:—Ion tap IT6; Duodecal tube holder; low impedance line and frame scanning coils. **PRICE 15/-.** Postage 1/6 extra.



No. 7. One of each T.V. Mains auto-transformers (type AT/9), 60+100mfd. 350 v.w. condenser; 5H 250 mA. choke; 14A100 rectifier. **PRICE 60/-.** Carriage 2/6 extra.

FILAMENT TRANSFORMERS
6.3 v. 1.5 a., 5/9. 6.3 v. 3 a., 9/6. 6.3 v. tapped at 4 v. 2 amps., 7/9. **Special Transformer.** 2 amps. with the following tappings: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts. Price 17/6.

COIL PACKS
Medium and 2 short/Long, medium and short wave bands. Price 16/- wave bands. 29/6.

RF25 UNITS. New, with valves. 19/11. Carriage 2/6.

LASKY'S RADIO

Lasky's (Harrow Road) Ltd.,

370 HARROW ROAD, PADDINGTON, LONDON, W.9

(Opposite Paddington Hospital)

MAIL ORDER AND DESPATCH DEPARTMENTS, 485/487 HARROW ROAD, PADDINGTON, LONDON, W.10

Telephones: CUNningham 1979 and 7214. ALL DEPTS. Hours: Mon. to Sat. 9.30 a.m. to 6 p.m. Thurs. half day 1 p.m.

TERMS: Pro forma, Cash With Order or C.O.D. on post items only. Postage and packing on orders value £1-1/- extra

£5-2/- extra; £10-3/6 extra. Over £10 carriage free, unless specifically stated otherwise.

STAND-OFF INSULATOR

3-hole fixing porcelain, with solder tag and wing unit by Bulgín, 1/- each.

SOLDERING IRONS

964 Solon oval bit type, 19/- each.
968 Solon pencil bit type, 21/- each.

TORCHES, ETC.

2 cell torch complete with bulb and 2 U2 type batteries, 1/8 each.
Cycle rear lamp complete with bulb and battery, 1/8 each.

HAND MICROPHONE

Crystal insert. Mic chrome plated. Black handle. Usual price 2 gns. Our price 24/-.

FUSES

Standard cartridge fuses. 1 amp., 1 amp., 2 amp. and 3 amp., 4jd. each.

OUTPUT TRANSFORMERS

Multi ratio type, 6/8 each.
AWF Power/Pentode, 4/- each.
Midget for 3S4 valves, etc., 3/6 each.

CONDENSERS

Chassis mounting .1 mfd. 350 v. can, 6d each. Electrolytic, dual section (plain foil) 12.4 mfd. 450 v., 2/- each. Electrolytic (plain foil) .50 mfd. 12 v., 1/9 each.
Tubular paper (in std. tubes) .05 mfd. 500 v., 1/- each.
1 mfd. 230VAC 50 to 100 cycles with leads, 1/2 each.
100 mfd. 25 v., 1/9 ea.; 8 mfd. 500 v. 2/8; 25 mfd. 25 v. CR32C, 1/9 ea.; 50 mfd. 50 v., 2/- ea.; 16x16 mfd. 450 v., 3/- ea.; .02 mfd. 1,000 v., 7d. ea.

YAXLEY SWITCHES

1 pole 8 way, 1/6 ea.; 2 pole 2 way, 1/- ea.; 4 pole 3 way 2 bank, 1/6 ea.; 4 pole 3 way spindle 4in. long, slotted end, 1/6 ea.; 4 pole 3 way 2/8 ea.; 4 pole 2 way, 1/9 ea.; 3 pole 2 bank, 1/6 ea.

LOUDSPEAKER CABINETS

Available for 6in. and 8in. Speaker Units. Polished walnut finish. A very attractive cabinet at quarter of today's prices. Price: 6in. Type Cabinet, 15/8 each. Price: 8in. Type Cabinet, 19/8 each. See under loudspeakers for suitable speaker units.



RECEIVER 1132A

Complete with all valves, VR35, VR65 and VR27. 5 band tuning meter and full scale dial. In good condition. 50/- each. Carriage and packing 7/6. Single hole fixing face holders, Belling type, 1/- each.

WIRE WOUND VARIABLE RESISTORS

Colvern CLR902 1K Ω , 1/9 ea.
Polar 600 Ω , 1/9 ea.
Colvern 5 Ω , 200 Ω , 10K Ω , 20 K Ω , 25K Ω , 30K Ω , 50K Ω , 2/- each.
Colvern CLR501, 10K Ω , 20K Ω , 25K Ω , 20 Ω , 1/3 each.

EX-GOVERNMENT VOL. CONTROLS

500 Ω , 600 Ω , Double 1,500 Ω 10K Ω , 20K Ω , 25K Ω , 50K Ω , 100K Ω , 160K Ω , 200K Ω , 1/2 meg Ω , 1/2 meg Ω , 1 meg Ω , 2 meg Ω . All 1/- each.

COLLARO AC49

Or Gram. Motors. Tape Recording Motors. Available Clockwise or Anticlockwise. Retail price, 38/6 ea. Our price: 28/6 ea.

Standard cartridge fuses. 1 amp., 1 amp., 2 amp. and 3 amp., 4jd. each.
Bulgín Toggle Switch DPST, 2/- ea.
Bulgín Toggle Switch DPST, 2/3 ea.
Extension Speaker Vol. Control, 1/3 each.
44 Variable Resistors suitable for train sets, etc., 5/- each.
Welwyn 50K Pre-Set Carbon Controls, 1/9 each.
Throat Microphones, 2 in a box, 1/8 box.
G.P.O. Jack Plugs, 1/3 each.



OFFER THESE SPECIAL PURPOSE VALVES

EF8	6/6	807	8/-	VR137	5/-	VR56A	3/6
6G6G	6/6	5Z3	8/6	VR55	7/3	956	3/6
9004	6/3	6Y6G	8/-	VT105	4/-	9003	6/3
VR136	7/-	955	4/-	PT15	10/-	2X2	5/6
VR66	3/9	TT11	6/6	6SA7	9/-	VR65	3/9
VU120A	3/6	VR116	4/-	ATP4	6/9	6557	8/-
9002	6/3	VR56	7/-	VU111	3/6	VT75	7/6
VR53	7/6	954	2/-	9001	6/3	1A5GT	7/6
VR91	6/-	CV71	1/-	VU39	8/6	65T7	8/-

Block Condenser 4 mfd. 500 v. Flying Leads, 1/8 each.
T.V. Coil Formers, 1in., 9d. each; 1in., 7d. each.
Microphone Transformer, 60 to 1 Ratio, 1/6 each.
Intervalve Transformer, 1/- each.
WHANDA wires and cable stripper. Retail price 15/- each. Our price 5/- each.
T.R.F. Switch, 1/- each.
Crystal Diodes, wire ends, 1/8 each.
16x16 mfd. 350 v. Can type, 2/9 each.
16x16 mfd. 450 v. Can type, 3/- each.
Bridge Rectifiers 12 v. 3 A., 13/8 ea.
Octal and British screened valve caps, 3d. each.
Standard Iron Elements, 450 watts, 1/8 each.
Morphy Richards and H.M.V. Elements, 3/- each.
Hydrometers, brand new in wooden case, 8/6 each.

HALF WAVE 1 M/A PENCIL RECTIFIERS

K3/25 665V	5/8
K3/40 1KV	7/6
K3/45 1.140KV	8/2
K3/50 1.260KV	8/8
K3/60 1.5KV	9/8
K3/100 2.550KV	14/8

VR97 Cathode ray tubes complete with base and screw 29/8 ea.
Packing and Post 3/-.

LOUDSPEAKER CHASSIS

Plessey 3in. Round type for personal portables, 2 to 3 ohm.	12/8
Elac 4in. Square type 4/02, 2 to 3 ohm.	13/9
Elac 5in. Round type 5/04, 2 to 3 ohm.	12/3
Goodmans 5in. Round type, 2 to 3 ohm.	14/9
Goodmans 6in. Lightweight, 2 to 3 ohm.	13/8
Plessey 6in. Round type, 2 to 3 ohm.	12/6
Truvox 6in. Wafer only 1 1/2 in. deep, 2 to 3 ohm.	20/-
Plessey 8in. Lightweight, 2 to 3 ohm.	15/-
Plessey 8in. Mains Energised 1,500 ohms field.	21/-
Plessey 10in. Lightweight, 2 to 3 ohm.	19/6
Rola 10in. Type Z10DB, 2 to 3 ohm.	26/-
Leetrona 10in. 2 to 3 ohm.	16/6
Truvox 12in. Heavy duty model 889 with 15 ohm. Speech coil.	25
Goodmans 10in. Loudspeaker	32/6

GOLDRING PICKUP HEADS

Pick-up head type No. 112 (2,000 ohms), complete with lead. Price 20/- each.

TRUVOX MODEL BX11

Lightweight type 12in. Loudspeaker, 49/8 each.

MOULDED MICA CONDENSERS

All wire ends, .0001, .0003, .0004, .0005, .01, .001, .005, .0027, .0038, .00065, .003, 4/6 doz.

MAINS TRANSFORMERS

3-Way Mounting Type.
MT1. Primary 0-210-230-250 v. Secondary 250-0-250 v. 80 mA. 6.3 v. 4 amps. 5 v. 2 amps., with taps at 4 v. on Filament Winding. Price 17/8 each.
MT2. Primary 0-210-230-250. Secondary 250-0-250 v. 80 mA. 6.3 v. 4 amps. 5 v. 2 amps. Both filament windings tapped 4 v.

FILAMENT TRANSFORMERS

All 220 to 240 v. Input. 2 volts 1/2 amp., 4/6; 2 volts 3 amps., 7/8; 4 volts 1 1/2 amps., 5/-; 4 volts 3 amps., 10/-; 5 volts 2 amps., 10/-; 6.3 volts 1 1/2 amp., 6/-; 6.3 volts 1/2 amp., 5/-; 6.3 volts 3 amps., 9/-.

BULLDOG CHARGER CLIPS

3in. long, 6d. each.

MOULDED BAKELITE CASE CONDENSERS

.001 mfd. 4 Kv., 1/- ea.; .01 mfd. 4 Kv., 1/8 ea.; .25 mfd. 800 v., 1/3 ea.; .1 mfd. 1,000 v., 1/- ea.

A modern Radio Cabinet with drilled chassis; dial drive and drum; back plate; dial spring; pointer; size 15 1/2 in. x 11 1/2 in. x 5 in. Price \pounds 11.68. Post and Packing 2/-.

We can supply a circuit diagram with instructions for constructing a 3 valve plus metal rectifier T.R.F. receiver for Long and Medium wave bands for 1/6. The complete kit supplied for \pounds 6.6.0. Plus Packing and Post 2/6.

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; 25 add 2/- unless otherwise stated. Minimum C.O.D. fee and postage, 2/3. MAIL ORDER ONLY.

SCREENED MICROPHONE CABLE

with outer P.V.C. 7/0076, 1/- yd.

00035 MFD. 2-GANG CONDENSER

complete with trimmers and dust cover. 8/3 ea.

DIAL BULBS

M.E.S. Types. 6.3 v. 15 a., 8jd. ea.; 6.3 v. 3 a., 8jd. ea.; M.B.C.T. Types. 6 v. 3 a., 5d. ea.; 6.5 v. 3 a., 5d. ea.

30 AMP ROTARY SWITCH

4 position, complete with knob, 4/- ea.

HEADPHONES

Type CLR Low Resistance Headphones, 120 ohms, 7/6 pair. Type CHR High Resistance Headphones, 4,000 ohms, 11/- pair. Type DHR A. Super Quality Headphones, 13/9 pair. Headbands, Wide type, 1/9 ea.

MISCELLANEOUS CONDENSERS

8 mfd. 20% 1,000 v. D.C., 13/- ea.; .001 mfd. 6 kv. D.C., 3/8 ea.; .001 mfd. 12.5 kv. D.C., 6/9 ea.

ENAMELLED COPPER WIRE ON REELS

14 S.W.G., 1/4; 16 S.W.G., 1/4; 18 S.W.G., 1/6; 20 S.W.G., 1/7; 22 S.W.G., 1/8; 24 S.W.G., 1/10; 26 S.W.G., 1/10; 28 S.W.G., 2/-; 30 S.W.G., 2/2; 32 S.W.G., 2/3; 34 S.W.G., 1/6; 36 S.W.G., 2/8; 38 S.W.G., 2/8; 40 S.W.G., 2/11; 44 S.W.G., 3/3.

J.B. DRIVES, ETC.

8L8 Spin Wheel Drive, 27/6; Airplane Drive, 13/-; Pull Violon Drive, 13/-; Square Plane Drive, 12/8; 8L5 EV Drive, 26/6.
Send for catalogue of drives, condensers, etc.

WALNUT CABINET



Complete with drilled chassis, dial, back plate, pointer, dial drive and drum, etc. Price 27/6, post 2/-.

★ SPECIAL OFFER OF CO-AXIAL CABLE

Best quality Grade "A" cable, solid, 1/022 70 ohms, 7jd. yd.
Best quality Grade "A" cable, stranded 7/0076, 8jd. yd.
Best quality Grade "A" cable, air-spaced 1/036, 1/- yd.

"SWAN" RADIO CABINET



Address your requirements to Dept. W.W.

ALPHA RADIO SUPPLY CO.
5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

SEND 6d. IN STAMPS FOR ILLUSTRATED CATALOGUE

CONSTRUCTORS
say "IT'S STILL THE
BEST MAINS or BATTERY
PORTABLE
SET"

You're SURE to get it at
STERN'S
ESTABLISHED 25 YEARS

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Aldry" battery. The set is designed so that the mains section can be supplied as a separate unit, and can be added at any time. The Set supplied as an "Aldry" battery Superhet can be accommodated in the attaché case illustrated (size 9 1/2 in. x 4 1/2 in. x 7 1/2 in.), this is attractively finished in lizard, maroon, dark green or blue rexine. As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delayed A.V.C. and pre-selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. trans. and drilled chassis, etc. Overall size of assembled chassis 8 in. x 4 in. x 2 1/2 in. This receiver, as illustrated, can be completely built for approx. £10 (plus Mains Unit if required). Send 1/9 for the fully descriptive Assembly Book which includes Practical Layouts and complete Pricelist of Components. Attaché case available separately 3/7/6.

SELENIUM RECTIFIERS

6 or 12 Volt 1 amp. rating	7/6
6 or 12 Volt 2 1/2 "	12/6
6 or 12 Volt 4 "	17/6
6 or 12 Volt 6 "	£17/9

THE WILLIAMSON AMPLIFIER

We have the complete range of specified Components in stock for this famous quality Amplifier. Enquiries are welcomed and immediately dealt with. The complete assembly instructions and diagrams are available for 3/6.

TWO BATTERY PORTABLES
(a) THE "MINI TWO-THREE"

An "Aldry" Battery Portable of midget size, 6 1/2 in. x 4 1/2 in. x 3 1/2 in., designed to cover medium waveband 190-559 metres, with use of short trailer aerial. The simple design of this Receiver is so arranged that either a 3-valve set, or a 2-valve (afterwards easily converted to the 3-valve) can be made. Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up IT4-IT4-DL94. The 2-valve set can be completely built for £4 3/6 (less case), and the 3-valve for £5 3/6 (less case). Each price includes valves, speaker and drilled chassis. Send 2/- for the assembly instructions: they include simple and complete practical component layouts and diagrams, which enable the most inexperienced constructor to successfully build either set. All components are available for separate sale, a price list being supplied with assembly instructions.



(b) THE "MINI-FOUR"

A 4-valve Battery Superhet Receiver designed to receive 4 pre-set stations, three on medium waveband and one on long wave to suit local conditions. Each station is obtained on the set by the turn of a rotary switch. No tuning is necessary. It is of midget size, being only 4 1/2 in. x 6 1/2 in. x 4 1/2 in. when completely built and is very easily assembled from diagram supplied. Cost of all components to build this set in accordance with the design, including a drilled and cut chassis and panel and new valves, is £9 10/- (or less valves for £8 7/6). Attractive carrying case finished in blue leatherette, 18/9. Complete constructional data with a blue print, which shows the practical component layout and wiring diagram, together with an individual component price list are available separately, 1/6. Our battery eliminators (illustrated above) available in kit form are suitable for use with this set.

WE HAVE THE NEW "W. B. "STENTORIAN" HIGH FIDELITY SPEAKERS IN STOCK

Model H.F. 6-inch	£2 10 6
Model H.F. 9-inch	£3 7 0
Model H.F. 9-inch	£3 0 0
Model H.F. 10-inch	£3 13 6

These speakers are of the very latest design and provide quality reproduction for the lower price range, 3 or 15 ohm models are available.

THE VIEWMASTER TELEVISOR

We have had very considerable experience in assisting customers to build this T.V. and can supply SPECIFIED COMPONENTS EX-STOCK. The assembly instructions showing practical layouts and pricelist are available for 7/6 for London, Sutton Coldfield, Holme Moss, Kirk-o-Shotts and Wenvoe.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build Midget "Aldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltages, as above, or approx. to 69 volts. The Kits quite easily and quickly assembled and is housed in a light aluminium case, size 4 1/2 in. x 1 1/2 in. x 3 1/2 in. Price of complete Kit with easy-to-follow assembly instructions, 35/6 (plus 1/- carriage and insurance). In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7 in. x 2 1/2 in. x 1 1/2 in. Price 42/6 (plus 1/- carriage and insurance).



The "Wireless World" 3-Valve Set

A Midget 3-valve T.R.F. Receiver for operation on A.C. mains, covering long and medium wavebands. We are able to supply all of the components to build this set, as designed and specified in the Feb. 1950 issue, including the drilled chassis, Valves and moving coil speaker, etc., at the following prices:— To construct complete chassis less dial and drive assembly, 25/5/-. Ditto including dial and drive assembly 28/-. To construct the complete set, including dial and drive assembly and cabinet, 27/3/6. Overall size of cabinet 18 7/8 in. x 11 in. A reprint of the designer's article, giving circuit and assembly instructions (this is available separately for 9d.) together with a practical component layout is included with each of above assemblies.



"MINI-TWIN"

1-VALVE BATTERY SET



A design of a simple 1-valve 9-stage Battery Receiver, giving excellent results on medium and long wavebands and having exceptionally low battery consumption. Drilled chassis and practical diagrams make it the ideal set for the beginner to build. The complete chassis, including valve, can be built for 37/6 plus 8/11 P/Tax, the attractive plastic case is 9/6, and suitable headphones, 14/9. The complete assembly instructions, layouts and a component price list are available for 1/6. This Receiver also performs excellently, without modification, as a tuning unit, and, in addition, with simple modifications for which a complete diagram is provided, makes a first-class pre-amplifier for pick-up or microphone.

A DUAL CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides a full control of bass and treble in conjunction with a main Volume/Mixer Control.



It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-up and all nature of recordings, i.e., English, American and long-playing, without recourse to pick-up correction. The extreme flexibility of the bass and treble controls is such that the level of brass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier advt. The unit measures only 7 in. x 4 in. x 2 in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price, including drilled chassis, valves (68N7 and 6J5), £3 16/9. Complete assembly data is available separately for 1/-. Completely assembled and ready for use, £5/5/-.

A Famous Manufacturer's SHADED POLE GRAM MOTORS 10/6

(Plus 1/- carr. and ins). Clockwise rotations and incorporates a Mains Adjustment Panel. Could also be used as Recording Take Up or Rewind Motor.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR



A design of a complete 5-VALVE SUPERHET RECEIVER employing an R.F. stage and incorporating a separate VIBRATOR PACK size 4 1/2 x 3 1/2 x 6 1/2 in. for use on 6 or 12 volt D.C. supplies. We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case. Valves, Drilled Chassis and 5in. P.M. Speaker for £12/19/6. (Carr. and Ins. 5/6 extra). Or the Receiver Components for £9/19/6, and the Vibrator Components for £3. This is NOT an EX-GOVT. Receiver, it is a new design employing new Components. Send 2/8 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.

