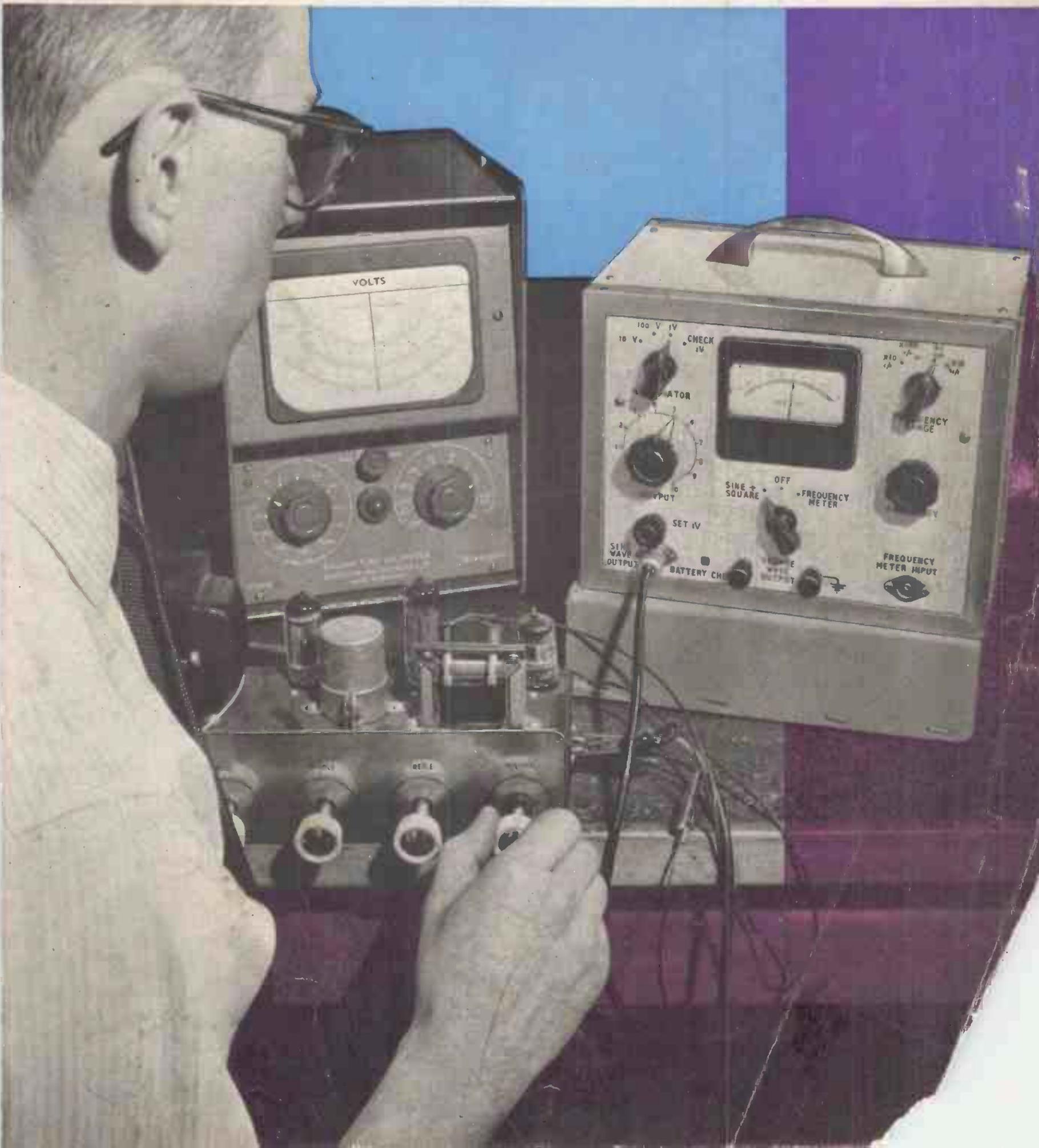


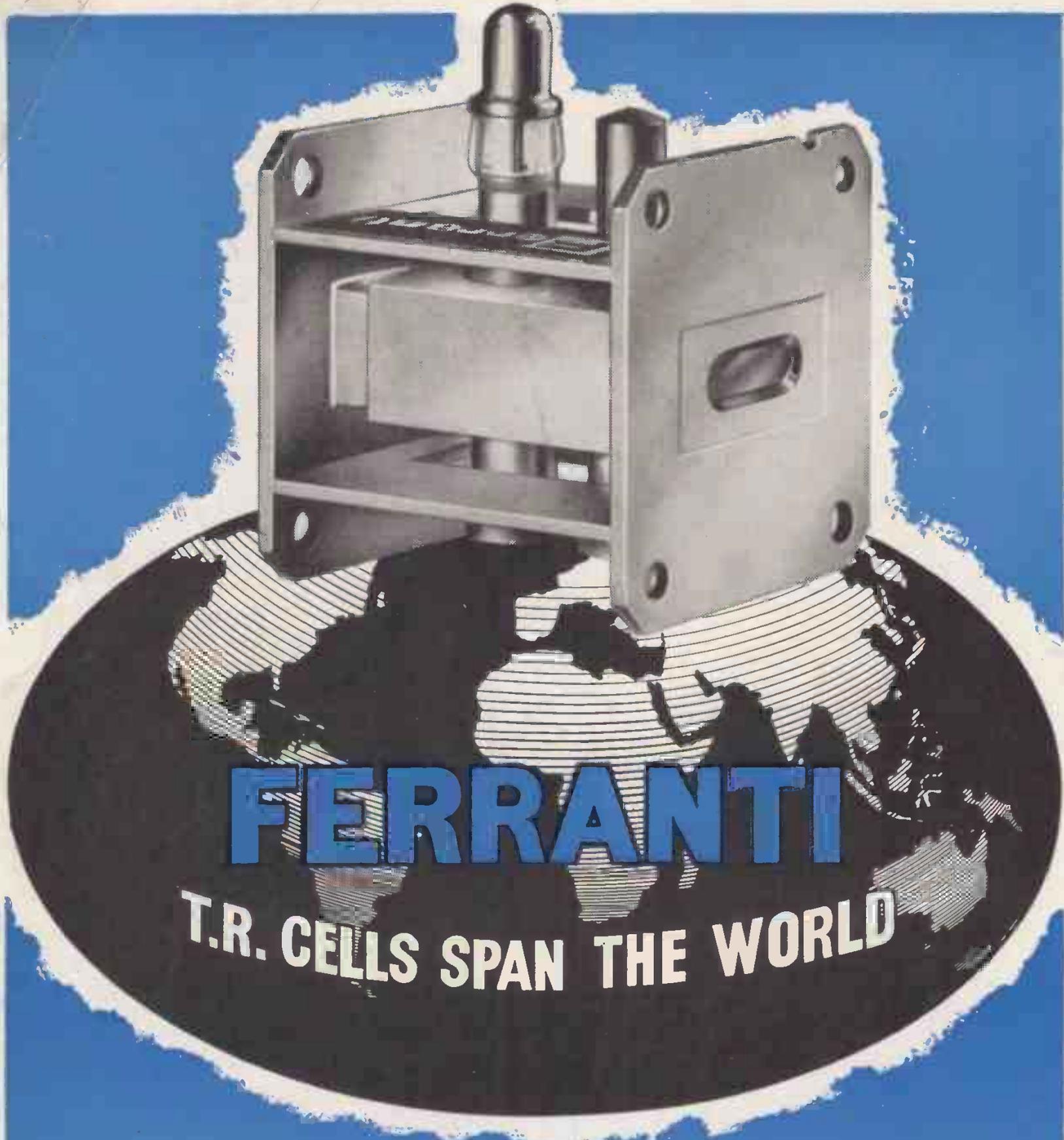
BUILDING AN AUDIO SIGNAL GENERATOR

# Wireless World

ELECTRONICS  
RADIO  
TELEVISION

NOVEMBER 1963 Price Two Shillings and Sixpence





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# Wireless World

ELECTRONICS, RADIO, TELEVISION

NOVEMBER 1963

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# PY88-BOOSTER DIODE

*For Dual-Standard  
T.V. Receivers*

**LINE OUTPUT  
PENTODE  
PL500  
FOR DUAL-STANDARD  
RECEIVERS**

It is important in dual-standard television receivers to ensure that the performance of the line timebase does not deteriorate when the receiver is switched from one line standard to another.

Most of the functions of the line timebase are critical in application and such changes in performance would therefore be noticed by the viewer. Thus consistency in performance must be achieved despite the fact that the energy requirements for 625-line operation are roughly half as great again as those of 405-line operation.

In many new dual-standard receivers, the task of ensuring comparable performance has been simplified by utilising the new Mullard line output pentode, type PL500. This new valve has improved ratings compared

## WHAT'S NEW IN THE NEW SETS

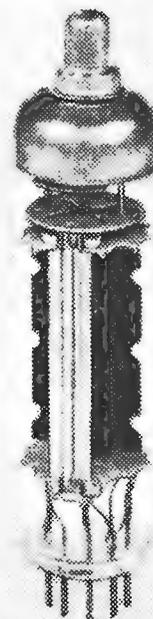
These articles describe the latest Mullard developments for entertainment equipment

with valves previously recommended for 405-line operation. In particular, an exceptionally high ratio of anode current to screen-grid current is achieved by an entirely new form of anode—the 'cavitrapp' anode. With this construction, secondary-emission electrons from the anode—which contribute greatly to the screen-grid current—are recaptured by the partitions of the cavitrapp anode. Because of the improved current ratio, the PL500 is capable of delivering greater deflection power, which helps to prevent any significant change in performance between the two line standards.

**T**HE PY88 is a Mullard television booster diode now to be encountered in the line timebase circuits of switchable receivers, especially in conjunction with the Mullard PL500 line output pentode.