THE DENCO ULTRA MIDGET SUPERHET COIL TURRETS WITH A ROTARY TURRET ACTION

Type CT9 consists of a four-station "pre-set" unit from which any three stations on medium waveband and one on long wave can be received by a turn of the turret switch. Price 39/6. Type CT10 is a 3 waveband coil pack incorporating a fourth switch position for Gram. Complete coverage is, long waveband 700-2,000 metres, medium waveband 190-570 and shortwave 15-80 metres. Price £2/8/-. A complete receiver circuit and all necessary data are included with each turret. These can be supplied separately for 6d.

SPECIAL OFFER

A 12in. P.M. SPEAKER (2-3 ohm Voice Coil) by a very famous manufacturer (for only 49'6 plus 2/- carriage and insurance). THESE ARE BRAND NEW IN MAKER'S CARTONS

"HOME CONSTRUCTORS" THE NEW "SOUNDMASTER"

TAPE RECORDER IS NOW AVAILABLE

Send 8/6 for the complete set of building and operating instructions. These provide for an easily assembled complete PORTABLE TAPE RECORDER including a component price list enabling all components to be bought separately.

When submitting please include cost and packing charge
STERN RADIO LTD.
109 & 115 FLEET STREET, E.C.4
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Constructors everywhere are amazed!

AT THE EXCELLENCE OF

The **"TELE-VIEWER"**

**5 CHANNEL TELEVISOR
DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER**

HUNDREDS SOLD IN 4 MONTHS
PERFECT FRINGE AREA RECEPTION
BETTER RECEPTION AT HALF COMMERCIAL COST
SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY



We can supply New 12in. C.R.T. at specially reduced price of

This complete TELEVISOR including all Valves, can be built for only **£28-16-4** (Plus cost of C.R.T.)

£12-19-6

Here are some of the features which combine to make this such a fine receiver.

- The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O-SHOTT'S. (The extreme ease of tuning is accomplished by the provision of pre-aligned I.F.T.'s.)
- A lifelike, almost stereoscopic, picture quality made possible by the following factors:
 - a. Excellent band width of I.F. circuits.
 - b. A really efficient video amplifier.
 - c. C.R.T. Grid modulated from low impedance source.
 - d. High E.H.T. voltage (approx. 10 kV.)
- The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
- FIRM picture "HOLD" circuits (Frame-Line) ensures a steady picture, free from bounce or flicker even under the most adverse conditions met with in "fringe" areas and excellent "interlace" ensures the absence of "liney effect."
- Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
- Entire receiver built on two chassis units each measuring 14 1/2" x 6 1/2" x 3 1/2".

- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.
 - All pre-set controls are mounted on side of chassis enabling all adjustments to be carried out whilst facing the C.R. Tube.
- As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is now available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA and COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE. A CABINET WILL ALSO BE AVAILABLE.

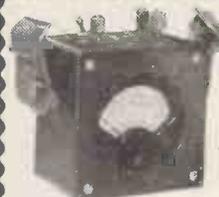
NOW available at Stern's

The **"WIDE ANGLE" TELE-VIEWER**

- A design that retains all the distinctive features of the 12in. Televisor but with increased Time Base efficiency, producing 15 to 18 K.V. E.H.T., with ample scanning power for C.B. Tubes up to 17in.

● It can be completely built including supply of all valves for **£34** (plus cost of C.R.T.) and is as simple to construct as the 12in. model.

- This is the most efficient "WIDE ANGLE" large-screen design yet offered to constructors, and yet it can be built for almost half the cost of similar designs.
- Complete assembly instructions, diagram, etc., available for 5/-.



Ex W.D. TESTMETER

Complete with case and carrying strap.

23/6 Post and Ins. 1/3

Provides direct readings of (a) 1.5 volts and 3 volts D.C. (b) 6 mA. and 60 mA. D.C. current. (c) 500 ohm and 5,000 ohm resistance ranges.

Voltages can be increased to 150, 300 and 600 volts D.C. at 6 mA. F.S.D. by an external series resistor arrangement for 6/-.

**AN AMAZING OFFER!
A COMPLETELY ASSEMBLED
4 VALVE**

T.R.F. CHASSIS
Including a 5in. P.M. SPEAKER and VALVES FOR ONLY

£6.9.6
(Plus 7/6 carr. and Ins.)



This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern BVA miniature valves. The line up being 12 BA6-12AT6-12A6-35W4. It incorporates Permeability Tuned Coils thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker is 10in. x 4 1/2in. x 6 1/2in. An attractive Bakelite Ivory finished Cabinet size 13 1/2in. x 5 1/2in. x 6 1/2in. is available for 16/6 (Plus 2/6 carriage and insurance).

**The GARRARD Model RC75A
A 3 SPEED AUTOCHANGE UNIT**

COMPLETE WITH THE TWIN **£13/15/0** (Plus 7/6 carr. & Ins.)

- These Units will autochange on all three speeds, an adaptor, price £1/0/7, being required for the 45 r.p.m. Records.
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a switch on the pick-up head. These Units are one of the best made today. They are brand new, complete with mounting instructions, etc.

**FOR HOME CONSTRUCTORS
A 5 VALVE 3 WAVEBAND
SUPERHET RECEIVER
FOR £10.10.0**



For use on A.C. Mains 200 to 250 volts. The following are outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands.
- A 3 1/2in. P.M. Speaker accurately matched for good quality reproduction.
- The latest range of new 6-volt B.V.A. miniature valves.
- Built-in frame aerial with provision for external aerial for distant stations.
- A white plastic cabinet of very attractive appearance, overall size 7 1/2in. x 5 1/2in. x 5 1/2in.

 Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams, with which complete price details are given.

**SMITHS
"PRESET"
SELF-STARTING
SYNCHRONOUS
CLOCK**



incorporating automatic "on-off" switching.

SPECIAL OFFER 57/6 (Normal Price £4-7-6).

(Postage and Packing 1/3)

NEW !! and carries maker's guarantee.

- WILL SWITCH ON (AND OFF) YOUR RECEIVER AT ANY PRESELECTED TIME.
- WILL ALSO OPERATE ANY APPARATUS (i.e. LIGHTING etc.) UP TO 300 WATTS.
- EASILY INSTALLED—SIMPLY CONNECTED IN THE MAINS LEAD.
- THE IDEAL "ALARM CLOCK."
- FOR USE ON A.C. MAINS 200-250 VOLTS.

HIGH FIDELITY PICK UP

Incorporating the famous CONNOISSEUR Light Weight Moving Iron Head and including the Connoisseur matching Transformer (plus 1/- carriage and Ins.) **39/6**

!! The TRUVOX TAPE UNIT !!

We can now offer this very successful Unit ex stock. Price **£23/2/0** (Plus 5/- carr. and Ins.)
A really good class TAPE AMPLIFIER is also available. Price **£16/16/0** (Plus 5/- carr. and Ins.)
The combination of these two Units provides a really first-class complete TAPE RECORDER. Send S.A.E. for complete details.

AMPLIFIERS !

TWO COMPLETE KITS OF PARTS



A 4-VALVE QUALITY "PUSH-PULL" 6-8 watt AMPLIFIER for A.C. mains. Incorporating Negative Feedback. Filter Input Circuit and employing 6V6's in Push-Pull. A simple arrangement is provided to enable either a magnetic-crystal or lightweight pick-up to be used, and is suitable for use with Standard or long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match

2 to 15 ohm speakers. The overall size of the assembled chassis is 10in. x 8in. x 7 1/2in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, £8/17/6. Price of assembled chassis, supplied ready for use, £8/12/6. Plus 5/- Carr. & Ins. Full descriptive leaflets are available separately for 1/-.

A 12-watt HIGH FIDELITY "PUSH-PULL" AMPLIFIER designed for A.C. mains 200 to 250 volts, employs 6 valves plus rectifier with negative feedback, and comprises a main amplifier chassis and a remote controlled Preamplifier and Tone Control Unit. Incorporating four controls—bass, treble, main volume or mixing control, and a radio, gram, microphone, selector switch. This control unit measures only 7 x 4 x 2in. The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps, and 30 mA. H.T. is provided for tuning unit, etc. Price of complete kit, including drilled chassis and valves, £14. Complete specification and layout, 2/- . We can also supply completely assembled and ready for use at £17. Plus 7/6 Carr. and Ins.



THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT A FRACTION OF THEIR COST.

MODERNISE YOUR OLD RADIOGRAM

WITH THE VERY LATEST EQUIPMENT FOR **£25**

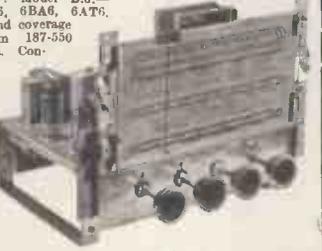
Half the price of comparable commercial 3 speed Auto Radiogram.

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- Model B.3. A 5-valve 3-waveband Receiver.
- Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 100/200 volts and 200/250 volts, and employ the very latest miniature valves. They are designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram, and radio, making them the ideal replacement chassis for that "old Radiogram," etc.

Brief specifications: Model B.3.— Valve line-up, 6BE6, 6BA6, 6AT6. 6BW6, 6X4—waveband coverage short 16-50 medium 187-550 long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wave-change and gram.; (4) tone (3-position switch operative on gram and radio). Negative feedback is employed over the entire audio stage. Chassis size: 11 x 7 1/2 x 5 1/2 in. high. Dia. size 9 1/2 in. x 4 1/2 in. Price complete and READY FOR USE, excluding speaker, £12/12/- (carr. and Ins. 7/6 extra). Model B.3. P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price £15/15/- (plus 7/6 carr. and Ins.). Model B.3. P.P./R.F. This model is similar in appearance and has same waveband coverage as the Model B.3, but in addition it incorporates an R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. Price £18/18/- (plus 7/6 carr. and Ins.).



This AUTOCHANGE UNIT by a Famous Manufacturer is offered for £11/14/6

We will supply this 3 speed Autochanger and the Model B.3 Chassis on the left together with a 10in. (or 8in.) P.M. speaker for £25 or with the B.3. P.P. for £28/7/6 or with the Model B.3 P.P. / R.F. for £31/5/- Carr. and Ins. 10/-.

(Plus 7/6 Carr. and Ins.) (Normal price is £16/10/-)

- These units will auto-change on all three speeds. 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 10in. x 12 1/2in. with height above 5 1/2in. and height below baseboard 2 1/2in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

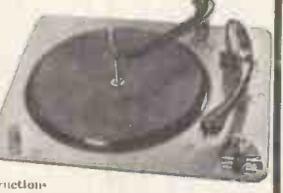


The COLLARO 3RC/521 3 Speed AUTO CHANGE UNIT £9/17/6

(Including Carr. and Ins.) (Normal price is £18/10/-)

- With separate crystal heads for standard and L.P. records.
- Incorporating pick-up weight adjustment.
- Will autochange on 7in., 10in. and 12in. records not intermixed.
- Minimum Base plate size 13in. x 12 1/2in., with height above 4 1/2in. and below baseplate 3in.

● Brand new in Makers Cartons, complete with Mounting Instruction.



The COLLARO 3RC/514 3 Speed Non-Auto Change Unit £6/19/6

We will supply this 3 speed Record Player and the Model B.3 Chassis on the left together with a 10in. (or 8in.) P.M. speaker for £20, or with the B.3.P.P. for £23/5/-, or with the Model B.3.P.P./R.F. for £26 Carr. and Ins. 7/6 extra.

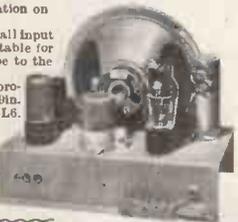
(Plus 5/- Carr. & Ins.) (Normal price £12/7/6.)

- With the New Autodynamic Hi-Fi Magnetic head and matching transformer.
- Incorporating separate alloy stylus for L.P. and standard records which are moved into position by a simple switch together with pick-up weight adjustment.
- These units are quite new and contained in the makers original cartons complete with Mounting Template.



A COMPLETE KIT OF PARTS TO BUILD A 3-4 WATT HIGH GAIN AMPLIFIER

For operation on A.C. or D.C. Mains, 200-250 volts. This amplifier will give 3 watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type. A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9in. x 8in. x 7in. and valve line-up 25Y5-ba7-25L6. Price of complete kit, including drilled chassis and valves, £4/2/9, plus 6 1/2in. P.M. (which fits on chassis), 16/-, or 8in. P.M., 18/9. Price of fully assembled chassis ready for use, £5/5/- (plus cost of speaker). Copy of assembly instructions and components price list available for 1/3.



The "REGENT" Crystal Hand Microphone 25/6

Plus 1/- Carr. & Ins. Complete with screened lead. Price £2/2/-.

The COLLARO Model A.C. 514 Record Player £3/19/6

(Plus 5/- carr. and Ins.) RIM DRIVE 78 r.p.m. complete with the COLLARO Plug in type MAGNETIC HEAD and 10 inch TURNABLE. These are COMPLETE BRAND NEW UNITS for A.C. Mains 200-250 Volts.

HALF-WAVE H.T. RECTIFIERS

250 Volts 150 mA. 12/9 ; 250 Volts 250 mA. 16/9.

The DENCO M.T.O.I. Modulated Test Oscillator £3/15/-

(Plus 2/- carr. and Ins.) Has Frequency range continuously variable from 170-475 Kcs and 350-1,900 Kcs. Battery operated and thereby completely self contained.

BATTERY CHARGER KITS

All Kits are for A.C. Mains 200-250 Volts. They comprise of a Metal Rectifier and Transformer, tapped for 6 or 12 volt charging, and a tapped Resistor, with Selector Switch, to enable the charging rate to be varied. For 6 or 12 volt batteries at max. 1 amp. £1/17/6 For 6 or 12 volt batteries at max. 2 1/2 amp. £2/5/3 For 6 or 12 volt batteries at max. 4 amp. £3/2/6 An easily followed Wiring Diagram is included with Each Kit.

VARLEY HEATER TRANSFORMER

Input 200-250 volts. Output 4 volts (centre tapped) 5 amps 14/9 (1/- postage).

When submitting orders, please include post and packing.

STERN RADIO Ltd.

109 & 115, FLEET STREET, E.C.4

Tel.: CENTRAL 5812-3-4

R.S.C. MAINS AND OUTPUT TRANSFORMERS

Fully Guaranteed, Interleaved and Impregnated

FILAMENT TRANSFORMERS

Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.	5/9
6.3 v. 2 a.	7/6
6.3 v. 3 a.	9/6
0-4-6.3 v. 2 a.	7/9
12 v. 1 a.	7/11
6.3 v. 6 a.	17/6
0-2-4-5-6.3 v. 4 a.	16/9
12 v. 3 a. or 24 v. 1.5 a.	17/6

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s. Primaries: 0-9-15 v. 1.5 a., 14/9; 0-9-15 v. 3 a., 16/9; 0-9-15 v. 6 a., 22/9; 0-4-9-15-24 v. 3 a., 22/9; 0-9-15-30 v. 3 a., 23/9. 0-22-23-24 v. 5 a., 19/6.

TOP SHROUDED DROP THROUGH TYPE

Primaries 200-230-250 v. 50 c/s.

250-0-250 v. 70 mA., 6.3 v. 2.5 a.	12/11
260-0-260 v. 70 mA., 6.3 v. 3 a., 5 v. 2 a.	14/11
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	16/9
350-0-350 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a.	14/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 100 mA., 6.3 v. 4 v., 4 a., c.t., 0-4-5 v. 3 a.	23/9
350-0-350 v. 100 mA., 6.3 v. 4 v. 4 a., c.t., 0-4-5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/11
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	29/11

E.H.T. TRANSFORMERS. 2,500 v. 5 mA.,

3-0-2 v., 1.1 a., 2-0-2v. 1.1 a., for VCR97, VCR517 or ACR2X	35/-
5,000 v. 5 mA. 2 v. 2 a.	39/6

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001µF), .002 mfd. (2,000 pfd.). All at 5d. each; 3/9 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., 6/9 doz. 6.5 v., 0.15 a., 6/9 doz.

VOLUME CONTROLS with long spindles, all values less switch 2/9; with S.P. switch, 3/9.

WIRE WOUND POTS: 20 ohms, 30 ohms, 1,000 ohms, 5K, 50K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K, 50K Preset type, 1/9 ea. **AMMETERS.** Moving coil. G.E.C. 0-5 amps., 2in. scale, 11/9.

ELECTROLYTICS (Current production. NOT ex-Govt.)

Tubular Types		Can Types	
8µF 450 v.	1/11	16µF 450 v.	2/9
8µF 500 v.	2/9	24µF 350 v.	2/11
16µF 350 v.	2/3	32µF 350 v.	2/11
16µF 450 v.	2/9	32 mfd. 450 v.	4/9
16µF 500 v.	3/9	40µF 450 v.	4/9
24µF 350 v.	3/3	64 mfd. 450 v.	4/9
32µF 350 v.	3/9	8-8µF 450 v.	3/9
32 mfd. 500 v.	5/9	8-8µF 450 v.	3/11
8-16µF 500 v.	4/11	16-16 mfd. 450 v.	4/8
25µF 25 v.	1/3	16-16 mfd. 500 v.	5/9
50µF 12 v.	1/3	16-32µF 350 v.	4/9
50µF 50 v.	2/3	32-32µF 350 v.	4/9
Can Types		32-32µF 450 v.	5/11
8 mfd. 450 v.	2/3	64-120 mfd. 350 v.	7/6
8 mfd. 500 v.	2/11		
16 mfd. 350 v.	1/11		

MISCELLANEOUS EX-GOVT. ITEMS

SlideLock Fuses, 15 amp., 1/9. Bulgin panel mounting Fuseholders (ex-equip.), 11d. Bulgin octal type moulded Bakelite, 5-pin or 7-pin Plugs and Sockets, 1/11 pr. Earphones (Single), low resistance, 1/3.

EX-GOVT. ACCUMULATORS with non-spill vents. Unused and guaranteed. 2 v. 16 A.H. Size in wood carrying case 9-7-5in., 14/9, plus 2/6 Carr.

P.M. SPEAKERS. All 2-3 ohms. 3in. Goodmans (Ex New Units) 10/9, 6in. Elac, 14/11, 6in. Plessey with Pentode Trans., 14/11, 8in. Plessey, 15/9, 8in. R.A. Heavy duty, 18/9, 10in. Goodmans, 31/-, 10in. Plessey, 18/6, 10in. Rola with Trans., 29/6, 12in. Truvox, 49 9.

M.E. SPEAKERS. All 2-3 ohms. 6in. Rola field 700 ohms, 11/9, 10in. R.A. field 600 ohms, 23/9. 10in. R.A. field 1,500 ohms, 23/9. 10in. R.A. Field 1,000 ohms, 23/9.

Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a., Midget type 2½-3-in.	16/9
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
300-0-300 v. 60 mA., 12 v. 1.5 a., c.t.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.	25/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion	29/9
300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
350-0-350 v. 160 mA., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a.	45/9
350-0-350 v. 250 mA., 6.3 v. 6 a., 4 v. 8 a., 0-2-6 v. 2 a., 4 v. 3 a., for Electronic Eng. Televisor	67/6
425-0-425 v. 200 mA., 6.3 v. 4 v. 4 a., c.t., 6.3-4 v. 4 a., c.t., 0-4-5 v. 3 a., suitable Williamson Amplifier, etc.	49/9
425-0-425 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a.	65/6

EX-GOVT. E.H.T. SMOOTHING CONDENSERS

.02 mfd. 5,000 v. Bakelite Tubulars.	1/6
.02 mfd. 8,000 v. Cans	1/11
.1 mfd. 2,500 v. Cans	3/6
.1 mfd. plus .1 mfd. 8,000 v., large blocks (common negative isolated)	9/6

BAKELITE AND WALNUT VENEERED CABINETS



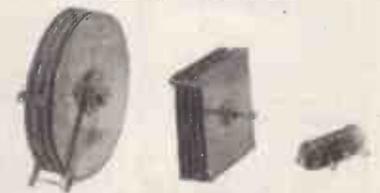
Size approximately 12in. x 6½in. x 5in. Bakelite type available in Brown or Cream. Price of Cabinets, 17/6 ea., carr. 2/6.

Suitable fully punched T.R.F. 3-valve and rectifier chassis	3/9
Suitable fully punched superhet chassis (4 valves and rect.)	4/9
Dial Scales, 2 colour, 2 waveband, station named, glass	1/6
Dial Scales, 3 colour, 3 waveband, station named, glass	1/9
Suitable coloured Metal Backplates	1/3
Pointers, Double ended	4d.
T.R.F. Coils, 2 waveband with circuit	6/9
Drum Drives, complete	2/6

THE SKY CHIEF T.R.F. RECEIVER

A design of a 4 stage, 3 valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in any of cabinets illustrated above. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point to point wiring diagrams, instructions, and parts list, 2/6. This receiver can be built for a maximum of £4/16/- including cabinet.

SELENIUM RECTIFIERS



L.T. Types	H.T. Types H.W.	
2/6 v. j.a.h.w.	70 v. 20 mA.	2/11
F.W. Bridge Types	90 v. 20 mA.	3/6
6/12 v. 1 a.	120 v. 40 mA.	3/11
6/12 v. 2 a.	250 v. 50 mA.	5/9
6/12 v. 4 a.	350 v. 50 mA.	7/9
6/12 v. 6 a.	250/350 v. 80 mA.	8/9

SMOOTHING CHOKES

250 mA., 7-10 H. 200 ohms Shrouded	16/9
250 mA., 3 H. 50 ohms	11/9
100 mA., 15 H. 350 ohms	7/6
80 mA., 10 H. 350 ohms	5/6
60 mA., 10 H. 400 ohms	4/11
50 mA., 40 H. 1,000 ohms Potted	10/9

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s. 120 v. 40 mA.	7/11
90 v. 10 mA., 8-0-8 v. 250 mA.	9/11

OUTPUT TRANSFORMERS

Midget Battery Pentode 66: 1 for 3S4, etc.	3/6
Small Pentode, 5,000Ω to 3Ω	3/9
Standard Pentode, 5,000Ω to 3Ω	4/9
Standard Pentode, 8,000Ω to 3Ω	4/9
Standard Pentode, 10,000 ohms to 3 ohms	4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull	5/6
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω	15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-Pull 15-18 Watts to match 6L6, etc., to 3Ω or 15Ω Speaker	22/9
Push-Pull 20 Watts high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω	47/9
Williamson type, exact to author's specification	85/-

MICROPHONE TRANSFORMERS

100:1	5/9
------------	-----

EX-GOVT. AUTO TRANSFORMERS 50e/c/s

15-10-5-0-215-235 v. 200 watts	25/9
Double wound 10-0-200-220-240 v. input, 10-0-270-290-310 v. output 200 watts	27/9

EX-GOVT. MAINS TRANSFORMERS.

All 230 v. 50 c/s input 48 v. 1 a. output	9/6
Outputs 250-0-250 v. 40 mA., 6.3 v. 2 a., 5 v. 2 a.	10/9
350-0-350 v. 150 mA. 5 v. 3 a.	17/6

VALVE SCREENING CANS. International

Octal 3 piece, 10/6 doz., 1/3 each.

EX-GOVT. SMOOTHING CHOKES

250 mA., 10 H. 50 ohms.	14/9
250 mA. 20 H. 250 ohms. Tropicalised	13/9
250 mA. 10 H. 100 ohms	14/9
250 mA. 3 H. 50 ohms Potted	7/6
150 mA. 10 H. 50 ohms	10/11
100 mA. 10 H. 100 ohms. Tropicalised	6/9
100 mA. 5 H. 100 ohms. Tropicalised	4/6
90/100 mA. 10 H. 100 ohms. Potted	8/9
50 mA. 5-10 H. 1,250 ohms. Potted type	8/11
70 mA. 5-10 H.	3/9
50 mA. 5-10 H.	2/9

EX-GOVT. T.V. TYPE TRANSFORMERS. All 230 v. 50 c/s input.

1250-0-1250 v. 250 mA. 4v. 3a.	25/-
6.3 v. 6 a., 0.3 v. 6 a., 5 v. 3 a., 5 v. 3 a., 4 v. 3 a.	22/6
278-0-278 v. 80 mA.	7/9
400 v. C.T. 150 mA. 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a.	22/9

EX-GOVT. BLOCK PAPER CONDENSERS

4 mfd. 500 v.	2/9	4 mfd. 1500 v.	4/9
4 mfd. 750 v.	3/3	10 mfd. 1500 v.	7/9
10 mfd. 500 v.	6/9		

EX-GOVT. CATHODE RAY TUBES

VCR517 (guaranteed full picture) (carr. 5/-) 29/6 ea. ACR2X (guaranteed full picture) (carr. 5/-) 12/6 ea.

SPECIAL OFFERS. Germanium Crystal Diodes 1/11. Midget Mains Transformers (size approx. 2½ x 3 x 2½in.). Screened Primary 220/240 v. 50 c/s Output, 250-0-250 v. 60 mA., 6.3 v. 2.5 a. Only 11/9.

CO-AXIAL CABLE. 75 ohms ½in., 8d. yard.

EX-GOVT. CATHODE ISOLATING FILAMENT TRANSFORMERS. 6.3 v. to 6.3 v. c.t., 3/9 ea. (GUARANTEED)

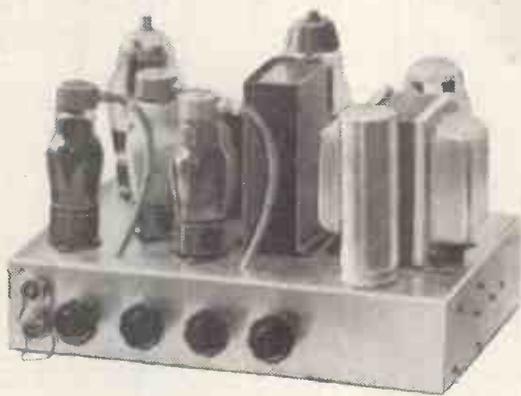
SPECIAL PURPOSE EX-GOVT. VALVES (GUARANTEED)
 VR91, 5/9, SP61 (VR65) 2/9, VR56 3/11, 807 6/11, 6J6 10/6, 6SH7Met 6/11, 12SC7GT 6/11, VU120A 2/9, VS110 1/9.

R.S.C. 25 WATT "PUSH PULL" AMPLIFIER

Now firmly established and proving extremely popular, our A11 Quality Amplifier we consider to be the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands.

The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

Twin volume controls with twin input sockets allow SIMULTANEOUS INPUTS for BOTH MICROPHONE and GRAM, or TAPE and RADIO. SEPARATE BASS and TREBLE CONTROLS giving both LIFT and CUT. FOUR NEGATIVE FEEDBACK LOOPS with 15 db in the main loop from output transformer to voltage amplifier. Frequency response ± 3 db. 50-20,000 c.p.s. Hum and distortion LESS THAN 0.5 per cent. measured at 10 watts. This is comparable with some of the highest priced amplifiers. Six B.V.A. valves, Marconi/Osram KT series output valves. A.C. only, 200-230-250 v. 50 c/s. input. 420 v. H.T. LINE. Paper reservoir condenser. Compact chassis. Matched components. OVERALL SIZE 14-10-9in. approx. Output impedances for 3 and 15 ohms speakers.



Available in kit form at **9 gns.** Plus the amazingly low price of carriage 5/- Or ready for use 50/- extra.



R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE." Ideal also for use as "Baby Alarm." Sound amplification 4 watts. Price only £5/19/6. "Listen-Talk Back Unit" as illustration can be supplied at 30/- each. Full descriptive leaflet 10d. The Master Unit can be supplied assembled and tested for 30/- extra.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., 25/9.

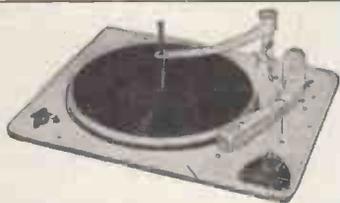
To charge 6 v. or 12 v. accumulator at 2 amps., 31/6.

To charge 6 v. or 12 v. accumulator at 4 amps. 49/9.

ABOVE KITS CONSIST OF BLACK CRACKLE STEEL CASE, MAINS TRANSFORMER, FULL

WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. Due to careful design the use of resistors for regulation of charge has been obviated. The mean charging rates are as indicated above, and complete safety is ensured by fusing of both input and output. Chargers supplied assembled and tested for 6/9 extra.

A PUSH-PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/12/6, plus carr. 2/6. For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick-up. Output is for 2-3 ohm speaker. (We can supply a very suitable 10in. unit by Goodmans at 31/-). The amplifier can be supplied ready for use for 25/- extra. Full descriptive leaflet 7d.



COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS (brand new), type RC3/521, complete with 2 plug-in Crystal P.U. heads for long playing or standard records 7, 10 or 12in. Not intermixed. Mains input 200-250 v. Limited number available at only £9/15/-, plus carr. 5/-.

COLLARO 3-SPEED RECORD PLAYER UNIT. Type RC3/514, complete with Orthodynamic Pick-up, and matching transformer. Separate Stylus for long playing or standard records are moved into position by a switch which also makes necessary weight adjustment. Mains input 200-250 v. A.C. Brand new in Makers cartons, £6/19/6, plus 5/- carr.

COLLARO RECORD PLAYER UNIT. Type AC/514. Standard 10in. turntable. Speed normal 78 r.p.m. Crystal pick-up. Mains input 200-250 v. A.C. Brand new cartoned £3/19/6, plus 5/- carr.

COLLARO GRAM MOTORS, TYPE AC37. Governor controlled at 78 r.p.m. Mains input 110-200-230-250 v. Shaded pole type, 35/-.

COLLARO TAPE DESK MOTORS. Shaded pole type. Clockwise or anti-clockwise. Mains input 110-200-250 v., 31/6.

R.S.C. TONE CONTROL-PRE-AMP. UNIT. A complete set of parts for the construction of a very efficient but simple pre-amplifier and tone control unit. Suitable for use with any amplifier and pick-up. Fil. supply is self-contained. Overall size is 7½-5-5½in. approx. Full descriptive leaflet 9d. Price including wiring diagrams 37/6. Or ready for use 15/- extra.

CHASSIS

18 s.w.g. undrilled aluminium amplifier type (4 sided)	
12in. x 9in. x 2½in.	6/11
14in. x 9in. x 2½in.	6/11
14in. x 10in. x 3in.	7/11
16in. x 10in. x 3in.	8/3
18 s.w.g. aluminium, receiver type. 6in. x 3½in. x 1½in.	1/11
7½in. x 4½in. x 2in.	2/9
10in. x 5½in. x 2in.	3/3
11in. x 6in. x 2½in.	3/11
16 s.w.g. aluminium, receiver type, 12 x 8 x 2½in.	5/3
16in. x 8in. x 2½in.	7/6
20in. x 8in. x 2½in.	8/11
16 s.w.g. aluminium, amplifier type, 4 sided.	
12in. x 8in. x 2½in.	7/11
16in. x 8in. x 2½in.	10/11
20in. x 8in. x 2½in.	13/6
14in. x 10in. x 3in.	13/6

PERSONAL SET BATTERY SUPERSEDER KIT.

All parts for an "All Dry" Battery Eliminator Complete with case. Supplies 90 v. 10 mA. and 1.4 v. 250 mA. fully smoothed, from normal. 200-250 v. 50 c/s. mains. For 4-valve superhet receivers. Price with circuit 35/9. Or ready for use 42/6. Size of unit 5½-4-1½in.



BATTERY SET CONVERTER KITS. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only 48/9. Supplied ready for use for 7/9 extra. **H.T. ELIMINATOR AND TRICKLE CHARGER KIT.** Consists of h.t. and l.t. transformer, h.t. and l.t. rectifiers, smoothing electrolytic choke, and steel case. For mains input of 200-250 v. Output 120 v. 40 mA. and 2 v. ½ a. Price with circuit 29/6. Or in working order, 37/6.

RADIO SUPPLY CO. (LEEDS) LTD.

32 THE CALLS, LEEDS 2

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/1 extra under £1, 1/9 extra under £3. Full Price List 6d. Trade List 5d.

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BARTON'S (Radio) LIMITED

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OUR MOTTO IS—

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Telephones: LANGHAM 1151/2

TERMS OF BUSINESS: Cash with order (or C.O.D. Post items only); all orders for small items totalling over £2 post free unless otherwise stated.

THE FAMOUS RANGE OF

'DULCI'

RADIO CHASSIS

Allchassis 11in. x 7in. x 8in. high. Latest type valves 6B6, 6BA6, 6AT6, 6BW6, 6XA. Flywheel tuning. Negative feedback over entire audio section. Engraved knobs. 3 tone positions for radio and gram.
Model B3.—Long, Medium Short
 5 Valves. Output 3½ watt £12 12 0
 Plus Push Pull Stage £15 15 0
Model B3.—Double Feature with P/Pull & R.F. Stage. 7 Valves.
 Output 6 watt £18 18 0
Model B6.—Six Wavebands. Med., Long, 4 Short. (3 Bandsread).
 5 valves. Output 3½ w. £15 15 0
Model B6.—Plus Push Pull Stage
 6 Valves. Output 6 watt £18 18 0
Model B6.—Double Feature with P/Pull & R.F. Stage. 7 Valve.
 Output 6 watt £23 2 0

FULLY GUARANTEED. TAX PAID.
 For A.C. Mains 100/120 and 200/250 volts.
 The Double Feature chassis are supplied with separate Power Packs.

5 VALVE SUPERHET CHASSIS

Fitted with Valve Holders, Aerial, Earth and Gram Sockets; Full Vision 3 Waveband Dial and Drive Assembly; 2 gang Tuning Condenser. Chassis dimensions—13½in. long, 5½in. wide, 2½in. deep.
 Plus 1/6 pkg., carr., ins. Price **42/6**

LARGE STOCKS OF B.V.A. VALVES
 and Ex-Govt. Special purpose valves.
 Your enquiries invited.

SPECIAL OFFER

TANNOY HEAVY DUTY SPEAKER UNITS—BRAND NEW—

These units consist of a solid wooden cabinet (cream finish) 11½in. long; 11½in. high; 4½in. deep. Fitted with heavy duty 8in. speaker, 3 ohms impedance. Will handle 5 watts. Normal price 45.
 Plus 5/- packing, carriage and insurance. **79/6**

FILAMENT TRANSFORMERS

6.3 v. 1 amp, 5/11; 6.3 v. 3 amp, 8/11; 6.3 v. (with 4 v. and 2 v. tappings), 1½ amp., 7/6. All plus 1/- p.p.

CONDENSERS

Silver Mica; Moulded Mica; Wax Tubular; Paper Block Types.
 Huge Stocks carried—please state your requirements.

ELECTROLYTIC CONDENSERS—NEW!

8 mfd., 150 v.	1/8	25 mfd., 50 v.	1/6
8 mfd., 450 v.	2/6	20-20 mfd., 275 v.	2/3
8-16 mfd., 450 v.	3/11	25 mfd., 25 v.	1/6
16 mfd., 450 v.	3/6	50 mfd., 50 v.	2/-
32 mfd., 500 v.	4/11	4 mfd., 450 v.	3/11
50 mfd., 12 v.	1/6	32-32 mfd., 350 v.	3/11

RESISTORS (CARBON)

½ and 1 watt, 3d. each. 1 watt 5d. each.
 All preferred values from 10 ohms to 10 meg.

EXCEPTIONAL OFFER!

1.5 AMP. HOT WIRE METER

3½in. dia. Suitable for use with Battery Charger. Plus 1/- post., carr., ins. **3/6**

METAL RECTIFIERS

S.T.C. R.M.1. 125 v. 60 mA.	4/6
R.M.2. 125 v. 100 mA.	5/-
R.M.3. 125 v. 125 mA.	6/-
R.M.4. 250 v. 250 mA.	18/-

E.H.T. PENCIL RECTIFIERS—

K350. 4 Kv.	8/8
K3/100. 8.5 Kv.	14/8

METAL RECTIFIERS (FULL WAVE)

12 v. 1 amp. (Bridge Type), 7/6; 12 v. 2 amp., 11/3; 12 v. 3 amp., 12/-; 12 v. 4 amp., 15/-.

METAL RECTIFIERS—BRAND NEW!

300 v. 75 ma., may be used in series or voltage doubling to give any required voltage, 7/11, plus 6d. post/pkg.

VIBRATORS

WEARITE, Type QFA/12, 12 v. 7-pin Sync. (Self Rectifying). BRAND NEW, in orig. cartons, 15/-.
 MALLORY, Type G48, 12 v. 6-pin (Non-Sync.), 7/6.
 Pkg., carr. on either of above 1/-.

LOUDSPEAKERS (2-3 ohms imp.)

ELAC, 2½in. dia. ...	15/-	TRUVOX (MEBCO), 6½in. dia.	12/6
PLESSEY, 3in. dia. 9/11		ELAC, 6½in. dia.	16/6
ELAC, 3½in. dia. ...	15/-	PLESSEY, 6½in. dia.	12/6
PLESSEY, 10in. dia. 13/9		ELAC, 8in. dia. ...	17/6

All the above plus 1/6 pkg., carr., ins.

GOODMANS 8in., H.F. 15 ohms 5 w. peak A.C. Axiom 101	£6 12 0
GOODMANS 8in., H.F. 15 ohms 5 w. peak A.C. Axiom 102	£9 18 2
R.A. 10in., with transformer, 2-3 ohms	£1 8 6
R.A. 10in., 2-3 ohms	£1 3 6
LECTRONA 10in., 2-3 ohms	17 6
ELAC 10in., 2-3 ohm	£1 2 6

THE LATEST RANGE OF W.B. H.F. SPEAKERS

Incorporating the NEW Composite Cone

W.B. 6in. H.F., 10,000 lines, 3 ohms	£2 10 6
W.B. 8in. H.F., 10,000 lines, 3 ohms	£3 0 6
W.B. 9in. H.F., 12,000 lines, 3 ohms	£3 7 0
W.B. 10in. H.F., 12,000 lines, 3 ohms	£3 13 6

(Also available 15 ohms imp.)

WHARFEDALE BRONZE 10in. Flux Density, 10,000 lines 6 w. 15 ohms	£4 12 8
WHARFEDALE GOLDEN 10in. Flux Density 13,000 lines, 8 w. 15 ohms	£7 13 3
WHARFEDALE GOLDEN/CSB 10in. Flux Density 13,000 lines, 5 w. 15 ohms	£8 6 7
WHARFEDALE SUPER 8in./A 8in. Cloth Suspension, Flux Density 13,000 lines, 40 w. 10 ohms	£6 13 3
WHARFEDALE SUPER 5/OS/AL 5in. Cloth Suspension, Flux Density 13,000 lines, 10 ohms	£6 13 3
WHARFEDALE W12/CS 12in. Cloth Suspension. Flux Density 13,000 lines, 10 w. 15 ohms	£9 15 0
WHARFEDALE W13 12in. Flux Density 13,000 lines, 15 w. 15 ohms	£9 5 0
GOODMANS 12in. Axiom 150 twin cone H.F., 15 ohms, 15 w. peak A.C.	£10 5 6
GOODMANS 12in. Axiom 60 H.F. 15 ohms 15 w. Peak A.C.	£12 6

All the above plus 2/6 pkg., carr., ins.

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Type LP1. 250-0-250, 60 mA. 6.3 v. 3 amp., 5 v. 2 amp. Fully shrouded	22/9
.. LP4. 275-0-275 v. at 80 mA., 0/4/6.3v. at 4 amps., 0/4/5 v. at 2 amps.	22/6
.. LP6. 350-0-350, 60 mA. 6.3 v. 5 amp., 5 v. 3 amp. Half shrouded	29/-
.. LP8. Fully shrouded as above	29/6
.. LP7. 350-0-350 120 mA. 6.3 v. 5 amp., 5 v. 3 amp. Fully shrouded	37/6
.. LP9. 425-0-425 150 mA. 3 v. 4 amp. O/T. 5 v. 3 amp. Fully shrouded	52/6
.. LP10. 430-0-430 200 mA. 6.3 v. 4 amp., 6.3 v. 4 amp., 5 v. 3 amp. P/B.	55/-
.. LP11. 350-0-350 150 mA. 6.3 v. 5 amp., 5 v. 3 amp. Fully shrouded	44/6
.. B12. 350-0-350 150 mA. 6 v. 3 amp., 4 v. 3 amp., 30 v. 0.5 amp., incorporates voltage adjustment panel tapped 200/0 v. 220/230 v.	21/-
.. B13. 250-0-250 80 mA., 6.3 v. 4 amp., 5 v. 2 amp. Universal upright mounting.	23/6
.. B14. 350-0-350 80 mA., 6.3 v. 4 amp., 5 v. 2 amp. Universal upright mounting.	23/6
.. B15. General Purpose Step-down Transformer. Tapped 3 v., 4 v., 5 v., 6 v., 8 v., 9 v., 10 v., 12 v., 15 v., 18 v., 20 v., 24 v., 30 v. Total output 30 v. at 2 amps.	22/-

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Tapped 10 v., 120 v., 200 v., 230 v., 250 v. 100 w., 22/-.
 All the above are plus 1/6 post & pkg.