Because of the excellent insulation between the heater and cathode, the PY88 has a high heater-to-cathode voltage rating of 6.6kV. The peak and average anode current ratings of the valve are also high—550 and 220mA respectively—but to achieve these it has been necessary to increase the heater voltage from the 19V required with the PY800 Mullard booster diode to 30V.

With its improved ratings, the PY88 is thus well equipped to meet the more stringent booster diode requirements of 625-line operation, and the valve is particularly suitable for stabilised timebase circuits using the PL500 high-output line pentode.



## COMPLEMENTARY MATCHED PNP AND NPN TRANSISTORS FOR TRANSISTOR PORTABLES

Designed for use in transformerless audio amplifiers, the new Mullard audio frequency package—the LFK3—is now to be encountered in many portable receivers. The output pair of the package consists of the complementary matched p.n.p. and n.p.n. transistors types OC81 and AC127. The p.n.p. driver transistor type OC81D completes the package.

The current amplification factor of the output transistors is greater than 50 at 200mA and 38 at 300mA. The base currents of every pair are matched to within 20% at a collector cur-

rent of 50mA, and each output transistor is cross-matched with the driver transistor to give reduced current gain spreads.

The peak collector current rating of the output transistors is 300mA, which enables an output power of up to 500mW to be obtained using a 9V battery. The sensitivity of the package is such that outputs of up to 100mW can be achieved without a pre-amplifier, and outputs of up to 500mW necessitate only a simple single-transistor pre-amplifier.

MVE1974

## International Exhibitions

THIS year's exhibition report season seems to have produced more than the usual crop. The glut is partly due to the fact that Continental radio shows have become either biennial or erratic and, in spite of much discussion and many attempts to arrive at some degree of rational distribution, are showing klystron tendencies to bunching. Last year there were no shows in Berlin, Paris or Amsterdam; this year they were all back again with some overlap both in time and in the goods exhibited. Paris had followed Amsterdam in opening its doors to foreign competitors, but Berlin awaits reciprocal agreements—notably with London—before admitting other nations' products.

It has often been suggested that instead of national shows there should be a single peripatetic international European radio and television show, but we do not think that this would ever be accepted because, with at least five countries interested in playing host, the gap would be too long to satisfy national requirements. In the U.K. this year's experience, of dropping the national show has taught everyone its importance as an annual sales stimulus at the start of the winter season. We do not think this unfortunate experiment is likely to be repeated.

There is always the possibility of holding national exhibitions annually and expanding each in turn into an international show, but this seems to us to be forcing the issue for the benefit of exhibition organizers rather than for the benefit of buyers or manufacturers. It is permissible to ask why one wants an international exhibition in Europe at all. Certainly it is of interest for the natives of one country to be able, without travelling, to compare the methods of design and quality of finish of other people's goods, but until the Common Market has been running long enough for tariffs to have practically disappeared, and until all countries are participating, a foreign television set or radiogram has to be very good indeed to compete with the indigenous product.

Every industrial European nation has, or could soon acquire, the capacity to satisfy its home market; many have production methods, developed for cutting costs to compete with their own nationals, which give them a vast surplus capacity. This is a world problem and not one special to the radio industry. With home markets within sight of saturation, future markets must be sought in the emergent and developing countries of the world. It is to these spheres of interest that international competition will increasingly be directed and for which international exhibitions will have the greatest attraction.

The venue of international exhibitions can to some extent be decided by the competitive publicity of

exhibition organizers, but in general it is finally settled by inclination, by a consensus of acceptance by visitors. Whether buyers from the expanding overseas markets will prefer to come to Europe to make their decisions or whether they will expect us to demonstrate to their customers on the spot remains to be seen. Meanwhile we learn that one German manufacturer has, in the first nine months of this year, exhibited in no fewer than fourteen exhibitions in Europe, the Americas and north Africa.

## Gatherings of the Clans

The announcement, recorded on p. 549 of this issue that the Institute of Electrical and Electronic Engineers is to open a branch in the U.K. and has obtained the consent of the Institution of Electrical Engineers to use part of their premises at 2 Savoy Hill, London, W.C.2, will be welcomed by all who believe that science (and with certain reservations technology) should be international. It should also give pleasure to sons of the Emerald Isle who have adopted electronics as a career, for the full title is to be the U.K. and Eire Section of the I.E.E.E.

One of the reasons given for the formation of this new Section is that it will provide the nucleus for English language conferences, for which there has been increasing interest throughout the European Region. The International Television Conference held in London in 1962 was a good example of Anglo-American co-operation between the British learned societies, for not only the I.E.E. but also the Brit. I.R.E., the Television Society and the British Kinematograph Society played an active part. No doubt the newly formed I.E.E.E. United Kingdom and Eire section will continue to encourage collaboration with *all* English speaking associations fostering allied interests and also with those of our European friends who favour English as the language for international exchange and pooling of knowledge.