MICROPHONE TRANSFORMERS

Ratio 100:1, Mu metal. Has innumerable uses, 1/11 plus 6d. post/packing.

MICROPHONES

ACOS Mic. 22 (Crystal)	£4 4 0
Mic. 16 (Crystal)	£12 12 0
LUSTRAPHONE M.C. with T.P. C51	£5 15 6
Heavy Table Base for above	£1 1 0
RESLO (M/C Low Imp.)	£7 5 0
Ribbon High Fidelity	£1 15 0
Mumetal Transformer	£1 15 0

THE NEW ACOS 35-1.

Crystal Mike, Output level—55 db. Ref. 1 v./dyne/cm., 25/- plus 6d. post/pkg.

REGENT HAND MICROPHONE

A high impedance crystal microphone complete with screened lead and Jack-pkg. (Normal list price £22/-). **22/6**
 Plus 1/6 post/packing.

BUILD YOUR OWN

HIGH FIDELITY

TAPE RECORDER

THE SENSATIONAL

'SOUND MASTER'

BY THE CREATORS OF THE FAMOUS

"VIEW MASTER"

Precision machined parts and standard radio components. Easily wired and assembled without previous experience. **KITS can be purchased separately as follows—**

Tape Deck Kit	£13 13 0
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N.S.F. Switches	21 15 6
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EASY STEP BY STEP INSTRUCTION ENVELOPE, 5/6
 Working model may be heard at our shop.

TRUVOX TAPE DECK MARK III

Incorporating high impedance mu-metal twin-track heads. Two-speed capstan, for tape speeds of 7½ and 3½ inches per second. Three heavy-duty motors allowing for fast forward and rewind facilities without tape handling. All controls operated by electrically and mechanically interlocked push buttons.
 Price £23/2/- carriage free.

LANE TAPE DECK MARK IV

Made to high standards and incorporating features ensuring low level of "Wow" and "Flutter" throughout the full length of tape. Provision for fast rewind and forward run in less than 1 min. in either direction. WIND AND REWIND WITHOUT UNLACING OF TAPE. INSTANTANEOUS BRAKING. THREE MOTORS obviating friction drive. The Table is fitted with high fidelity record playback head of new design wound to high impedance and a separate A.C. Erase Head. The Heads are half-track size allowing approx. 1 hr playing from standard 1,200ft. Reel of Tape.
TAPE SPEED: 7½in. sec. FOR USE ON A.C. 200/250, 50 CYCLES MAINS ONLY
 Price £17/10/- carriage free.

TAPE DECKS AND TABLES

WEARITE 2A TAPE DECK	£35 0 0
MOTEK K4 TAPE TABLE. Push Button operation	£17 17 0

TAPE RECORDER

The Famous "GRUNDIG" 2 Speed £84 0 0

RECORDING TAPE

FERROGRAPH, 1,200ft.	22 5 0
GRUNDIG, 1,200ft.	22 0 0
SCOTCH BOY, 1,200ft.	£1 15 0
EMITAPE, 1,200ft.	£1 15 0
FERROVOICE, 1,200ft.	£1 2 6
GRUNDIG, 600ft.	£1 4 0
SCOTCH BOY, 600ft.	£1 1 0
EMITAPE, 600ft.	£1 1 0
FERROVOICE, 600ft.	£1 15 0
FERROVOICE, 300ft.	8 6

THE NEW COLLARO STUDIO PICK-UP

Type "O" or "B" £3 14 8

THE FAMOUS 4-VALVE

"SOBELL"

SUPERHET TABLE RECEIVER

MEDIUM/LONG WAVES

Valve line up: 12J7, 35L6, 1487, 35Z4. This very sensitive receiver, incorporates a carrying handle making it entirely transportable. Housed in an attractive plastic cabinet of modern design, it can be used on either A.C. or D.C. 200/250 v. mains.
£8.5.0
 Plus 3/6 Pkg. carr., ins.

CHOICE OF THREE COLOURS: WALNUT BROWN GREEN, CREAM.
GUARANTEED FOR TWELVE MONTHS

"TYANA" SOLDERING IRON

Weight 4 ozs.; Adjustable Bit; heating time 3 mins. Length 10½in., 16/8 plus 1/- post.

"TYANA" ELECTRIC SOLDER GUN
 Instant heating, low voltage, bit which can be bent to shape to reach corners, balanced grip. A.C. 220/250 v. Guaranteed 12 months.
Complete with 6 Bts, 63/-

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BARTON'S (Radio) LIMITED

TELEVISION

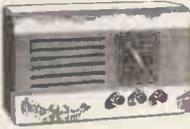
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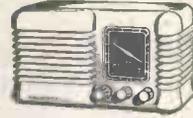
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SERVED WITH CIVILITY"

TERMS OF BUSINESS: Cash with order (or C.O.D. Post items only); all orders for small items totalling over £2 post free unless otherwise stated.

BUILD YOUR OWN RADIO!



We can supply all the parts (including valves, 5in. moving-coil speaker, cabinet, chassis, and every thing down to the last nut and bolt) to enable YOU to build a professional looking radio. The chassis is punched and drilled ready to mount the components. There is a choice of any of three attractive cabinets 12in. long, 5in. wide by 5in. high as follows: either Ivory or brown bakelite, or wooden, finished in walnut. Complete and easy-to-follow point-to-point and circuit wiring diagrams supplied.



Model 1 T.R.F. RECEIVER

This is a 3 valve plus metal rectifier T.R.F. receiver with a valve line-up as follows: 6K7 (HF), 6J7 (Det) and 6V6 (Output). The dial is illuminated and when assembled the receiver presents a very attractive appearance. Coverage is for the Medium and Long Wave bands. Operates on 200/250 volts A.C. mains.

PLUS 2/6 PACKING,
CARRIAGE & INSUR.

£5 · 15 · 0

Model 2 SUPERHET RECEIVER

This is a powerful midget 4 valve plus metal rectifier Superhet Receiver with a valve line-up as follows: 6K8, 6K7, 6Q7, 6V6. The dial is illuminated and coverage is for the Short Wave bands between 16-50 metres, the Medium Wave bands between 190-540 metres, and the Long Wave bands between 1,000-2,000 metres. Operates on 200/250 volts A.C. mains.

PLUS 2/6 PACKING,
CARRIAGE & INSUR.

£7 · 19 · 6

T.R.F. RECEIVER

To those who require this Receiver ready-built we can supply it at £6 · 19 · 6 plus 3/6 packing, carr. and insurance.

ALL COMPONENTS SUPPLIED GUARANTEED FOR ONE YEAR

NOTE: We would respectfully suggest to those interested in building these receivers that they send for OUR Instruction Booklets. Intending constructors can then judge for THEMSELVES how comprehensive these Booklets are.

Instruction Booklets and Priced Parts List available separately at 1/-. This money will be refunded if the Booklet is returned as NEW within 7 days.

THE
IDEAL
GRAMOPHONE
AMPLIFIER

Announcing a NEW 4 watt AMPLIFIER KIT

THE
IDEAL
MICROPHONE
AMPLIFIER

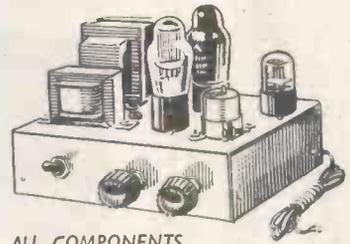
This is a 3 valve-3 stage Amplifier for use with Gramophone, Microphone or Radio. Valve line-up is as follows—6SL7; 6V6; 5Y3. Negative feed-back. Tone control and voltage adjustment panel incorporated. 4 watts output. For operation on A.C. Mains 200/250 volts. The complete Kit, which includes every item down to the last nut and bolt, drilled and punched chassis, and comprehensive point-to-point wiring circuit diagram can be supplied at

PLUS 2/6 PACKING,
CARRIAGE & INSUR.

£4 · 19 · 6

The Output Transformer supplied is for use with a loudspeaker of 3 ohms impedance and we would suggest that the output of the completed amplifier justifies the use of one of the latest W.B. H.F. Speakers which can be supplied as follows:—8in., 60/6; 9in., 67/-; 10in., 73/6. All plus 2/6 pkg., carr., insur.

Circuit Diagram only, available separately at 1/-.
To those who require this Amplifier ready-built we can supply it at £5.19.6, plus 3/6 pkg., carr., ins.



ALL COMPONENTS
SUPPLIED GUARANTEED
FOR ONE YEAR

BATTERY CHARGER KIT

Incorporates metal rectifier. Transformer is suitable for A.C. mains 200/250 volts. Charge either 12, 6 or 2 volt accumulator at 1 amp. Complete with circuit diagram. Price 22/6, plus 1/6 post and packing.

CHARGER TRANSFORMER

For charging 6 v. at 1 amp., 8/3 plus 1/- p.p.

ELIMINATOR AND 2V TRICKLE CHARGER UNIT—BRAND NEW MANUFACTURERS' STOCK

For use on A.C. mains 200/250 v. Smoothed output of 19 or 18 mA. at 150 v. Voltage panels tapped at 50, 60, 75, 80, 90 and 150 volts. Housed in strong metal case, meas. 6in. long; 8 1/2in. wide; 3 1/2in. deep. Normal price £5/15/-.

Complete with instructions and in manufacturers' orig. carton plus 2/6 post, carr., ins.

77/6

MAINS NOISE SUPPRESSOR KIT

Consisting of 2 specially designed chokes and 3 condensers. Extremely effective, cuts out all mains noise. Can be assembled in existing receiver or separately as desired. Complete with circuit diagram, 4/11 plus 1/- P.O.

CONSTRUCTOR'S PARCEL

We can supply the basic parts to help you construct the radio illustrated above. Most radio enthusiasts have stocks of small components such as condensers, resistors, valves, etc., around their workroom. For those people we supply a special constructor's parcel of the main components to enable them to build a set of their own circuit. This parcel consists of: Cabinet (Bakelite) in Ivory or Brown. Or wooden (as above), 17/6, plus p. & c. 2/6. Punched chassis, 3 valves T.R.F., 3/9. Dial front plate, 2/6. Dial M. and L. with station names, 1/6. Drum 1/6. Driving head, 1/6. Double pointer, 4d. Spring, 3d. Chassis fixing bracket, 9d. pr. T.R.F. coils, 180-550, and 800-2,000 metres, 5/6 pr. The above items may be purchased separately or as a complete parcel at 31/-, plus p. & c. 2/6.

Comprehensive stocks available of such small items as:—bolts; nuts; washers; solder tags; resistance wire; tinned and enamelled copper wire; blank aluminium chassis (reinforced corners); croc. clips; wander plugs and sockets; and other items too numerous to mention, all of which are useful to constructors. We invite your inquiries.

NOW BEING
DEMONSTRATED
AT OUR SHOP!
TIMES OF BUSINESS:
MON. to FRI. 9—6 p.m.
SAT. 9—1 p.m.



QUALITY GOODS · MONEY BACK GUARANTEE · PROMPT DESPATCH

MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-
 300-0-300 100 mA., 6 volt 3 amp., 5 volt 2 amp., 22/6.
 Drop thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., 14/6.
 Drop thro' 250-0-250 v. 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.
 Drop thro' 110-110 60 mA., 6 v. 0.5 amp., 6/6.
 280-0-280, drop through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.
 250-0-250 80 mA., 6 v. 4 amp., 14/-
 Pri. 230 v. Sec. 200-0-200 35 mA., 6 v. 1 amp., 8/6.
 Pri. 200/250 v., secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps., 13/-
 Drop thro' 280-0-280, 200 mA., 6 v. 5 amps., 5 v. 3 amps., 27/6.
 Drop thro' 270-0-270 80 mA., 6 v. 3 amp., 4 v. 1.5 amp., 13/6.
 Drop thro' 270-0-270 60 mA., 6 v. 3 amp., 11/6.
 Heater Transformer, Pri. 230-250 v. 6 v. 1 1/2 amp., 6/-; 2 v. 24 amps., 5/-; 2, 4 or 6 v. at 2 amps., 7/6; 2 v. 24 amp. and 6 v. 0.6 amp. E.H.T. insulated, 8/6. P. & P. each 1/-
 Input 200/250 sec. v. 6.3, 6 amp., 4 v. 4 amp., 2 v. 2 amp., 14/6. P. & P. 1/6.
 1000-0-1000 v. 250 mA. 4 v. 3 amp., 37/6. P. & P. 5/-

P.M. SPEAKERS (closed field) with less trans. trans.
 2 1/2 in. 15/6
 3 in. 13/6
 6 in. 18/6
 8 in. 18/6
 P. & P. on the above 1/4 each.
 10 in. L.E. trans., 19/6. P. & P. 1/4.
 5 in. M.E. field coil 750 ohms with O.P. trans., 17/6. P. & P. 1/4.
 Truvor BX11. 12 in. P.M. 3 ohm speech coil, 45/- P. & P. 3/6.
 6 in. M.E. Speaker, 1,000 ohm field 15/- P. & P. 1/6.
 E. & A. T.V. Energised 8 in. speaker with O.P. trans., 6V6 matching, field coil 175 ohms. Requires a minimum 150 mA. to energise, maximum current 250 mA. 15/- P. & P. 2/-

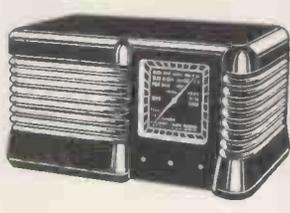
Extension Speaker Cabinet, in contrasting walnut veneer, size 15 x 10 in. Will take 6 1/2 or 8 in. speaker 17/6. P. & P. 2/-
 Volume Controls, Long spindle less switch, 50K, 500K, 1 meg., 2/6 each. P. & P. 3d. each.
 Volume Controls, Long spindle and switch 1/4, 1 and 2 meg. 4/- each; 10K, & 50K, 3/6 each. 1/4 and 1 meg., long spindle double pole switch, miniature, 5/- P. & P. 3d. each.
 Trimmers, 5-40 p.f., 5d.; 10-110, 10-250, 10-450 p.f., 10d.
 Twin-gang .0005 Tuning Condenser, 5/- With trimmers, 7/6. P. & P. 1/-
 Line Cord, 2-way 0.3 amp., 60 ohms, per foot, 1/3 per yard.
 Twin-Gang .0005 with feet, size 3 1/2 x 3 1/2 in., 6/6.
 3-gang .0005, with feet, size 4 1/2 x 3 1/2 in. 7/6.
 Hoover Variable Speed 600-1,200 revs. Tape Recording Motor, Silent running, 200/250 v. A.C. Shaded pole with fixing. Weight 5 lb., 27/6. Plus P. & P. 2/6.

PERSONAL SHOPPERS ONLY. 9 in. Enlarger 17/6. 12 in., 27/6.
 Germanium Crystal Diode, 2/3 post paid.
 Television Masks, White Rubber 9 in. with glass, 7/6. Cream Rubber, 12 in., with armour-plate glass, 15/-, 15 in. Cream, 17/6 plus 1/6 P. & P.
T.V. Width Controls, 3/6.
 T.V. Sub Assembly, all-chassis, 12 in. x 3 1/2 in. with frame osc., line osc., 12 mid, 275 wdg., Matrosil, 3 condensers, 4 resistors and tag panel 15/- p. & p. 1/6.
CRYSTAL PICK-UP by famous manufacturer complete with sapphire trailer needle and volume control 23/- P. & P. on each 1/-
 Amplifier case, black rexine covered leather carrying handle, chrome plated corners, rubber feet, felt lined, detachable lid. External dimensions, 12 1/2 x 13 1/2 in., £1. P. & P. 2/6.
 Mains Droppers, 0.3 amp., 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, 1/6; 0.3 amps., 950 ohms, tapped 700 and 825, 2/6; 0.2 amp., 1,800 ohms, vitreous, tapped, 2/6. Vitreous 3 amp. 700 tapped 820, 640, 600, 3/6. P. & P. on each 3d.

D. COHEN RADIO AND TELEVISION COMPONENTS
 Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/- up to 10/-, 1/6 up to £1, and 2/- up to £2. All enquires and lists, S.A.E.
SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE.

23 HIGH STREET (Uxbridge Road) ACTON, W.3 Telephone: ACOrn 5901
 Hours of Business: Saturday 9-6 p.m. Wednesday 9-1 p.m. Other days 9-4.30 p.m.

HIGH-IMPEDANCE PLASTIC RECORDING TAPE, by famous manufacturer, 1200 ft., on aluminium spool, 17/6, post and pkg. 1/6.

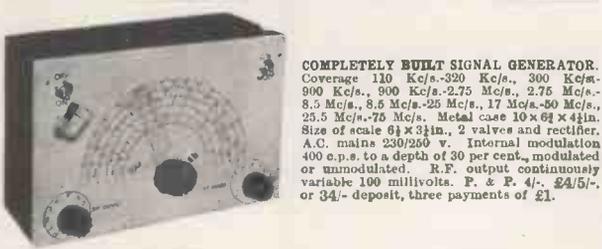


CABINET, as illustrated, 1 1/2 x 6 1/2 x 5 1/2 in. In walnut or cream complete with TRF chassis, 2 waveband scale, station names, new waveband, backplate, drum pointer, spring, drive spindle, 3 knobs and back, 22/6. P. & P. 3/6.
 AS ABOVE, with superhet chassis, 23/6. P. & P. 3/6.
 AS ABOVE, complete with new speaker to fit, and O.P. trans., 35/- P. & P. 3/6, with superhet chassis, 36/- P. & P. 3/6.
 Used metal rectifier, 230 v. 50 mA., 4/6; gang with trimmers, 6/6; M. & L. TRF coils, 5/-; 3 obsolete ex-Govt. valves, 3 v/6 and circuit, 8/6; heater trans., 6/-; volume control with switch, 3/6; wave-change switch, 2/-; 32 x 32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-
 M. & L. Superhet Coils with circuit, 6/6; Iron cored 465 IF's, 7/6; min. gang, 5/6; volume control with switch, 4/6; wave-change switch, 2/6; heater trans., 7/6; 4 v/6, 1/6; 4 obsolete ex-Govt. valves, metal rectifier a-d Xtal diode with circuit, 14/6; 25 x 25 mfd., 1/-; 16 x 16 mfd., 3/3; condenser kit (17, 7/6; resistor kit (14), 3/6.
 USED 4-VALVE PLUS METAL REC. A.C. MAINS 230/250 SUPERHET. Valve line-up: 6K8, 6K7, 6Q7 and 6P6. Medium wave, in mahogany cabinet, size 14 1/2 x 9 x 7 1/2 in. These have been checked and are in first-class working order, and first-class performance. 6 in. P.M. speaker, £3/18/6. P. & P. 5/6.
 USED 5-VALVE A.C. MAINS 200/250 3 WAVEBAND SUPERHET. Complete in outstanding walnut cabinet, size 22 x 14 x 10 in. Valve line-up: 6K8, 6K7, 6B8G, 6P6, and U50 rec., 8 in. P.M. speaker. In first-class working order. £7/10/6. P. & P. 12/6. We have a few of these in A.C./D.C. price as above, or £2/10/- dep. 6 monthly payments of £1/1/-
 T.V. POWER SUPPLY CHASSIS, size 13 x 5 1/2 in. A.C. mains 200/250 v. Complete with smoothing choke, main transformer, 40 mid. 350 wkg., 3.16 mfd., 450 wkg., 32 mid. 400 wkg., 5U4G, 2 min. fuses, 11 pin output socket and mains lead. Smoothed output 350 v. 200 mA., heaters 6.3 v. 7 amp., 70/- P. & P. 5/-
 FULLY SHROUDED MAINS TRANSFORMER, input 110/250, sec. 350-0-350 175 mA. 6.3 v. 7 amp., 5 v. 3 amp. 35/- P. & P. 3/-
 FULLY SHROUDED PUSH-PULL TRANS. Pri. 6,000 ohms, sec. 16 ohms (2 L66) in push-pull £1. P. & P. 2/-
 FULLY SHROUDED CHOKE 16 Henry 180 mA., 15/- P. & P. 2/-
 FULLY SHROUDED CHOKE 5 Henry 120 mA., 8/6. P. & P. 2/-
 These last four items by very famous manufacturer.

change switch, 2/-; 32 x 32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-
 M. & L. Superhet Coils with circuit, 6/6; Iron cored 465 IF's, 7/6; min. gang, 5/6; volume control with switch, 4/6; wave-change switch, 2/6; heater trans., 7/6; 4 v/6, 1/6; 4 obsolete ex-Govt. valves, metal rectifier a-d Xtal diode with circuit, 14/6; 25 x 25 mfd., 1/-; 16 x 16 mfd., 3/3; condenser kit (17, 7/6; resistor kit (14), 3/6.
 USED 4-VALVE PLUS METAL REC. A.C. MAINS 230/250 SUPERHET. Valve line-up: 6K8, 6K7, 6Q7 and 6P6. Medium wave, in mahogany cabinet, size 14 1/2 x 9 x 7 1/2 in. These have been checked and are in first-class working order, and first-class performance. 6 in. P.M. speaker, £3/18/6. P. & P. 5/6.
 USED 5-VALVE A.C. MAINS 200/250 3 WAVEBAND SUPERHET. Complete in outstanding walnut cabinet, size 22 x 14 x 10 in. Valve line-up: 6K8, 6K7, 6B8G, 6P6, and U50 rec., 8 in. P.M. speaker. In first-class working order. £7/10/6. P. & P. 12/6. We have a few of these in A.C./D.C. price as above, or £2/10/- dep. 6 monthly payments of £1/1/-
 T.V. POWER SUPPLY CHASSIS, size 13 x 5 1/2 in. A.C. mains 200/250 v. Complete with smoothing choke, main transformer, 40 mid. 350 wkg., 3.16 mfd., 450 wkg., 32 mid. 400 wkg., 5U4G, 2 min. fuses, 11 pin output socket and mains lead. Smoothed output 350 v. 200 mA., heaters 6.3 v. 7 amp., 70/- P. & P. 5/-
 FULLY SHROUDED MAINS TRANSFORMER, input 110/250, sec. 350-0-350 175 mA. 6.3 v. 7 amp., 5 v. 3 amp. 35/- P. & P. 3/-
 FULLY SHROUDED PUSH-PULL TRANS. Pri. 6,000 ohms, sec. 16 ohms (2 L66) in push-pull £1. P. & P. 2/-
 FULLY SHROUDED CHOKE 16 Henry 180 mA., 15/- P. & P. 2/-
 FULLY SHROUDED CHOKE 5 Henry 120 mA., 8/6. P. & P. 2/-
 These last four items by very famous manufacturer.

USED C.R.T. TUBES. Heater cathode short 9 in., 45/- 12 in. 75/- Ion burn 9 in., 35/- 12 in., 55/- P. & P. on each 7/6.
COMPLETELY BUILT SIGNAL GENERATOR. Coverage 110 Kc/s.-320 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-25 Mc/s., 17 Mc/s.-50 Mc/s., 25 Mc/s.-75 Mc/s. Metal case 10 x 8 1/2 x 4 1/2 in. Size of scale 6 1/2 x 3 1/2 in. 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30 per cent, modulated or unmodulated. R.F. output continuously variable 100 millivolts. P. & P. 4/- £4/5/- or 34/- deposit, three payments of £1.
CONSTRUCTOR'S PARCEL comprising chassis 12 1/2 x 8 x 2 1/2 in., cad. plated 18 gauge, v/6, 1P and trans. cut-outs, back-plate, 2 supporting brackets, 3 waveband scales, new wave-length station names. Size of case 1 1/2 x 4 1/2 in., drive spindle drum, 2 pulleys, pointer, 2 bulb holders, 5 paroxlin international octal valve holders, 4 knobs and pair of 465 IFs, 16/6. P. & P. 1/9.
 AS ABOVE, but complete with 16-16 mfd. 350 p.f. and semi-shrouded drop thro' 250-0-250 60 mA. 5 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/6.
BATTERY CHARGER KIT comprising metal case 4 1/2 x 5 1/2 in., transformer 230/250 v., and metal rectifier. Will charge 6 or 12 v. battery 1 1/2 amp. 19/6. P. & P. 2/6.
PERSONAL PORTABLE CABINET. In cream-coloured plastic: size 7 x 4 1/2 x 3 in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7 1/2 v. batteries 9/- post and pkg. 1/6.
 3 in. P.M. Speaker to fit above, 10/- Miniature output transformer, 5/- Miniature wavechange switch, 1/6. Miniature 1-pole 4-way used as Volume and Off, 1/6. 4B7G valve holders, 2/4. Midget twin gang 1 in. dia., 1 in. long and pair medium and longwave TRF coils 1 in. long x 1 in. wide complete with 4-valve all-chassis mains and battery circuit 3/6. Condenser kit, comprising 11 miniature condensers, 3/6. Resistor kit comprising 16 miniature resistors 4/- The above receiver (less valve and batteries) could be built for approximately 51/-. All valves to suit above available. Point to Point Wiring Diagram 1/-

USED C.R.T. TUBES. Heater cathode short 9 in., 45/- 12 in. 75/- Ion burn 9 in., 35/- 12 in., 55/- P. & P. on each 7/6.



CONSTRUCTOR'S PARCEL comprising chassis 12 1/2 x 8 x 2 1/2 in., cad. plated 18 gauge, v/6, 1P and trans. cut-outs, back-plate, 2 supporting brackets, 3 waveband scales, new wave-length station names. Size of case 1 1/2 x 4 1/2 in., drive spindle drum, 2 pulleys, pointer, 2 bulb holders, 5 paroxlin international octal valve holders, 4 knobs and pair of 465 IFs, 16/6. P. & P. 1/9.
 AS ABOVE, but complete with 16-16 mfd. 350 p.f. and semi-shrouded drop thro' 250-0-250 60 mA. 5 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/6.
BATTERY CHARGER KIT comprising metal case 4 1/2 x 5 1/2 in., transformer 230/250 v., and metal rectifier. Will charge 6 or 12 v. battery 1 1/2 amp. 19/6. P. & P. 2/6.
PERSONAL PORTABLE CABINET. In cream-coloured plastic: size 7 x 4 1/2 x 3 in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7 1/2 v. batteries 9/- post and pkg. 1/6.
 3 in. P.M. Speaker to fit above, 10/- Miniature output transformer, 5/- Miniature wavechange switch, 1/6. Miniature 1-pole 4-way used as Volume and Off, 1/6. 4B7G valve holders, 2/4. Midget twin gang 1 in. dia., 1 in. long and pair medium and longwave TRF coils 1 in. long x 1 in. wide complete with 4-valve all-chassis mains and battery circuit 3/6. Condenser kit, comprising 11 miniature condensers, 3/6. Resistor kit comprising 16 miniature resistors 4/- The above receiver (less valve and batteries) could be built for approximately 51/-. All valves to suit above available. Point to Point Wiring Diagram 1/-

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 AS ABOVE, but complete with 16-16 mfd. 350 p.f. and semi-shrouded drop thro' 250-0-250 60 mA. 5 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/6.
BATTERY CHARGER KIT comprising metal case 4 1/2 x 5 1/2 in., transformer 230/250 v., and metal rectifier. Will charge 6 or 12 v. battery 1 1/2 amp. 19/6. P. & P. 2/6.
PERSONAL PORTABLE CABINET. In cream-coloured plastic: size 7 x 4 1/2 x 3 in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7 1/2 v. batteries 9/- post and pkg. 1/6.
 3 in. P.M. Speaker to fit above, 10/- Miniature output transformer, 5/- Miniature wavechange switch, 1/6. Miniature 1-pole 4-way used as Volume and Off, 1/6. 4B7G valve holders, 2/4. Midget twin gang 1 in. dia., 1 in. long and pair medium and longwave TRF coils 1 in. long x 1 in. wide complete with 4-valve all-chassis mains and battery circuit 3/6. Condenser kit, comprising 11 miniature condensers, 3/6. Resistor kit comprising 16 miniature resistors 4/- The above receiver (less valve and batteries) could be built for approximately 51/-. All valves to suit above available. Point to Point Wiring Diagram 1/-

R.I. MAINS TRANSFORMERS, chassis mounting feet and voltage panel Primaries 200/250.

300-0-300 60 mA. 6.3 v. 1 a., tapped at 4 v. 6.3 v. 2 a. tap 4 v., 13/6.
 350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., 13/6.
 350-0-350 70 mA. 4 v. 5 a. 4 v. 2.5 a. C.T., 18/6. P. & P. on the above transformers, 2/-
 500-0-500 125 mA. 6.3 v. C.T. 4 a. 6.3 v. C.T. 2 a. 5 v. C.T. 2 a., 27/6.
 500-0-500 125 mA. 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., 27/6.
 500-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., 39/6.
 P. & P. on the above transformers 3/-

Line and E.H.T. transformer 9KVA, using ferrocast core complete with built-in line and width control. Mounted on small all-chassis. Overall size 4 1/2 x 1 1/2 in. EY61 rec. winding. 27/6. P. & P. 2/6.

Valve Holders, moulded octal Mazda, and octal, 7d. each. Faxolin, octal, Mazda and octal, 4d. each. Moulded BYG, 3B4, and 5Y4, 7d. each. 3Y4 moulded with screening can, 1/6 each.
 32 mid., 350 wkg. 2/-
 16 x 24 350 wkg. 4/6
 4 mid., 200 wkg. 1/6
 40 mid., 450 wkg. 3/6
 16 x 16 mid., 500 wkg. 4/6
 16 x 16 mid., 500 wkg. 5/9
 16 x 16 mid., 450 wkg. 3/9
 32 x 32 mid., 350 wkg. 4/6
 32 x 32 mid., 350 wkg. and 25 wkg. 6/6
 25 mid., 25 wkg. 11d.
 250 mfd., 12 v. wkg. 1/-
 16 mid. 500 wkg., wire ends 2/6
 8 mid., 500 v. wkg., wire ends 3/6
 8 mid., 350 v. wkg., wire ends 1/6
 60 mid., 25 v. wkg., wire ends 1/9
 100 mfd. 350 wkg. 4/-
 100-0-200 mid., 350 wkg. 3/6
 16+16 mid. 350 wkg. 9/6
 Ex-Govt. 8 mid., 500 v. wkg. 2/6
 16 x 32 mid., 250 wkg. 6/-
 50 mid., 180 wkg. 1/6
 65 mid., 220 wkg. 1/9
 8 mid., 150 wkg. 1/6
 80+100 mid., 250 wkg. 7/6
 60 mid., 12 wkg. 11d.
 32+32 mfd., min., 275 wkg. 1/6
 60 mid., 50 wkg. 1/9
 Miniature wire ends moulded, 100 pt., 500 pt., and .001 ea. 7d.

Combined 12 in. mask and escutcheon in lightly tinted perspex. New aspect in brown. Fits on front of cabinet, 17/6. P. & P. 2/-

Frame Oscillator Blocking Trans., 4/6. Tube Mounting Bracket, size 9 1/2 x 1 1/2 in. tube clamps, 2/-

Smoothing Choke, 2 henry 150 mA., 3/6. 250 mA. 3 henry, 5/-; 250 mA., 10 henry, 10/6; 5 henry, 250 mA., 60 ohms, 8/6.

P.M. Focus Unit for any 9 or 12 in. tube except Mazda 12 in., with Vernier adjustment, 15/- P. & P. 1/6.
 P.M. Focus Unit for Mazda 12 in., with Vernier adjustment, 17/6. P. & P. 1/6.
 Wide Angle P.M. Focus Units, Vernier adj., state tube, 25/- P. & P. 2/-
 Energised Focus Coil, low resistance mounting bracket, 17/6 plus 2/- P. & P. Scan Coils, low line low impedance frame, complete with O.P. transformer, 17/6. P. & P. 2/-

Ion Traps for Mullard or English Electric tubes, 5/- post paid.

465 kc. I.F.s, size 2 1/2 x 1 1/2 in. Q.110 removed from American equipment. 5/- per pair. Standard 465 Kc. iron-cored I.F.s, 4 x 1 1/2 x 1 1/2 in., per pair, 7/6. Wearite standard iron-cored 465 Kc. I.F.s, 3 1/2 x 1 1/2 x 1 1/2 in., per pair, 9/6.

Iron-cored 465 Kc. Whistle filter, 2/6.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/8, 4-21 with extra feed-back windings, 4/3. Miniature 42-1, 3/2. Multi-ratio 3,500, 7,000 and 14,000, 5/8. 10-watt push-pull, 6V6 matching 7/- 90-1 3 ohm speech coil, 6/6.

PUSH-BACK CONNECTING WIRE. Doz. yds., 1/8, post paid.

STANDARD WAVE-CHANGE SWITCHES. 4-pole 3-way. 1/8; 5-pole 3-way. 1/8; 3-pole 3-way. 1/8; 9-pole 3-way. 3/6; Miniature-type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. P. & P. 3d.
 465 Kc. MIDGET I.F.s. Q.120, size 1 1/2 in. long, 1 in. wide, 1 in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair, 12/6.

Prices slashed at Clydesdale

F24 AIRCRAFT CAMERA in Transit Case.



Full Details:

Lens 5in. f/4 with internal iris diaphragm stops to f/11, fixed focus set at infinity, screw-in housing projects 5 1/2in. Focal plane shutter, speeds 1/60th to 1/1,000th of a second and time, fitted in film magazine designed for 5 1/2in. wide film, picture size 5 1/2 x 5 1/2in. Shutter release and rewind spindle for standard spanner. Hand operated as it stands. Nett. weight 17lb. Packed in fitted transit case 42lb. Dimensions: body 6 1/2 x 9 x 9 1/2in., overall including lens housing 11 1/2 x 9 x 9 1/2in. Provision for external motor drive (not supplied). Lens housing grooved for fitting to aircraft camera port. A precision Air Survey Camera, could be adapted for Laboratory, Industrial or Portraiture use.

ASK FOR **£4.19.6** each CARRIAGE PAID X/H302

F24 AIRCRAFT CAMERA in Transit Case.

With 8in. f/2.9 lens, otherwise as H.302.
ASK FOR **£9.19.6** each CARRIAGE PAID X/H300

14in. f/5.6 LENS FOR F24 CAMERA

Complete with Iris, Filter, Mount and Extension. In Transit case.

ASK FOR **£6.19.6** each CARRIAGE PAID X/H563

CAMERA CONTROL ELECTRICAL, type 35 No. 20, Ref.: 14A/3208, Input 24 volts D.C. Time interval selection switch 15-51 second, calibrated in height, thousands of feet. Suitable as the basis of an enlarger timer or many other timing uses. Dim.: 8 x 3 1/2 x 4 1/2in. overall including controls. In Transit Case.

ASK FOR **15/-** each POST 1/6 EXTRA X/H962

RECORDER MK. II 24 VOLTS

As previously described, Used. Good condition, in Transit Case.

ASK FOR **27/-** each POST PAID X/H883

ONLY AVAILABLE with Recorder Mk. II. Film Cassette, 25ft. Capacity.

ASK FOR **10/-** each POST PAID X/H960

We are unable to supply external fittings or films for these units at present.

GLASS DOME INSULATOR, with Threaded Terminal Top and Metal Lead-through Rod. Dome dim.: 2 1/2 x 1 1/2in. high, lead-through projects 6 1/2in. Overall length 9 1/2in.

ASK FOR **2/-** each POST 3/4 EXTRA X/H54

CERAMIC AERIAL SPREADER individually boxed.

Length overall 11in., between centres 9 1/2in.
ASK FOR **1/-** per pair POST 3d. EXTRA X/H718

BLACK PLASTIC CHAIN AERIAL INSULATORS

Comprising 3 links, 3 1/2in. long, 1 1/2in. wide, each link. Total length 7 1/2in. A.M. ref. 10A/1275.

ASK FOR **9d.** per pair POST 3d. EXTRA X/H525

BC-456 SPEECH MODULATOR UNITS. Part of SCR-274-N. "Command Equipment." (U.S.A. made)

Complete with valves 1625, 1215 and VR150/30, transformers, relays, etc., less dynamotor. Overall dim.: 10 1/2 x 7 1/2 x 4 1/2in. Loose stored.

ASK FOR **17/6** each CARRIAGE PAID X/E42

Also available. BC-456 as above, in original carton.
ASK FOR **27/6** each CARRIAGE PAID X/E42A Circuit 1/3

FOR EXPORT ONLY WIRELESS SET NO. 38, Mk. II

Range 7.7-9 Mc/s., 5 valves and all accessories. Complete (less batteries) and unused in original wood case. 4 complete units per case.

ASK FOR **£20.0.0** PER CASE OF 4 SETS X/H519/4 F.O.B. GLASGOW

ROTARY CONVERTER TYPE 195

Input 24 v. D.C. 5 A. Output 230 v. A.C. 50 c/s. 100 w. Complete in metal case. Dim.: 13 x 11 x 8in. with carrying strap.

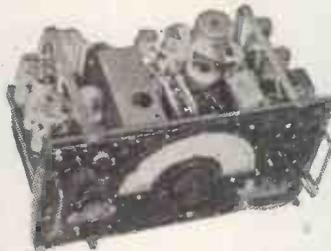
ASK FOR **£5.19.6** each CARRIAGE PAID X/H914

RECEIVER UNIT TYPE 25

Ref.: 10P/11

Part of TR1196, Range 4.3-6.7 Mc/s. with valves 2/VR53 (EF39), 2/VR56 (EF36), VR55 (EBC33), VR57 (EK32), 2/1.F.T. 460 kc/s, etc., in metal case 8 1/2 x 6 1/2 x 6 1/2in.

ASK FOR **35/-** each POST PAID X/H299



VISUAL INDICATOR TYPE I, Ref. 100/2

Dual reading left/right D.F. meter for R1155, 2 1/2in. Scale overall dim.: 3 1/2in. x 2 1/2in. In used condition. Ask for X/H862A

12/6 each Post Paid.



POWER UNITS FOR T1154/R1155 UNITS

Each a Motor Generator Unit, smoothed, etc., in metal case 16in. x 7 1/2in. x 6in.

LOOSE STORED. Types 33 or 33B. Input 24 v. D.C. 16A. Output 1,200 v. D.C. 200 mA.

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Type 35A. Input 18 v. D.C. 12 A. Outputs 7.2 v. D.C. 13 A. and 225 v. D.C. 110 mA.

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Each having Vernier tuning dial, Variable Capacitor, Tank Coil unit on ceramic former, Ceramic Switch, etc., etc. In metal cabinet 17 1/2 x 7 1/2 x 8in. Finish black. Unused, but externally soiled, scratched and dented, due to being Loose Stored.



TU.7B Range 4,500-6,200 Kc/s. Ask for X/H29.

TU.8B Range 6,200-7,700 Kc/s. Ask for X/H30.

TU.9B Range 7,000-10,000 Kc/s. Ask for X/H467.

EITHER UNIT **10/-** each CARRIAGE 2/- EXTRA

I.F. RECEIVER R3108. Ref.: 10DB/505

Contains Motor Generator Input 12 v. 3.8 A. Output 480 v. .04 A. D.C. with a gearbox operating a switching mechanism to detune the receiver at time intervals. Data available for converting to 250 v. 50 c/s use as motor.

Plus: 4/VR65A (SP.41), 2/VR92 (EA50), 2/VCV6 (Det. 20) Valves, etc., etc.

Metal case: Dim. 12 x 12 x 8in. Wgt. 24lb. Ask for **19/6** each CARRIAGE PAID X/H961

26 WATT OUTPUT TRANSFORMER

Parfemko type AF5084/1A (Mfg. Surplus). Primary: 6,600 ohms. C.T. Sec's. 3.5, 5, 7.5 or 10 ohms. Dim.: 3 1/2 x 2 1/2 x 3 1/2in. Fully shrouded.

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With valves VR55, 2/VR54, VR116, 3/VR56, 6/VR65, 2 relays, plus cond., etc. Input 80 v. 2,000 c/s A.C. In metal-case: 12 x 7 1/2 x 11 1/2in.