This journal has often deplored the proliferation of conferences and conventions, particularly where this has arisen through mistaken motives of prestige, "empire building" and rivalry between organizations. In our rapidly developing field there is material enough for discussion without unnecessary duplication, and we congratulate the I.E.E.E. on its initiative and the I.E.E. on its magnanimity in providing a home for the new Section. Provided that the declared intention to keep the association on a strictly two-way exchange basis is adhered to, we see no foundation for any talk of takeover bids. Furthermore, the I.E.E.E. is a learned society and not a professional qualifying and regulating body.

# Wireless World



## AUDIO SIGNAL GENERATOR

### TRANSISTOR DESIGN WITH SIMPLIFIED CALIBRATION

**T**HE *W.W.* oscilloscope has been described in recent months, and as one of its main applications is the testing of audio amplifiers, we now introduce a signal source for this purpose. An incidental use for the instrument is the calibration of the oscilloscope, which will be described shortly.

The oscillator covers the range 10c/s to 100kc/s, which is more than sufficient for any audio testing, and square waves are available over the whole range. A constant-impedance ( $600\Omega$ ) sine-wave output is provided by a 40dB step attenuator and a continuous control up to IV r.m.s.

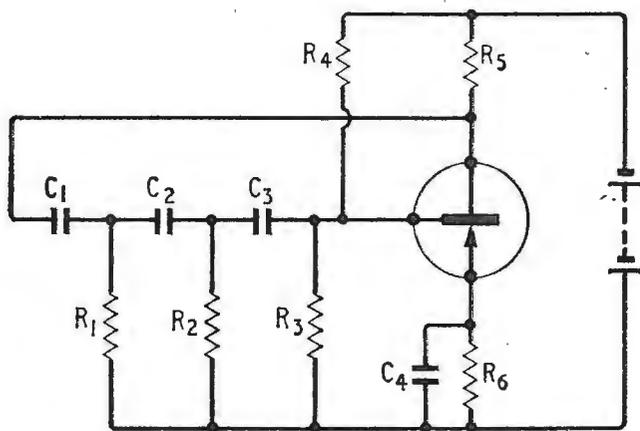
For several reasons, it was decided to use a moving-coil meter to indicate frequency, rather than the usual dial. The most important point is that only four easily-obtainable signals are required for the whole calibration. Secondly, frequency drift of the oscillator, which can happen in the best of circles,

is relatively unimportant, as it is immediately shown up by the meter, and calibration remains correct. Thirdly, the circuit required to operate the frequency meter is available for use in external frequency measurement.

Batteries are built into the unit, but are connected by a plug and socket, so that a common power supply can be used to feed the range of units we intend to describe. If it is desired to build only the oscillator part of the instrument, the switching will be considerably simplified, although difficulty with calibration will return.

#### Oscillator

At low frequencies, the ordinary type of oscillator using an inductance and capacitance to define its frequency becomes impracticable, as the values of



▲ Fig. 1. Phase-shift oscillator.

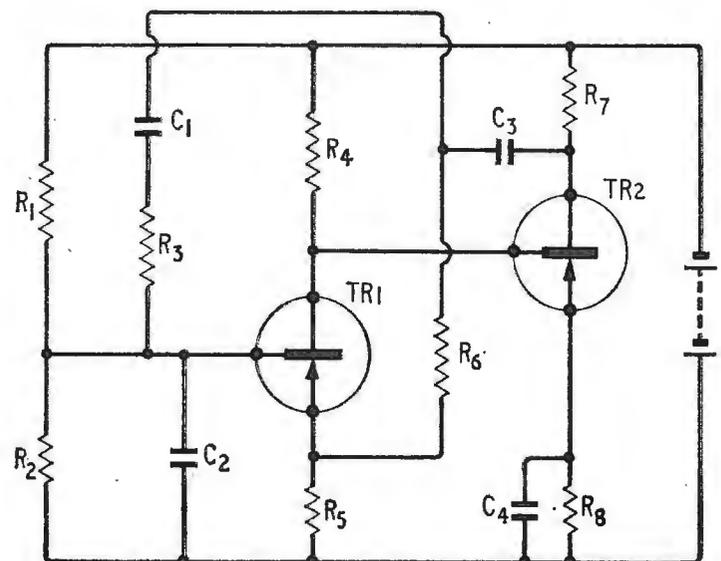


Fig. 2. Basic Wien-bridge oscillator. ►

these components are truly enormous. For instance, to obtain a frequency of 10c/s a tuned circuit of, say, 25 henrys and  $10\mu\text{F}$  would be required, and components of this size cannot be varied very easily, apart from the low Q that would be obtained.

There are two ways out of this problem. One is to use two higher-frequency oscillators with easily accommodated tuned circuits, and make one oscillator beat with the other. To obtain 10c/s, the two frequencies could then be, say, 100kc/s and 100.01kc/s. The fundamental frequencies would be filtered out leaving the 10c/s. This method has its advantages, but the waveform at low frequencies tends to become a little ragged, due to one oscillator "pulling" the other into step during part of the cycle, and in any case, two oscillators are needed.

The most common approach, and the one we have employed, is to use a resistance-capacitance-tuned oscillator. This can be rather more difficult than the inductive type in several respects, but the techniques are fairly well established and little trouble should be experienced.