ASK FOR **21/-** each CARRIAGE 2/6 EXTRA X/H884

R1155 RECEIVER UNIT

Communications, D.F. and "ham," 20, 40, 80, 5 ranges 18-7.5 Mc/s., 7.5-3 Mc/s., 1,500-600 Kc/s., 500-200 kc/s. and 200-75 kc/s. Complete with 10 valves. S.M. drive, M.E. tuning, B.F.O., etc. In metal case 16 1/2 x 9 x 9in. External Power Supply required. Used, good condition. In Transit Case.

ASK FOR **£8.19.6** each CARRIAGE PAID X/H916

ALSO AVAILABLE

R1155, as above, but loose stored. Ask for **£5.19.6** each CARRIAGE 7/6 EXTRA X/H898

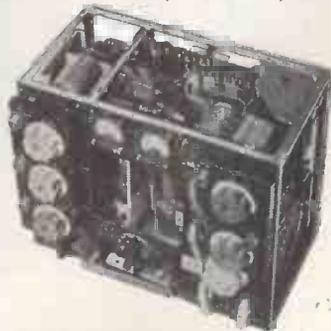
T1154 TRANSMITTER UNIT

Medium/high powered for C.W.-M.C.W. R/T, 3 ranges 10-5.5 Mc/s. 5.5-3 Mc/s. 500-200 kc/s. Complete with 4 valves, etc., in metal case 14in. x 16 1/2in. x 8 1/2in. External Power Supply required.

ASK FOR **39/6** each CARRIAGE 7/6 EXTRA X/E5A

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T1154 as above, but less valves. Ask for **15/-** each CARRIAGE 7/6 EXTRA X/E5B



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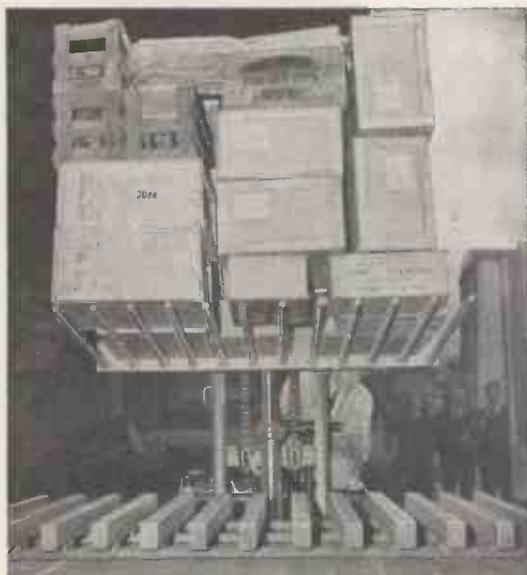
No technical manuals for sale. Please write for prices. TS3. S band power frequency meter. TS10. APNI Test set. TS13. AP. X band signal generator. TS14. S band signal generator. TS34. Radar Synroscope. TS36. X band power meter. TS62. X band echo box. TS69. 300-100 Mc/s. frequency meter. TS127. 300-700 Mc/s. frequency meter. TS226. 300-1,000 Mc/s. power meter. BC221. Frequency meter (Bendix). BC1277. S band signal generator. TS45/AP. 3 cm. signal generator. I-222A. 8-15 Mc/s. 150-230 Mc/s. signal generator. IE-19 signal generator. TS89. Pulse voltage divider. TS47. 40-500 Mc/s. signal generator. TS174. 20-250 Mc/s. FERRIS. 22A signal generator, Dumont scope, type 224A. GENERAL RADIO 804B. 30-300 Mc/s. signal generator.

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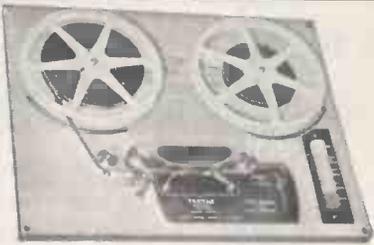


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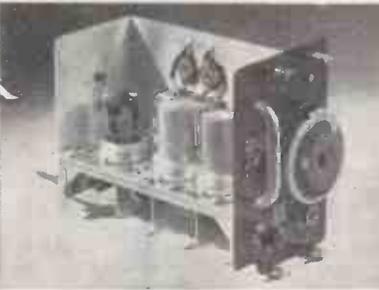
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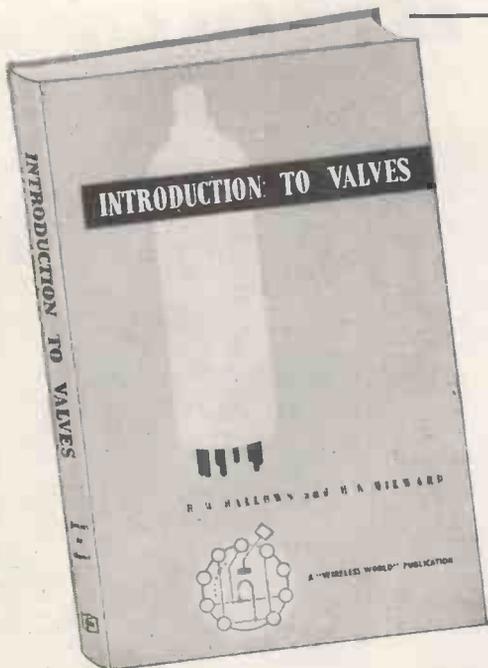
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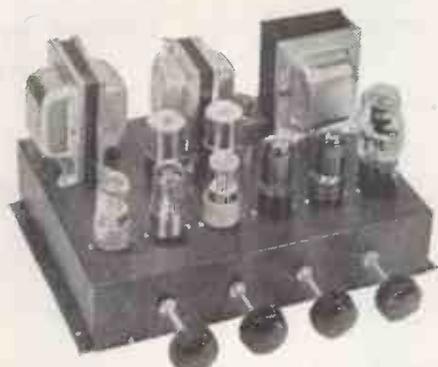
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 6 or 12 v. 3 A. F.W. bridge type 12/6
 6 or 12 v. 4 A. F.W. bridge type 15/-
 6 or 12 v. 6 A. F.W. bridge type 23/6
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CONSOLE RADIOGRAM CABINETS. This is an attractive figured walnut cabinet, originally intended for the above superbet chassis. It is constructed to take the chassis in the top part, dial being permanently visible through slotting front. Underneath, the gramophone unit is housed in a drawer which slides forward on steel runners—when required for use—Total Cabinet measurement is 36in. high, by 20in. wide, by 16in. deep—Our price for the cabinet only is £9/17/6 plus 10/- packing and carriage.

● The Collaro changer listed above fits neatly in drawer of this cabinet! ●
 We can supply the three units, cabinet, chassis and changer, if purchased together at one time, at a price of £32/10/- plus 20/- packing and carriage. May we suggest an 8in. Elac P.M. Speaker at 17/6? Fully assembled model being demonstrated at our shop premises.

THE NEW R.C. HIGH-FIDELITY AMPLIFIER. P.P. 6V6 output. Freq. 25—18,000 cps.—60db at 6 1/2 watts. Treble boost and cut—Bass boost—L.P. correction. Provision for Feeder Unit Max. UNDISTORTED OUTPUT 8 1/2 watts. Price 16 gns. plus 7/6. NOW AVAILABLE. Kit of Parts, complete with fully illustrated instructions, 13 gns., plus 5/- carriage. Illustrated booklet available separately at 2/6. Attractive metal cover, now available. With built-in carrying handle, 19/6.

F.S.D.		Size	Type	Meters	Price
250 microamp	D.C.	2 1/2in.	M.C.	F.R.	40/-
500 microamp	D.C.	2in.	M.C.	F.R.	18/6
500 microamp	D.C.	2 1/2in.	M.C.	F.R.	35/-
1 mA.	D.C.	2in.	M.O.	F.8q.	17/6
1 mA.	D.C.	2in.	M.C.	F.8q. (Scale Calib. 1.5kV.)	15/-
1 mA.	D.C.	2 1/2in.	M.C.	Desk Type	27/6
5 mA.	D.C.	2in.	M.C.	F.8q.	7/6
10 mA.	D.C.	2 1/2in.	M.C.	R.P.	10/-
15 mA.	D.C.	2in.	M.C.	F.R.	7/6
20 mA.	D.C.	2in.	M.C.	F.B.	7/6
50 mA.	D.C.	2in.	M.C.	F.8q.	8/6
200 mA.	D.C.	2 1/2in.	M.C.	R.P.	10/-
500 mA.	D.C.	2in.	M.C.	R.P.	8/6
0.5 amp.	R.F.	2in.	Thermo	F.8q.	4/6
1 amp.	R.F.	2in.	Thermo	F.8q.	5/-
2.5 amp.	A.C./D.C.	2in.	M.I.	F.R.	12/6
3 amp.	R.F.	2in.	Thermo	F.8q.	7/6
5 amp.	D.C.	2in.	M.O.	F.8q.	13/6
20 amp.	D.C.	2in.	M.C.	R.P. (with shunt)	10/6
10 v.	D.C.	2in.	M.C.	R.P.	8/6
150 v.	D.C.	2 1/2in.	M.O.	F.R.	15/-

R.P. = Round projection. Thermo = Thermo-couple.
 F.8q. = Fish Square. M.C. = Moving Coil.
 F.R. = Fish Round. M.I. = Moving In.

ALL-PURPOSE TEST METERS. We also offer very limited supply of Ex-Naval All-purpose test meters by Everett, Edgcombe. These instruments are not brand new, but all have been serviced and guaranteed 100 per cent condition. Complete in strong wooden case. Size 9in. x 6in. x 5 1/2in. Leather carrying handle. 3 1/2in. Scale—1,000 ohms per volt—Measures 0-1,000 volts A.C./D.C.—Capacity .02 mfd—16 mfd.—Resistance to 10 mega.—While stocks last—Price £7/19/6 only! Plus 2/6 packing and carriage.

SPECIAL OFFER.—Garrard A.C./D.C. Model "E" centre drive motor—Auto-stop and start for 78 r.p.m.—Speed regulator—Few only at £7/19/6, plus 2/6 packing and carriage. We also have in stock—Connoisseur 3-speed motor, pick-ups. Pick-ups and heads, Garrard, Decca, Collaro, Acos, Chancery, etc., etc., all at current prices!

BRAND NEW R1155A RECEIVERS guaranteed serviceable in original packing cases, £11/19/6. Fully assembled Power Pack and output stage, to plug straight in to R1155 for A.C. 200/250 volts, at 79/6—Deduct 10/- if purchasing receiver and power pack at the same time.

45 Mc/s PYE STRIP—Brand new complete with 6 valves type EF50 and one EA50, 7/0/- only.

PORTABLE RECORD PLAYER CABINETS. Manufacturer's surplus, brand new. External dimensions 15in. x 16 1/2in. x 8 1/2in. deep. Finished attractively in dark brown rexine. Motor board cut for R.S.R. Monarch Changer, but will take any standard single player; also room for amplifier. Front view shows attractive grille for speaker. Leather carrying handle, two snap locks. Price 45/- only, plus 2/6 packing and carriage. Also available to take any standard single player—brown leatherette covered. Complete with locks and carrying handle. Size 15in. x 13 1/2in. x 5 1/2in. 22/6 only, plus 2/6 packing and carriage.

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Readers are warned that Government surplus components and valves which may be offered for sale through our columns carry no manufacturers' guarantee. Many of these items will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

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12-watt high quality amplifiers, bass and treble boost; £12/15; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombledon Norwich. [0065]
REAL bargain clearance, all new goods, e.g., 4v L.M.S. wave s/het, £3/10, incl. valves, coil pack, etc.; A.F. oscillator sine/sq atten., o/p 20-20kcs/only, £4/10; low quality high gain ampr., perfect, £4; tape recorder ampr., osc., offers over £7; numerous other smaller items; s.a.e. for list in confidence.—J. A. Vansstone, "Cleland," Agates Lane, Ashted, Surrey. [2328]

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

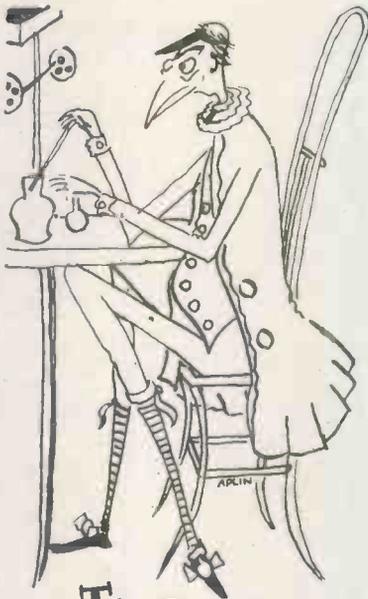
EXC. cond 750, £45 o.n.o.; working 12in TV kit.—Box 2608. [2327]
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FTV projector, under maker's guarantee; good price to dealers, what offers?—Box 2563.
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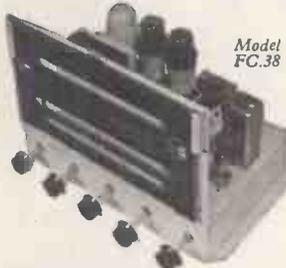
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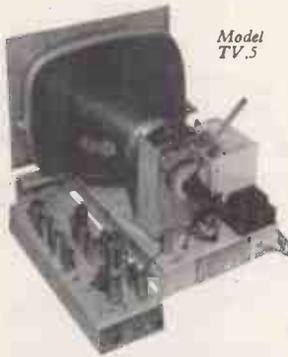
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WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components.
LOWE BROS., 5, Fitzroy St., London, W.1. Tel. Museum 4389. [9745

WANTED, HRO coils, Rxs, etc., A.R.88s, BC348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

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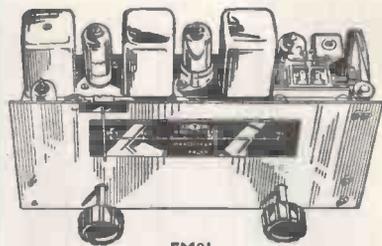
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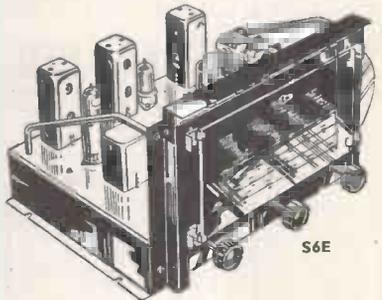
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PATENTS

THE proprietor of British Patent No. 573313, entitled "Multiple section electronic tube and method of making it," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. [2191]

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is exempted from the provisions of The Notification of Vacancies Order 1952.

ELECTRONIC engineers.
ENGINEERS interested in radar as a career, are invited to apply to Decca Radar, Ltd., to join the Company on its development programme, covering a wide field of radar and associated techniques. Applicants must have H.N.C. and a thorough knowledge of basic circuitry; British nationality essential; there are good starting salaries and prospects of rapid advancement with this expanding company. Write quoting ref. RLA/11 Decca Radar, Ltd., Research Laboratory, 2, Tolworth Rise, Surbiton, Surrey. [0257]

ELECTRICAL engineers.
WAYMOUTH GAUGES & INSTRUMENTS, Ltd., a subsidiary company of Smiths Aircraft Instruments, Ltd. have vacancies in their Aircraft Fuel Gauge Laboratory for Assistant Engineer, required for development of electronic fuel gauging equipment; they should have an engineering degree or Higher National Certificate. Technical Assistants are also required for experimental work in electrical measurements; preference will be given to applicants holding a technical qualification.—Apply in writing to the Chief Development Engineer, Waymouth Gauges & Instruments, Ltd., Station Road, Godalming, Surrey. [2293]

TELEVISION.—Careers for young men.
LIMITED vacancies exist upon work which is an introduction to checking and adjusting of electronic circuits on TV receivers; specialized knowledge not necessary, as suitable applicants will receive training.—Apply in writing to Personnel Manager, Pye, Ltd., St. Andrews Rd., Cambridge. [2273]

ELECTRONIC engineers are required by THE ENGLISH ELECTRIC Co., Ltd., Luton, for work on a high priority defence project. Applicants will be required to undertake the engineering of circuitry already developed, which involves close liaison with, and the progressing of work through, the drawing office and production department. Applicants with experience of the engineering of radar and/or aircraft electronics for production will be especially welcome. The posts are permanent and progressive and a staff pension scheme is in operation. Applications to Dept. C.P.E., 336-7, Strand, W.C.2, quoting ref. 1211. [2114]

VACANCIES in Government Department.
DRAUGHTSMEN are required, with experience in the layout of telecommunication and electronic equipment, involving detailed mechanical design, preparation of all mechanical drawings, sub-assemblies and final assembly, circuits, specifications, and stock-lists; suitable for prototype and batch production manufacture.

PRACTICAL workshop experience, and knowledge of modern methods an asset but not essential.
SALARY.
FOR a week of 44 hours: £374 per annum at age 21, rising by annual increments of £20 to £597 per annum.
AN extra duty allowance of 3% will also be paid for working 45 1/2 hours each week.
APPLY in writing:—
PERSONNEL Officer, G.C.H.Q., 53, Clarence St., Cheltenham. [2311]

RADIO/television service engineer required, salary from £600 per year.—Tel. Pri. 1161. [2294]

METAL RECTIFIERS

- 6 or 12 v. 1 amp. F/W..... 5/6
- 6 or 12 v. 2 amp. F/W..... 8/6
- 6 or 12 v. 3 amp. F/W..... 11/6
- 6 or 12 v. 4 amp. F/W..... 12/6
- 6 or 12 v. 6 amp. F/W..... 18/6

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By well-known makers. Fully guaranteed.

- Prim. 230 v. Sec. 6.3 1.5 amp. 6/6
- Prim. 110/230 v. Sec. 6.3 3 amp. 11/6
- Prim. 230/240 v. Sec. 2 v. 2 amp. air spaced 10/-
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- 250 M/A. Prim. 200/210, 220/230, 240/250 v. Sec. 350-0-350, heaters 2 v. 6.3 amp., 2 amp., 4 v., 5 v., 3 amp. 6.3 v., 6 amp. 4 v., 8 amp. £3/19/6

- For Williamson Amplifier**
- 150 M/A. Prim. 200/210, 220/230, 240/250 v., Sec. 425-0-425 6.3 v. 7 amp., 5 v. 3 amp., fully shrouded £2/18/6
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- E.H.T. Transformer, Prim. 230 v. 5-6 Kv. E.H.T. 2 v. Fil with U22 TRect. £1/17/6

Send stamp for comprehensive catalogue.
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WATERLOO RADIO

METAL RECTIFIERS. Bridge, 2 Amp. 11/3, 3 Amp. 12/6, 4 Amp. 15/-. 6 Amp. 23/6, post 1/4.
TRANSFORMERS for use with above rects. Input 200-250V 50~A.C. to charge 6 or 12 Volts at:—1.5 Amps. 13/9, 3 Amps. 22/9, 6 Amps. 32/6, post 2/-.
HALF WAVE RECTIFIERS. 125 A.C. input RM1, 60mA 3/9. RM2. 100mA 4/3. RM3. 125mA 5/3. RM4. 250V A.C. in. 275mA. for TV 15/6, post 6d.
Overseas enquiries invited.

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NEW RECORDERS

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All types new and secondhand Tape, Wire, Microphones, Stands, Speakers, etc.

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See our NEW Showroom (address below) and inspect these and hundreds of additional bargains. Send 3d. for Bargain List.

1,500FT. BEAM FOCUSING TORCH

Highly polished nickel-plate finish, heavy duty, 14in. long, five standard U.2 batteries. Brand new. Complete with Ever-Ready batteries. 19/11.



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Fully focusing, nickel-plated. 7½in. Complete with Ever-Ready batteries. 9/11.

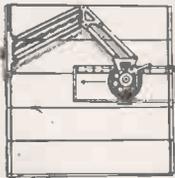
SELENIUM METAL RECTIFIER
Suitable for 2, 6, and 12 v. battery chargers. Max. capacity 15 v. at 1 amp. New and boxed. 9/6.

MODEL MAKERS MAINS TRANSFORMERS

All purpose—low voltage. Input 210/250v. Output 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30v. Rating 2 amps. Brand new, fully guaranteed. 24/-.