RC oscillators can be further sub-divided into phase-shift oscillators and Wien-bridge types. The phase shift variety, shown in Fig. 1, relies on the

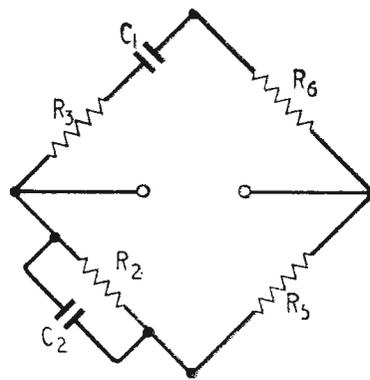


Fig. 3. Wien bridge, corresponding to left-hand side of Fig. 2.

Fig. 4. Super-alpha pair, giving very high input impedance.

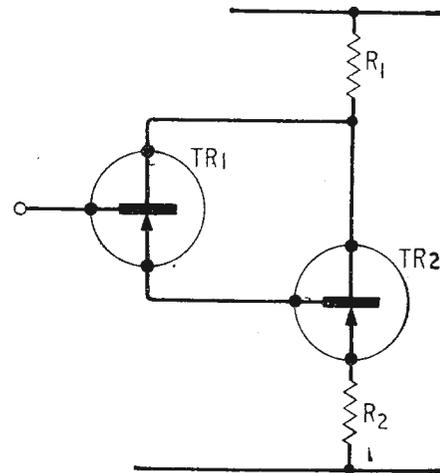
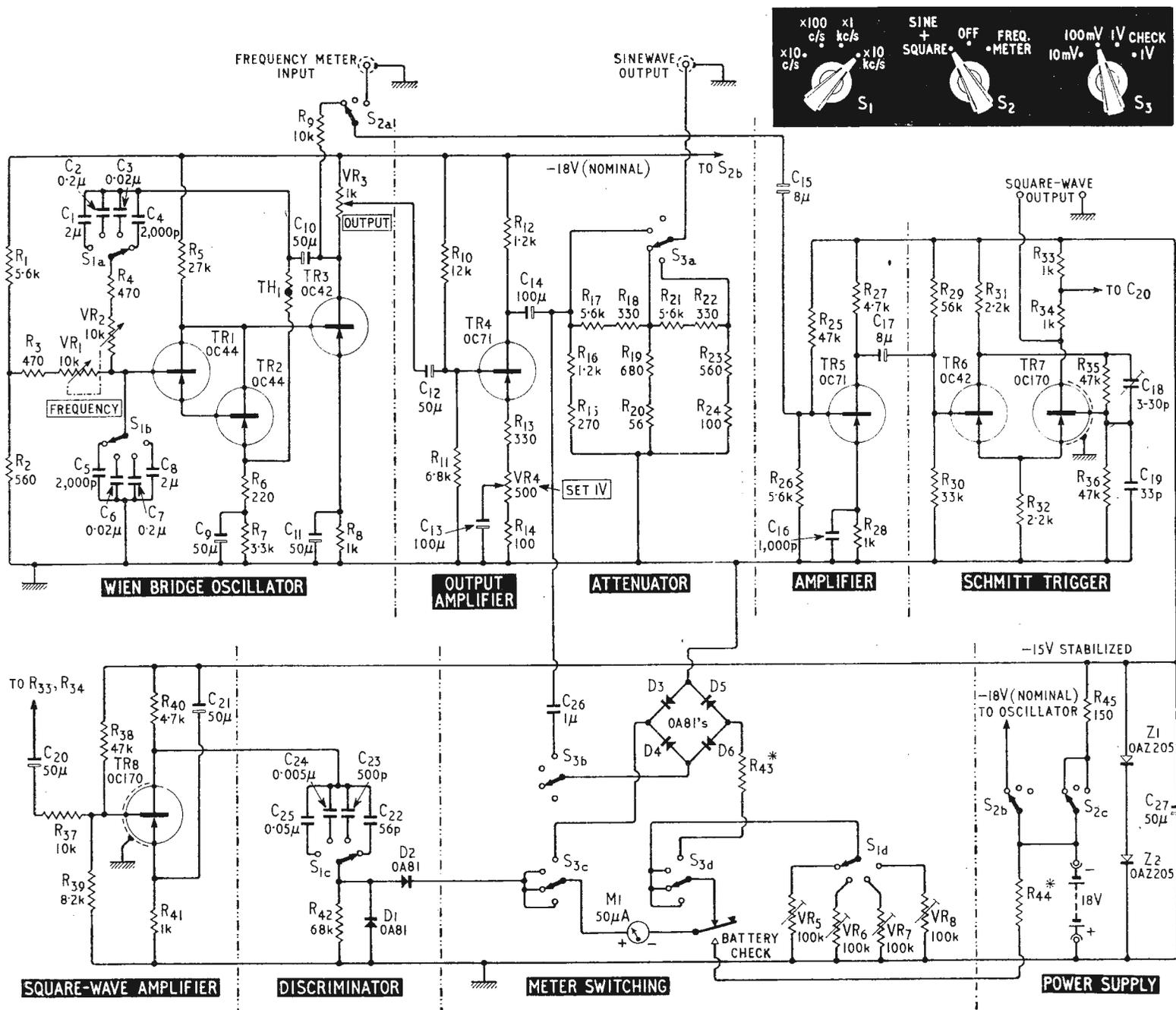


Fig. 5. Complete circuit diagram.