DOOR CHIMES

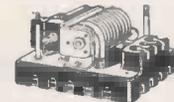
Frustrated Export Order enables us to offer these attractive door chimes at BELOW COST, suitable for operation direct from 200/240 Volt Mains. Brand New, in original cartons. 35/-.



ACCUMULATOR CUT-OUT

12 or 24 v., 60 A. Ex-R.A.F., originally cost over £6 each, suitable for battery charging, etc. Limited quantity at 15/- each.

CHART BOARD
Ideal as drawing board. 17in. sq. complete with pantograph arm, protractor head and Perspex scale. Each 25/-.



"MEGGER" CIRCUIT TESTING OHMMETER

4½ v. battery operated, 2 ranges 0-1,000 ohms and 100-200,000 ohms. Size 5½ x 4 x 2¼in., complete with fitted leather case, test prod and full instructions. Unrepeatable at £3/19/6.



Set of TWIST DRILLS
9 drills, ¼—½in., complete with plastic case and stand. Brand new. 4/6

OHMMETER. 4 scales, 2½ in. diameter, reading 0-5,000 ohms, 0-60 mA., 0-1.5 v., 0-3 v., suitable for continuity testing. Will operate from 1.5 v. battery, strong case, with full instructions engraved on back. Brand new, 19/6. Carrying sling, 1/- ex.

TOOL BOX

U.S.A. manufacture, size 18in. x 12in. x 5in. Strongly made waterproof ply, all external edges reinforced. Subdivided as illus., leather carrying handle. Outside resprayed green.



17/6

ALL ITEMS CARRIAGE PAID IN U.K. ONLY

TERMS—CASH WITH ORDER. C.O.D. 1/- EXTRA. Phone Orders Accepted—Money Back Guarantee

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479 HARROW RD., LONDON, W.10
LADbroke 1718.

SITUATIONS VACANT

microwave engineers are required by:—
THE ENGLISH ELECTRIC Co., Ltd., at Luton, for work on a high priority defence project. Applicants should have a good theoretical background to degree standard and experience of design or engineering of microwave equipment for development work on aerial and receiving systems. This work includes investigations of new methods of construction with a view to miniaturisation and weight reduction, the design of new components and engineering to the production stage. Successful applicants will be required to take charge of a group and to be responsible for one or more aspects of the system. The posts are permanent and progressive and a staff pension scheme is in operation. Applications to Dept. C.P.S., 356-7, Strand, W.C.2, quoting ref. 1160B. [2115]

MARCONI INSTRUMENT Co., Ltd., St. Albans. VACANCIES exist for both Senior and Junior Electronic Engineers with this well-known company. The vacancies which arise from an expansion of the company's business, cover a large field. Applications are particularly welcomed from young graduate engineers who have had some industrial experience. For the junior vacancies the minimum technical qualifications required is the City and Guilds Final Certificate in telecommunications. The posts are both pensionable and permanent which will be treated with the strictest confidence, should be sent to Dept. C.P.S., 356-7, Strand, London, W.C.2, quoting Ref. No. S.A.34A. [2211]

THE STEEL COMPANY OF WALES, Ltd. (Tinplate Division), Trostre Works. ELECTRONIC technicians required for maintenance of various types of industrial electronic control, consideration will be given to applicants without experience in the above, but with at least five years' experience in the radio industry on maintenance; excellent wages and working conditions in modern cold reduction plant.—Applications, giving details of age, qualifications and experience, should be submitted to: THE Supt. Labour and Wages, The Steel Company of Wales, Ltd. (Tinplate Division), Carmarthen Rd., Swansea. [2225]

TECHNICAL Instructor (Broadcasting) required by the NIGERIAN Government on contract for two tours of 12-15 months; possibilities of permanence, salary, etc., according to experience in scale £1,170 rising to £1,269 a year; outfit allowance £60; free passages for officer and wife and assistance towards cost of children's passages or grant up to £150 annually for their maintenance in this country; liberal leave on full salary; candidates must have been employed at the B.C. Technical Training School at Evesham and have reached Grade C minus or above. WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30305/W.F. [2266]

METROPOLITAN Ear, Nose and Throat Hospital, 14-16, Granville Place, London, W.1. (A HOSPITAL of the Fulham and Kensington Group.) HEARING Aid Technician required immediately. (Temporary post in first instance.) National salary scales and conditions. APPLICATIONS, giving full particulars, should be made to the Administrative Officer (WW156) immediately. [2258]

APPLICATIONS are invited from Senior Development Engineers with experience in any of the following fields:—
1. V.H.F./U.A.F., including tuners, for television and for communications equipment.
2. TELEVISION receiver design.
3. VARIABLE capacitors.
4. RELAYS and switches for special circuit applications.
APPLICANTS should possess an engineering degree or equivalent qualification and have experience in industry or one of the technical establishments engaged on this type of work. Initial salaries will be in accordance with qualifications, experience and age. The appointments are of a permanent and progressive nature and a company pension scheme is in operation.
APPLICATIONS, which will be treated in strictest confidence, should be addressed, quoting reference WW/844, to Box 2347. [2249]

FERRANTI, Ltd. (Computer Dept.), Moston, Manchester, have vacancies for the following:—
(1) ELECTRICAL Engineers possessing at least a good Honours Degree for development work on large-scale electronic digital computers. Ref.: DCD
(2) ELECTRICAL Engineers of approximately graduate status to be trained for the maintenance of the Ferranti computers. Experience in the servicing of large electronic equipments such as radar systems would be an advantage. Successful applicants would be based on the Moston factory but should be free to travel in the normal course of their work as maintenance engineers.
THE work might also be regarded for some candidates as post-graduate training in electronic equipment prior to joining the development sections of the department. Ref.: DCM. PERMANENT staff appointments with pension benefits. Application forms on request from Mr. R. J. Hobbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. [2095]

THE WORLD'S LOWEST PRICED TEST GEAR SUPPLIED IN KIT FORM READY CALIBRATED



RES./CAP. BRIDGE

SIX RANGES
10 to 1,000 ohms.
1,000 to 100,000 ohms.
50,000 to 5 megs.
500Ω to 0.1mΩ.
0.1mΩ to 1mΩ.
2mΩ to 50mΩ.

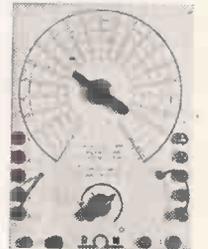
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NO CALIBRATING NO METAL WORK JUST ASSEMBLE AND USE

INDUCTANCE BRIDGE

FIVE RANGES

50 μHy to 1,000 μHy
1,000 μHy to 20 MHy
20 MHy to 400 MHy
400 MHy to 8 Hy
5 Hy to 100 Hy



42/6 P & P 1/6

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THE R.M. TWIN MULTI-OHMMER

A Heavy Duty 2,000 Ω w/v variable, calibrated in 50 ohm steps, plus all useful fixed resistance values up to 7 megs, switched. Separate outlets for each function.

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I.F. ALIGNER

Fully screened. Tunes over the 465 kc/s range of I.F. frequencies.

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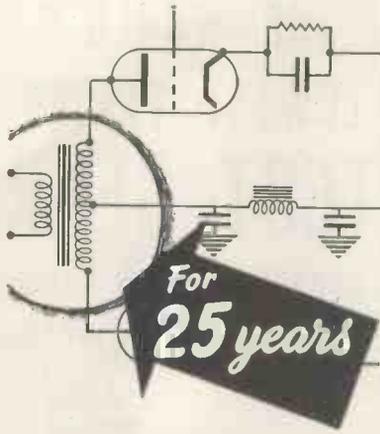
PRE-TUNED NO METAL WORK JUST ASSEMBLE AND USE

SIMPLE AND COMPREHENSIVE INSTRUCTIONS AND DIAGRAMS FOR ASSEMBLY AND USE WITH EACH OF THESE FAMOUS KITS. CASH WITH ORDER OR C.O.D.

FULL INSTRUCTIONS AND DIAGRAMS FOR ANY KIT SUPPLIED SEPARATELY. PRICE 1/6 POST PAID. 5/- FOR THE SET OF FOUR. STAMP FOR ILLUSTRATED LEAFLETS.

RADIO MAIL

DEPT. D, RALEIGH ST., NOTTINGHAM



Enthusiastic amateur and experienced research workers send testimonials of Savage accuracy and reliability. Here is one of many.

*A transformer and 2 chokes of your make purchased about 1932 are still doing yeoman service. T. F. MacD., London"

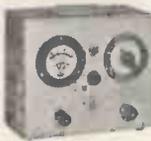


SAVAGE TRANSFORMERS LTD.
Nursted Road, Devizes, Wilts.
Telephone: Devizes 536.

NEW! Easco HOME BATTERY CHARGER

For 12, 6 or 2 volt batteries
Charging Rate 2 1/2 Amp.

Price Only £5.15s.



EASCO ELECTRICAL LTD. Dept. W.W.
Brighton Terrace, S.W.9
Phone/Grams: BRixton 4961-2-3.

EUREKA & CONSTANTAN RESISTANCE WIRES

Prices per ounce					
SWG	Enam.	DASC.	SWG	Enam.	DASC.
16	1/6	1/6	28	2/1	2/6
17	1/6	1/6	29	2/2	2/6
18	1/6	1/6	30	2/2	2/6
19	1/6	1/6	31	2/3	2,8
20	1/6	1/6	32	2/3	2,9
21	1/6	1/6	33	2/4	3/-
22	1/6	1/8	34	2/6	3/-
23	1/6	1/10	35	2/8	3/3
24	1/8	2/-	36	2/9	3/6
25	1/10	2/2	37	3/-	3/9
26	2/-	2/4	38	3/3	4/3
27	2/-	2/4	40	3/6	4/9

COPPER WIRE

ENAMELLED		TINNED		
SWG	2ozs.	4ozs.	2ozs.	
16	1/4	2/-	1/4	2/-
18	1/4	2/2	1/4	2/2
20	1/5	2/4	1/5	2/4
22	1/6	2/6	1/6	2/6
24	1/7	2/8	1/7	2/8
26	1/8	2/10	1/8	2/10
28	1/9	3/-	1/9	3/-

SEND STAMP FOR LIST. TRADE SUPPLIED
POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4

SITUATIONS VACANT

ELECTRONICS Division of Murphy Radio have vacancies in their design unit at Ruislip for:
1. **PHYSICS** or electrical engineering graduates preferably with experience of electronic design.
2. **DRAUGHTSMEN** with experience in this field.

APPLICATIONS should give full details of experience and qualifications and may be addressed in confidence to Personnel Department, Murphy Radio Limited, Welwyn Garden City when arrangements will be made for suitable applicants to be interviewed at the Ruislip Works. [2258]

RADIO testers required, some **V.H.F.** experience desirable together with some servicing knowledge on domestic or service equipment. **MODERN** factory pleasant working conditions; single board available.

APPLY in writing, with full details of past experience, to Personnel Manager, Pye Telecommunications, Ltd., Ditton Works, Cambridge. [2280]

TELEVISION and radio engineer required, good appearance, conversant with all makes and able to drive.—Write Maurice Richards, Ltd., Radio House, Leatherhead, Surrey. [2305]

KELVIN & HUGHES, Ltd., Barking, Essex have vacancies for research engineers for experimental work relating to underwater sound apparatus.

APPLICANTS should be of degree standard and should have a sound knowledge of communications, in particular electronics.

APPLICATIONS, stating salary required, should be addressed to the Personnel Manager, Kelvin & Hughes, Ltd., New North Rd., Barking, Essex. [2278]

RADIO and Radar Engineers required for work in test department, preference will be given to radio engineers with experience of testing communication receivers, or **RADAR** Engineers with experience on H/S aircraft equipment.

SUCCESSFUL applicants will be employed as testers, and must be capable of working with a minimum of supervision.

ATTRACTIVE conditions and rates to successful applicants. **APPLY** in writing, or phone to Airtech, Ltd., Aylesbury and Thame Airport, Haddenham, Bucks (Tel. Aylesbury 1163). [2325]

SALES Manager required, electronic equipment for services and industry, engineering background essential; London exceptional opportunity for young man.—Box 426. [2263]

TV service engineer wanted Heston, Middlesex; good salary, permanency; must drive, good appearance and ability; inside and outside work; progressive situation.—W. A. Fowler, 331, Vicarage Farm Rd., Heston. [2247]

TELEVISION engineer required, fully experienced, able to drive; permanent, progressive position; £600 p.a.—Full particulars to Central Radio, Ltd., 15, Langley Rd., Eastbourne. [2503]

TELEVISION—RADIO service engineer required, used to all makes of TVs; cleanliness, flat available if required.—Write, stating experience, wages, Paynes, 11, Ford St., Coventry. [2274]

FIRST-CLASS car radio mechanic required by Rootes Group distributors, good salary and prospects, permanent position; apply in writing in first instance with copies of references.—Kirbys, Ltd., 45, Duke St., Liverpool. [2284]

TELEVISION—RADIO, 1st engineer required to take charge of service, ability to drive an advantage; old-established firm London, N.W.3; salary in accordance with abilities; permanency.—Box 2496. [2281]

ELECTRONIC engineers required for research and development work on the application of electronic digital computing techniques to business accounting machines; there are vacancies for the following:—

(i) **UNIVERSITY** graduates with Honours Degree in Physics or Electrical Engineering; 1 or 2 years' experience in electronic research and development field an advantage but not essential.

(ii) **ENGINEERS** holding Higher National Cert., Ordinary National Cert., or similar qualifications, and with practical experience of electronic equipment.

APPLICANTS without academic qualifications would be considered if they have had experience of electronic equipment, preferably of pulse techniques as used in digital computing, radar, etc.; salaries will be based on qualifications, experience and age.—Applications, stating age, qualifications, experience, etc., to Personnel Office, British Tabulating Machine Co., Letchworth, Herts. [2142]

SENIOR position in servo analysis group (A) working on guided weapon control systems; applicants should hold honours mathematics degree, have some experience in servo mechanism systems or electrical engineering; age 28 to 32 approximately.

ELECTRONIC engineer (B) with desire to produce instructional literature on new product; engineering background, diplomatic approach and command of words more important than knowledge of printing; will ultimately function as technical editor in charge of section of publications department.

PLEASE write in detail quoting reference of post sought to Personnel Manager, de Havilland Propellers, Ltd., Hatfield, Herts. [2151]

RADIO REPAIR SERVICES
WOOL, DORSET

- 1. AC 5 v. Chassis 14in. W. x 5 1/2in. D. x 2in. H. 2/-
 - With valve holders (Octal) fitted 4/-
 - 2. AC/RG 6 v. chassis 10 1/2in. x 7 1/2in. x 3 1/2in. With valve holders fitted 4/6
 - 3. AC/DC 5 v. chassis 10 1/2in. x 5 1/2in. x 2in. With valve holder fitted 4/-
 - 4. AC/DC 5 v. chassis 9in. x 5in. x 1 1/2in. With valve holders fitted 3/6
- CABINETS** to fit Chassis 1, 16in. x 7 1/2in. x 11in., 27/6.

- SCALE AND BACK PLATE:**
- To fit Cabinet and Chassis 1 3/6
 - To fit Cabinet and Chassis 2 2/-
 - To fit Cabinet and Chassis 3 2/-
 - To fit Cabinet and Chassis 4 1/6

REVERSE VERNIER DIAL DRIVES (post paid) 1/9

TRIMMING SCREWDRIVERS (non-metallic) (post paid) 1/-

- AMPLIFIERS**
- 2 watt AC/DC, with valves £3 0 0
 - 2 watt AC, with valves £3 10 0
 - 4 watt AC, with valves £4 0 0

RECEIVERS as Chassis above complete (new) Superhet. State AC or DC.

- 2 Waveband £7 0 0
- 3 Waveband £8 10 0

RECEIVERS as Cabinet above, 3 v. and Rect. T.R.F.

- 2 Waveband £6 0 0

Post and packing up to £2, one shilling. Over, post free. Terms C.W.O. or C.O.D. **MONEY BACK GUARANTEE.**

Minifix Aerial with 25ft. of lead-in wire, 7/6. Fire Guards for slow-burning fires from 12/6. State 12in., 14in. or 16in. when ordering. Orders for wire-work taken against specifications.

Converter Units. 3-valve Superhet. Convert your single channel TV to your area Station. E.G. Wenvoe on London set. Unit costs £7/10/-.

BASS REFLEX CABINETS

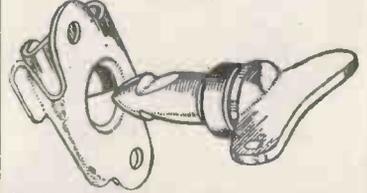
Walnut, Mahogany or Oak veneered, 30" high For 12-in. Speakers, 10-in. Speakers, 8-in. Speakers
Prices £10.0.0 £9.10.0 £9.0.0 carr. paid

CORNER CABINETS for Goodmans Axiom 150 Mk. 11 veneered and french polished £16.0.0 carriage paid. Without finishing mouldings £1.0.0 less.

A. DAVIES and Co. (Cabinet Makers), 3 Parkhill Place, off Parkhill Road, London, N.W.3. (Gulliver 5775)

ODDIE FASTENERS

PAT. 507249



THIS FASTENER WITH ENDLESS APPLICATIONS—SIMPLE—POSITIVE SELF-LOCKING. MADE IN A VARIETY OF TYPES AND SIZES.

SPECIAL FASTENERS TO SUIT CUSTOMERS' REQUIREMENTS.

WIDELY USED IN THE RADIO INDUSTRY.

Illustrated brochures and other information will be gladly sent on request. DEPT "W.W."

Oddie, Bradbury & Cull Ltd., Southampton
Tel.: 55883. Cables: Fasteners, Southampton

SHORT WAVE RECEIVERS R103a. For use on 100/110 volts 230/250 volts A. and 12 volt battery. Comprising six valves and built in vibrator unit Covering 1.7 mc/s. to 7.5 mc/s. Brand new In perfect working order £9/15/- plus 5/- carriage.

BRAND NEW AND BOXED METERS AS UNDER.

0/3500 volt meters D.C. Moving Coil 3in. scale 4in. stand off 20/- each.
0/6 amp. Therm Couple 2½in. flush, 7/6 each.
0/30 M/a Moving Coil D.C., 10/- each.
0/15 Volt A.C. Moving Iron 2½in. Flush 15/- each.
0/300 M/a. Moving Coil D.C. 2½in. Flush, 10/- each.
0/200 M/a. Moving Coil D.C. 2½in. Flush, 10/- each.
0/1 M/a. Moving Coil 2in. square, 15/- each. Postage 9d. extra on all meters.

LOUDSPEAKING TELEPHONE UNITS. These units are complete with 1 Large Press Button TRUVOX Carbon Mike and C.L.R. Headphones. Working off 12 volt battery can be used to speak to four positions at the same time. Brand new in cases at only £1/15/-, carr. free.

BUZZER VALVE UNITS Type 2. Can be used as Morse Training Aids with facilities for Interference input. Less valves (2) 7/6 each, carr. free.

SIGNALLING TORCHES. Still a few available at 3/9 each, post 9d.

CUT-OUTS. 12 and 24 volt 60 amp., as previously advertised, 10/- each, post 9d.

0/50 A.C. MOVING IRON 4in. PANEL MOUNTING METERS. Last few now offered at the knock-out price of 17/6 each, post 1/-.

TELEPHONE OPERATOR HEAD AND BREAST SETS. Twin Phones No. 2, 12/6 each, post 1/-.

TAPE DECK CABINETS. Finished in Imitation Lizard Skin. Colours Green, Red, Grey, Blue, Brand New, with space for amplifier, £3/12/6 each, Carriage 2/-. Please state alternative colour.

SOLDER. 1lb. reels of 40/60, 5/- per reel, post 1/-.

EARPHONES. 60 Ohm. C.L.R., 5/- pair, and 4,000 Ohm, 17/6 pair, post 1/-.

JONES PLUGS. 8-way chassis mounting, 7/6 doz. 8-way with covers, 9/- doz., 4-way chassis mounting, 6/-, post 9d. doz.

JONES SOCKETS. 8-way chassis mounting, 7/6 doz. 8-way with covers, 9/- doz. Post 9d. doz.