## COMPONENT LIST

<p>R<sub>1</sub> 5.6kΩ R<sub>2</sub> 560Ω R<sub>3</sub> 470Ω R<sub>4</sub> 470Ω R<sub>5</sub> 27kΩ R<sub>6</sub> 220Ω R<sub>7</sub> 3.3kΩ R<sub>8</sub> 1kΩ R<sub>9</sub> 10kΩ R<sub>10</sub> 12kΩ R<sub>11</sub> 6.8kΩ R<sub>12</sub> 1.2kΩ R<sub>13</sub> 330Ω R<sub>14</sub> 100Ω R<sub>15</sub> 270Ω ±5% R<sub>16</sub> 1.2kΩ    "    " R<sub>17</sub> 5.6kΩ    "    " R<sub>18</sub> 330Ω     "    " R<sub>19</sub> 680Ω     "    " R<sub>20</sub> 56Ω       "    " R<sub>21</sub> 5.6kΩ    "    " R<sub>22</sub> 330Ω     "    " R<sub>23</sub> 560Ω     "    " R<sub>24</sub> 100Ω      "    " R<sub>25</sub> 47kΩ R<sub>26</sub> 5.6kΩ R<sub>27</sub> 4.7kΩ R<sub>28</sub> 1kΩ R<sub>29</sub> 56kΩ R<sub>30</sub> 33kΩ R<sub>31</sub> 2.2kΩ R<sub>32</sub> 2.2kΩ R<sub>33</sub> 1kΩ R<sub>34</sub> 1kΩ R<sub>35</sub> 47kΩ R<sub>36</sub> 47kΩ R<sub>37</sub> 10kΩ R<sub>38</sub> 47kΩ</p>	<p>R<sub>39</sub> 8.2kΩ R<sub>40</sub> 4.7kΩ R<sub>41</sub> 1kΩ R<sub>42</sub> 68kΩ R<sub>43</sub> 20-30kΩ* R<sub>44</sub> 400kΩ* R<sub>45</sub> 150Ω All resistors are ¼W, ±10%, except where otherwise specified. *Selected as explained in text. VR<sub>1</sub>, VR<sub>2</sub> 10kΩ 2-gang log. VR<sub>3</sub> 1kΩ linear VR<sub>4</sub> 500Ω linear VR<sub>5</sub>-VR<sub>8</sub> 100kΩ pre-sets (RADIO SPARES) TH<sub>1</sub> Standard Telephones R53 thermistor C<sub>1</sub> 2μF paper or electrolytic C<sub>2</sub> 0.2μF C<sub>3</sub> 0.02μF C<sub>4</sub> 0.002μF C<sub>5</sub> 0.002μF C<sub>6</sub> 0.02μF C<sub>7</sub> 0.2μF C<sub>8</sub> 2μF paper or electrolytic C<sub>9</sub> 50μF 15V C<sub>10</sub> 50μF 15V C<sub>11</sub> 50μF 6V C<sub>12</sub> 50μF 15V C<sub>13</sub> 100μF 6V C<sub>14</sub> 100μF 15V C<sub>15</sub> 8μF 15V reversible or 2×16μF in series C<sub>16</sub> 0.001μF C<sub>17</sub> 8μF 15V C<sub>18</sub> 3-30pF beehive trimmer C<sub>19</sub> 33pF C<sub>20</sub> 50μF 15V</p>	<p>C<sub>21</sub> 50μF 15V C<sub>22</sub> 56pF C<sub>23</sub> 500pF C<sub>24</sub> 0.005μF C<sub>25</sub> 0.05μF C<sub>26</sub> 1μF 15V reversible electrolytic or paper 25V C<sub>27</sub> 50μF TR1 OC44 TR2 OC44 TR3 OC42 TR4 OC71 TR5 OC71 TR6 OC42 TR7 OC170 TR8 OC170 Z<sub>1</sub> OAZ205 Z<sub>2</sub> OAZ205 D<sub>1</sub>-D<sub>6</sub> OA81 M<sub>1</sub> 50μA meter Slow-motion drive (Jackson Bros. 4511 D.A.F.) Makaswitch shafting assemblies—3 off (Radiospares) Switch wafers 2-pole, 6-way—2 off (Radiospares) Switch wafers 3-pole, 4-way—3 off (Radiospares) Spacers for switch shafts—8, off medium (Radiospares) Burgess microswitch V4TI or similar. Coaxial sockets—2 off. 3-pin battery plug and socket. Battery clip connectors. Paxolin boards ⅛-in Thick. Turnet tags (Radiospares). Suitable handle. PP9 batteries—2 off.</p>
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fact that a sine wave emerging from a CR circuit such as C<sub>1</sub> R<sub>1</sub> is shifted in phase with respect to the input by anything up to 90°. In actual fact, it is arranged that one such circuit shifts the phase 60° and a further two circuits are added to bring the total phase shift to 180°. The input to the transistor base is now in the correct phase to produce positive feedback from the collector, and provided there is enough of it, oscillation will ensue. The voltage gain of the transistor must be at least 29, to overcome losses in the phase-shift network.