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RADIO service mechanics required by Smiths (Radiomobile), Ltd., for all parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [0342]

McMICHAEL RADIO, Ltd., require experienced radio technicians for the inspection, testing and servicing of Government radio and electronic equipment.—Apply to Personnel Manager, Wekham Rd., Slough, Bucks. [2129]

ARE you seeking a well paid permanent situation, with congenial conditions of employment? We have vacancies for television and radio engineers at our Service Dept.—Apply James & Adams Ltd., 1064, High Rd., Whetstone, N.20. Hillside 5555. [2315]

DRAUGHTSMAN required immediately for light electrical engineering factory, Stockport district; must be experienced in electronic instruments and test gear; 5-day week, canteen facilities; write stating salary required and qualifications.—Box 2603. [2326]

FIRST-CLASS public address engineers required by leading company for London and Home Counties; good remuneration to right men; own car an advantage.—Apply Tannoy Products, Ltd., West Norwood. Gipsy Hill 1131. [2298]

RADIO and television engineer required for old-established firm, high wages and permanent position for suitable applicant; all applications considered.—Apply A. Hartill & Sons, Ltd., 8-12, Mount Pleasant, Bilston, Staffordshire. [2152]

RADAR engineering.—Two important vacancies exist on the permanent staff of an influential company concerned with high priority production and installation in Huntingshire of radar systems, much of which involves American equipment. **BOTH** positions are progressive, pensionable and well salaried.

THE first is for a production controller (Ref. P.C.), who should already have had first-class experience of a similar nature and be thoroughly conversant with radar and/or radio engineering production of a high order; he will be a competent executive who knows assembly line production, can handle production layouts, in fact all aspects of this highly important function.

THE second vacancy concerns a production engineer (Ref. P.E.), who has already established his abilities in an efficient, well organized production unit, and who has an intimate knowledge of detailed engineering production in the radar/radar field.

APPLY, quoting above references, in strict confidence, to Box 2488. [2271]

YOUNG graduate engineers are invited to apply for interesting positions with The English Electric Valve Co., Ltd., at Chelmsford; experience of microwave work whilst desirable is not essential.—Write, quoting ref. 4195, to Dept. C.P.S., 336-7, Strand, W.C.2. [2256]

TECHNICAL Representative required in London area to deal with electronic instruments for marine purposes (not navigational or radio equipment); basic knowledge of physics and electronics essential; degree an advantage.—Box 2420. [2262]

ACOUSTICAL vibration general engineers for a new acoustic and physical laboratories; experienced men wishing to specialise in either or both subjects, please apply stating qualifications, age, salary required.—Goodmans Industries, Ltd., Axiom Works, Wembley. [2265]

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wiremen and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. 0258

DRAUGHTSMEN, experienced, required by Decca Radar, Ltd., for permanent posts in the expanding field of radar engineering; excellent opportunities for advancement exist, the salary ranges being well beyond A.E.S.D. rates; staff pension scheme; British nationality essential.

POSTS are to be filled in the following grades: Senior section leader, checker draughtsman and senior design draughtsman; intermediate draughtsman; circuit draughtsman; installation draughtsman.—Apply ref. R.D.J., Decca Radar, Ltd., Radar Research Laboratory, 2, Tolworth Rise, Surbiton, Surrey. [2050]

ELECTRONIC engineers with practical factory experience and technical training, preferably up to H.N.C. standard, required for liaison and development work on radar and allied equipment; staff and pensionable positions.—Apply to Personnel Dept. (OE/18), E.M.I. Factories, Ltd., Hayes, Middx. [2252]

RADIO and radar testers, first-class men required for work on V.H.F. communication gear and government contracts for radio and radar equipment by Midland manufacturers.—Men with wide experience of fault finding in any of the fields mentioned should write, giving full details, to Box 1562. [2046]

APPLICATIONS are invited from craftsmen for radio and television service in areas within Herefordshire and Shropshire; applicants must be fully experienced in the repair and maintenance of all types of radio and television receivers; rate of pay at present 3/8 per hour, N.J.I.O. conditions.—Apply in writing to Sub-Area Manager, Midlands Electricity Board, Ditherington, Shrewsbury. [2307]



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SITUATIONS VACANT

EXPERIENCED fault-finders wanted by Midland manufacturers of radio equipment; permanent posts located in the Midlands are offered to men with experience of radar, radio control, V.H.F. equipment.—Write, stating fully experience and salary required, to Personnel Manager, Box 1565 [2047]

DEVELOPMENT engineers required by Short Brothers & Harland, Ltd., Belfast, for work on Guided Weapons and other interesting projects; ideal conditions in new laboratories for applicants with a degree or equivalent, and good practical experience in one of the following fields:—

(1) **ELECTRONICS**, preferably D.C. Amplifiers, Electronic Computation, Pulse Techniques or Miniature Equipment.

(2) **SMALL Electro-Mechanical Devices, Servos or Instruments.**

(3) **PRECISION Mechanical Engineering**, including Hydraulic or Pneumatic Servos, Medium/Light Mechanisms or Instruments.

GOOD salaries and prospects for men with initiative. **PENSION** scheme, assistance with housing. **SEND** full particulars of age, qualifications and experience, with salary required, to Short Brothers & Harland, Ltd., Precision Engineering Division, Castlereagh, Belfast, quoting Ref. No. E.3. [2071]

TECHNICAL sales engineer possessing the ability to interpret electronic circuits is required by a large radio and electronic component manufacturing firm; this post offers excellent opportunities to a man of the right calibre.—Applicants who should be over 30 years of age, please reply to Box 2207. [2159]

ACOUSTICAL MANUFACTURING Co., Ltd., Huntingdon, require an electronic engineer for building A.F. equipment up to 1 K.W.; technical knowledge and experience essential, including some knowledge of sheet metal work involved; permanent position for suitable applicant. [2302]

EXPERIENCED radar, radio, or electrical control equipment mechanics required for maintenance of Anti-Aircraft equipment in South Wales, Midlands and North West, ages £7/7 to £8/9, minimum age 21 years.—Application forms from O/C, 4 A.A. Group Workshops, R.E.M.E., Deysbrook Lane, Liverpool, 12. [2320]

TELEVISION production engineer is required by a large company on Merseyside. Knowledge of radio and television manufacturing techniques with particular reference to the production of television receivers is essential.—Reply stating age, experience and qualifications to Box 2549, quoting ref. ABAD. [2289]

PRODUCTION manager who has considerable experience in the production of all types of paper dielectric capacitors is required by a large and well-known firm; this position carries high remuneration, and only men of proved ability should apply.—Applicants reply, in confidence, to Box 2206. [2158]

YOUNG electronic engineer required for development of equipment for the measurement of stress and vibration in rotary and fixed-wing aircraft. Degree desirable. Applications, with details of training and experience, should be made to the Personnel Manager, The Falrey Aviation Co. Ltd., Hayes, Middx., quoting reference TO/1. [2108]

THE M.S.S. Recording Co., Ltd., Poyle Close, Colnbrook, Bucks, have a vacancy for a technical assistant required for electronic development work on magnetic recording equipment; practical experience or knowledge of mechanical design an advantage.—Apply in writing, stating age, qualifications and experience to the above address. [2192]

SALES office manager, age 30-40, required to run small sales office, part of a large established business in Wiltshire, must be capable of handling customer's telephone enquiries, etc.; knowledge of radio an advantage; good prospects and opportunities; write stating age, past experience and salary required to—Box 2495 [2282]

LARGE firm of telecommunication engineers (East London) require a junior capacitor engineer; successful candidate will be trained in the design of capacitors for a wide variety of applications; ordinary National Certificate or Inter. B.Sc. in physics or engineering essential; salary according to age and experience.—Write, giving full details, to Box 2372. [2255]

ELECTRONIC engineer B.Sc. or H.N.C. for laboratory development work on miniature equipment using transistors; work in Slough/Marlow area; 5-day week; canteen; pension scheme; wide scope for energetic, versatile man with progressive ideas.—Full details of age, experience, salary required to Box M.1069, Haldens, Salisbury Sq., E.C.4. [2254]

THE Brown's Lane division of the G.E.C. Stammers laboratories urgently require a man for work in connection with radar development; a suitable applicant should have a knowledge of service procedure and a general, rather than specialized, knowledge of electronics; a degree or equivalent qualification is desirable, but a well-experienced man would be considered.

APPLICATIONS should be made in writing to the Staff Manager (Ref. R/BSP/AMMV), G.E.C. Stammers Laboratories, Brown's Lane Division, The Grove, Stammers Common, Stanmore, Middlesex, stating age, qualifications and experience. [2279]

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SERVICE engineers required for installation, flight testing, and servicing of aircraft navigational and auto-pilot equipment; applicants must be prepared to travel; essential to have sound knowledge of radio and electronic principles and practice, preferably to C. and G. Radio III standard; good conditions, pension scheme.

APPLY, with full details and salary required, quoting No. 1439, to Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middx. [2259]

PHYSICIST required to take charge of a development group on valve manufacture in London area; applicant should have some engineering background and a pronounced ability in administering a development group, age 30-35; salary £300-£1,000 to commence; give full details of qualifications and experience—Apply Box 2458. [2268]

DRAUGHTSMEN required. Electronic instrument, or radio experience. Salary according to qualifications. Saturday interview if required. Opportunity to broaden experience with reputable firm. Near City centre and all amenities. With easy access of London.—Marconi Instruments, Ltd., Longacres, Hatfield Rd., Albans. [2209]

ENGINEERS required for (a) maintenance and design of electronic test equipment, and (b) for quality control and investigational work on radio valves and other electronic devices; Inter B.Sc. or Higher National Certificate standard.—Write, giving experience and salary required, to Personnel Superintendent, The Edison Swan Electric Co., Ltd., Cosmos Works, Brimsdown, Enfield, Middlesex. [1966]

ELECTRO-ENCEPHALOGRAPHY recordist. Grade II, is required at Royal Edinburgh Hospital for Mental and Nervous Disorders, Morningside, Edinburgh; qualifications necessary and salary to be paid will be as laid down by Whitley Council.—Applications, with references, should be sent now to the Physician Superintendent, stating age and details of previous experience. [2297]

FIRST-CLASS television field and workshop engineers required, fully experienced on all popular current models, in the following areas: York, Leeds, Leicester, Banbury, Stratford, Slough, Southampton; attractive salary and congenial working conditions are offered to top grade men.—Apply to Personnel Manager, Belcher (Radio Services), Ltd., 59, Windsor Rd., Slough, Bucks. [2324]

MITCHAM WORKS, Ltd., require a graduate for development work in radio and television; applicants should have 5 years' experience in radio work.—Applications, with references and experience but not less than £650 p.a.—Applications, in writing, should be addressed to the Personnel Officer, Mitcham Works, Ltd., New Rd., Mitcham Junction, Surrey, quoting reference R.2. [2296]

RADIO and television service engineer required for work on domestic receivers by a progressive organization with central service depot in Bedford; vacancies also at branches in Hitchin, Northampton, Kettering and Luton; good working conditions; financial compensation by salary, and bonus scheme for energy and initiative; housing assistance provided for suitable applicants.

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SENIOR and junior engineers required for responsible work in radio and television laboratories, applicants for senior position should be able to undertake development work with minimum supervision; excellent conditions and salary available for applicants who are accepted.—Apply in first case to Personnel Manager (Dept. R.D.), Michael Radio, Ltd., Wexham Rd., Slough. Applicants must be of British nationality. [2021]

THE ENGLISH ELECTRIC CO., Ltd., Luton, have a vacancy for a designer of low power (up to 1kw) low frequency transformers and chokes; previous experience very desirable and applicant should be thoroughly familiar with winding and impregnation processes; varied interesting work, involving development of a number of designs for small quantities.—Applications to Dept. C.P.S., 336-7, Strand, W.C.2 quoting Ref. 137A. [2064]

ELECTRONIC INSTRUMENTS, Ltd. of Richmond, Surrey, has a vacancy for Chief Inspector; applicants must have sound practical experience in testing mechanical and electronic apparatus, together with administrative ability; a key post in expanding firm; application in first instance by letter giving full details of experience and salary; junior posts also available for electronic engineers, aged 23 upwards, having H.N.C. or equivalent qualification. [2269]

CHIEF Engineer, microwave link development; Decca Radar Limited is creating an appointment at the rank of chief engineer, to lead a growing division engaged in the development and exploitation of microwave link systems; the successful applicant must have held, in either this or closely allied fields, considerable industrial experience at a senior level; this experience must provide evidence of a faculty for leadership, organising ability and a capacity for drive; British nationality is essential; a starting salary commensurate with the level of the appointment will be paid.—Replies, which will be treated as strictly confidential, should be addressed to the Research Director, 2 Tolworth Rise, Surbiton, Surrey. [0450]

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MURPHY Radio require an engineer for the design and development of specialised electronic apparatus making use of the latest developments in circuit technique; the salary of £650 p.a. and upwards will be paid to one having the necessary qualifications.—Applications, giving full details of experience, etc., may be forwarded in confidence, to Personnel Dept. (A2), Murphy Radio, Ltd., Welwyn Garden City, Herts. [2286]

METHODS engineers required for senior positions in expanding manufacturers, S.E. London; principal duties concern radio and TV line layout; preference given to those with job study experience; to right applicants these will prove permanent and progressive posts with commensurate salaries and experience of competence with full particulars and salary required, Box D B.2221, A.K. Adv., 212a, Shaftesbury Ave., London, W.C.2. [2285]

SERVICE engineers required by cinema sound equipment company for duties in London area; applicants must have practical ability and good general knowledge principles of electricity and audio amplifiers; clean driving licence and reliable telephone contact essential; salary to scale £400-£500 plus car allowance and expenses; state age, education, experience and whether car and telephone available.—Box 2497. [2283]

LABORATORY technician (male), age 20-23 years, required for physics; commencing salary up to £360 per annum, according to age and qualifications; the post is a temporary one, but if a person suitably qualified for long maintenance should prove satisfactory, there is a possibility of permanence at a later date on a higher salary.—Written applications should be addressed to Head of Department of Physics, Chelsea Polytechnic, Manresa S.W.3. [2276]

BRITISH Relay Wireless and Television Group of Companies have vacancies for television and radio engineers in grades offering wage rates between £7/15 and £10 per week. Applicants should consider their appointment a stepping-stone in a career offering excellent opportunities. Superannuation scheme and active sports and social club. Apply in writing, stating radio experience and qualifications, to British Relay Wireless and Television, Ltd., 397, Albany Rd., S.E.5. [2312]

McMICHAEL RADIO, Ltd., require senior and junior engineers in their equipment division laboratory at Slough; training and experience in the field of applied electronics (including communications) and experience of working with Government Departments are the chief qualifications required.—Write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [0198]

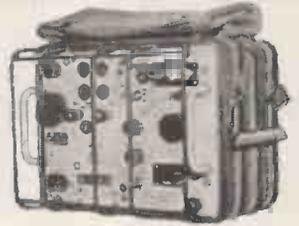
FILTER design group of Automatic Telephone & Electric Co., Ltd., Liverpool, has vacancy for engineer to deal with the problems associated with quantity production of electrical wave filters; previous experience in this or similar work is essential and a degree in engineering or physics is desirable; permanent staff position with contributory pension fund and usual staff conditions.—Write to Personnel Manager, Automatic Telephone & Electric Co., Ltd., Edge Lane, Liverpool 7. Give full details of experience, qualifications and age. [2150]

SALES representative, young, London resident, conversant with design and manufacture of Fixed Capacitors, required by manufacturers with London Head Office; preference given to man with established connections in the radio and electronics industries and who has had actual production experience of all stages of fixed capacitor manufacture must have a clean driving licence, car owner preferred.—Write fully stating age, experience, married or single and salary required to Box 2551. [2292]

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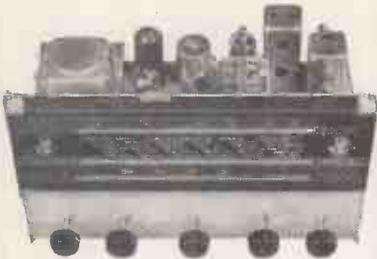
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TELEVISION trouble shooters are offered an opportunity to train as maintenance and development engineers of electronic test gear with a large manufacturer in East London; the posts, which are permanent and pensionable, will provide experience on all types of test gear connected with radio, television and radar equipment and there are exceptional prospects of promotion; the company works a 5-day, 40-hour week, and has excellent canteen and sports facilities.—Write, quoting reference WW/843, giving full particulars of previous experience, to Box 2348. [2250]

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Coventry, requires senior and junior electronic development engineers for work on guided weapons and like projects, particularly in the field of microwave and pulse applications; mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments, also required for the above projects; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager (ref. R.G.). [0259]

MURPHY RADIO have the following vacancies in their Electronics Drawing Office: (1) Senior Designer-Draughtsman, applicants must be of H.N.C. standard, fully experienced and capable of leading a design team. (2) Senior Draughtsman who must have considerable experience of Electronic Equipment and Ministry Contract procedure to work as Drawing Office checker. (3) Senior Draughtsman experienced in Ministry Contract procedure of Electronic Equipment as a modification draughtsman. Applications should include full details of experience and qualifications, age and salary required and may be forwarded in confidence to P.D. (EEDO), Murphy Radio, Ltd., Welwyn Garden City. [2291]

SPECIFICATION engineers are required by Marconi's Wireless Telegraph Company, Ltd., Chelmsford; these engineers will be expected to consult heads of design and production units and reflect their requirements in purchasing and user specifications based on B.S. or other national codes of practice; men of sound experience of this type of work are needed but additionally, consideration will be given to young candidates possessing some design or production engineering experience, together with qualifications up to H.N.C. or degree standard; the appointments are permanent and offer scope for advancement; pension scheme; good salaries will be offered dependent upon qualifications and experience.—Please apply, giving full details and quoting reference 881A, to Dept. C.P.S., 356-7, Strand, W.C.2. [2257]

VACANCIES for engineers and draughtsmen of senior and intermediate grades exist at the Ilford works of The Plessey Company for development work on components and mechanisms for radar, television and communications equipment; these vacancies occur as a result of the enlargement of the laboratories to permit a substantially increased interest in the design of circuits and components for specific applications; all positions are permanent and pensionable and the expansion now in progress offers good prospects of advancement; salaries are progressive and attractive initial salaries are offered to men who are qualified by reason of educational attainment or practical experience.—All applications will be dealt with in confidence and should be addressed, quoting reference WW/845, in the first instance, for the attention of the Personnel Manager. [2248]

ADMIRALTY—Royal Naval Scientific Service. Engineers and Physicists (particularly with electronics) required for appointments in Experimental Officer and Assistant Experimental Officer grades in Experimental Establishments in London, Portsmouth, Weymouth and Gloucestershire Areas and Scotland. Candidates, British Subjects, must possess one of the following qualifications: University degree in Science, Engineering or Maths. Graduate Membership of appropriate professional institute. Higher National Certificate, Final Certificate or five-year grouped course in relevant subjects at City and Guilds of London Institute or comparable institution. Higher School Certificate, General Certificate of Education, Scottish Leaving Certificate, Scottish Universities Preliminary Examination, Northern Ireland Senior Certificate (all in appropriate subjects and at appropriate levels). London salary inclusive of pay addition (men) E.O.S. £681-£858, A.E.O.s (according to age) £274-£507. All appointments are established posts with some opportunities to compete for established posts.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting A. 247/52/A. [2321]

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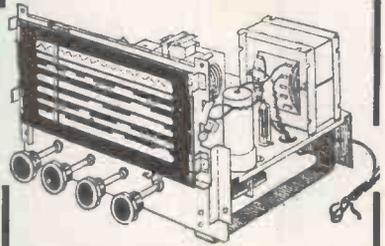
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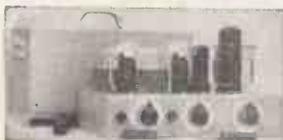
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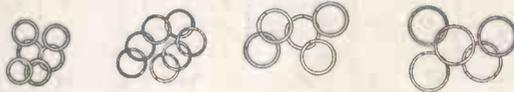
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Cataloge Ref. No.	Alloy Tin/Lead	S.W.G.	Approx. Length per Carton
C 16014	60/40	14	21 feet
*C 16018	60/40	18	55 feet
C 14013	40/60	13	19 feet
C 14016	40/60	16	38 feet

*Specially recommended for television work.



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