This kind of RC oscillator is not very attractive if the frequency is to be varied, because it means either a triple-gang potentiometer or capacitor, and the most common type for signal-generator work is the Wien-bridge oscillator. The basic circuit is shown in Fig. 2.

The output from TR1 is amplified and reversed

in polarity by TR2, which feeds back to TR1 via the Wien network R<sub>3</sub> C<sub>1</sub> R<sub>2</sub> C<sub>2</sub>. At a certain frequency, which can be shown to be equal to  $1/(2\pi\sqrt{R_3 C_1 R_2 C_2})$ , the signal voltage across R<sub>2</sub> C<sub>2</sub> is in phase with that across the whole network, and one-third as great. The voltage applied to the base of TR1 is therefore 180° out of phase with the collector voltage, and provided the gain of the two stages is three times, to make up the loss in the network, conditions are right for oscillation.

If matters were left like that, however, the Wien network would not have complete control of frequency. The amplifier itself would tend to exercise some influence over the phase angle, and the waveform would be anything but sinusoidal. The gain of the two-transistor loop is therefore made as high as possible, and negative feedback used. In Fig. 2, C<sub>3</sub>, R<sub>5</sub> and R<sub>6</sub> perform this function, the values

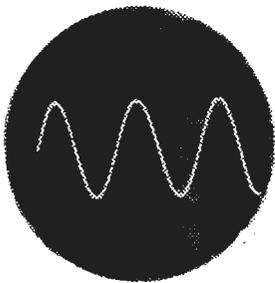


Fig. 6. Sine-wave output at 10c/s. Distortion is less than 0.25% over the range.

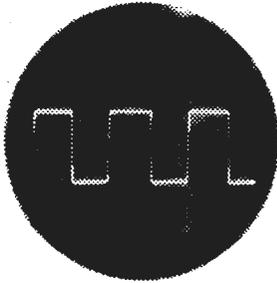


Fig. 7. Square wave at 100kc/s. Rise time is 0.15μsec.

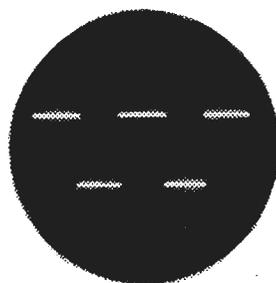


Fig. 8. 10c/s square wave. Oscilloscope amplifier is directly coupled.

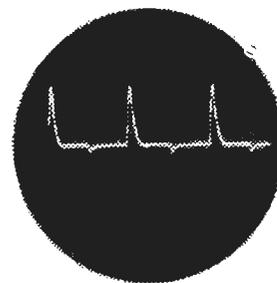


Fig. 9. Input to discriminator diodes across D<sub>1</sub>, which rejects negative spike.

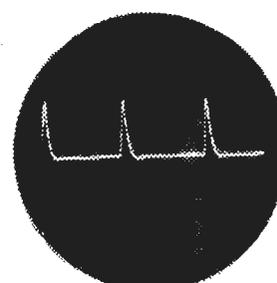


Fig. 10. Output of discriminator, constant-width pulses.

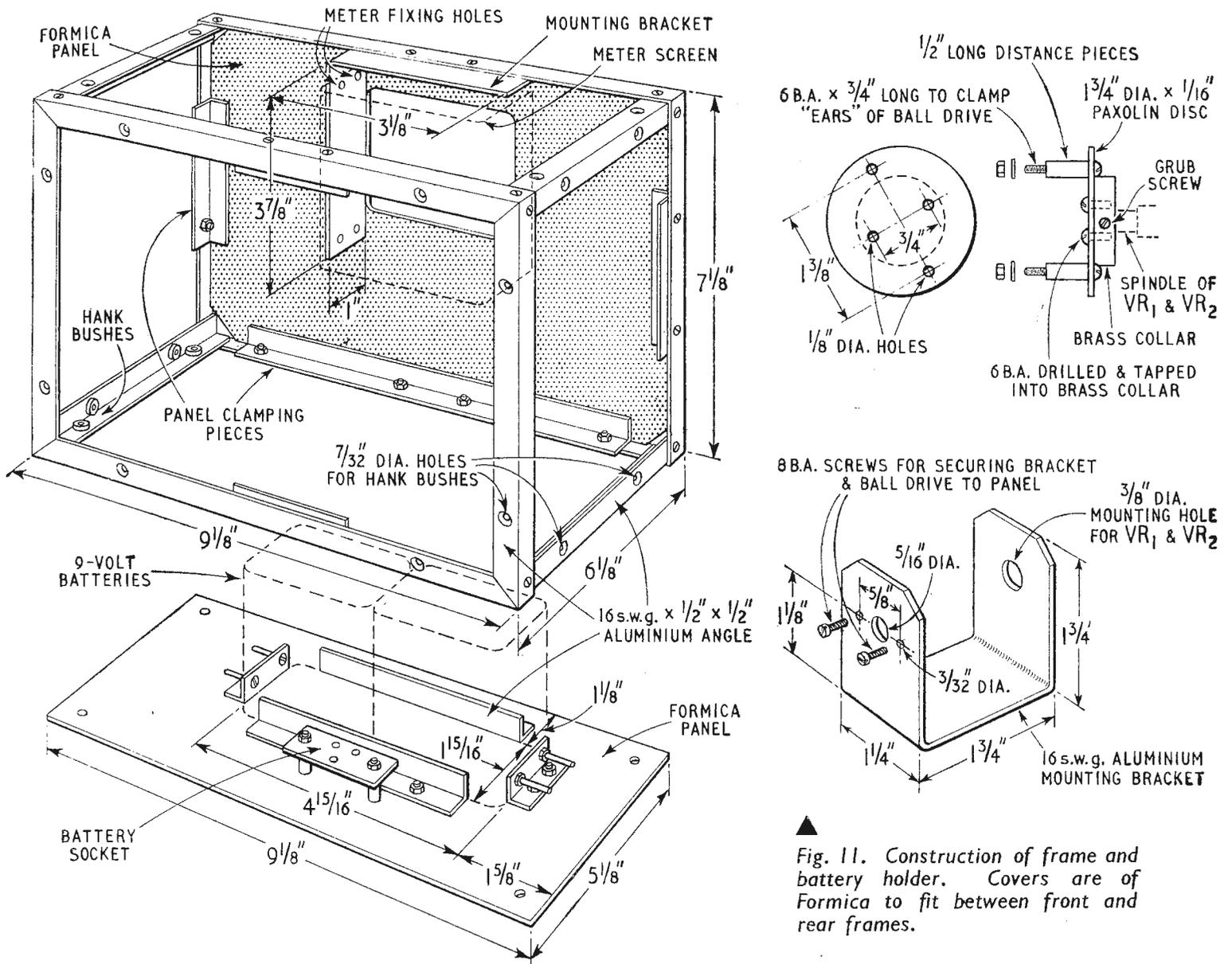


Fig. 11. Construction of frame and battery holder. Covers are of Formica to fit between front and rear frames.

being adjusted so that the total gain with feedback is 3. It can now be seen that the Wien network,  $R_5$  and  $R_6$  form a bridge, which is balanced at the frequency where  $R=1/2\pi fC$  assuming the  $R$ 's and  $C$ 's are equal. To maintain oscillation, the bridge, shown in Fig. 3, must be slightly unbalanced in order to supply an input to TR1.

Again, things are not quite as simple as this, and further modifications must be made. In an LC oscillator, the amplitude of oscillation builds up until the transistor or valve begins to distort, when gain falls and the amplitude is stabilized. Waveform does not suffer, as the LC circuit acts as a "flywheel" and smooths out the sine-wave. In an RC oscillator there is no "flywheel," and the oscillation will either collapse or build up until the result is almost a square wave. Some form of automatic level control is clearly required, and a thermistor is usually employed in the position of  $R_6$ , Fig. 2. This is in the negative feedback path to TR2 emitter; if the output amplitude increases, more current is passed through the thermistor, the resistance of which is thereby reduced. This allows more negative feedback to be applied, which reduces the amplitude. In this way, the output is kept almost constant.

A further modification is required because of the low input impedance of TR1. This is of the order of a few thousand ohms in a common-emitter amplifier, even with an un-decoupled emitter resistor,

and with a convenient value of variable tuning resistor,  $R_2$ , the transistor shunts the bottom reactive arm of the Wien bridge. A further transistor is therefore used to increase the input impedance of the first stage, the super-alpha-pair connection being employed. In the circuit shown in Fig. 4, the emitter current of TR1 is the base current of TR2, which in turn is less than the emitter current of TR2 by roughly the current gain of TR2. The base current of TR1 is therefore extremely small, negative feedback from the collector of TR2 serving to decrease it still further. In this way, the input impedance is raised to several hundred kilohms, and the Wien network is not shunted. Variation of the resistance arm of the bridge does not affect base current and gain to any marked extent, as it is already limited by the above mechanism.

**Attenuator**

The input to the attenuator is set to 1V r.m.s. exactly by the variation of negative feedback in the emitter of TR4 (Fig. 5). This signal is then attenuated in two 20dB steps to give outputs of 1V, 100mV and 10mV maximum in  $600\Omega$ . A continuous control of level is given by  $VR_3$ .

**Square-wave Shaper**

After amplification in TR5, the sinusoidal signal is passed to TR6 and TR7 which, together, form a

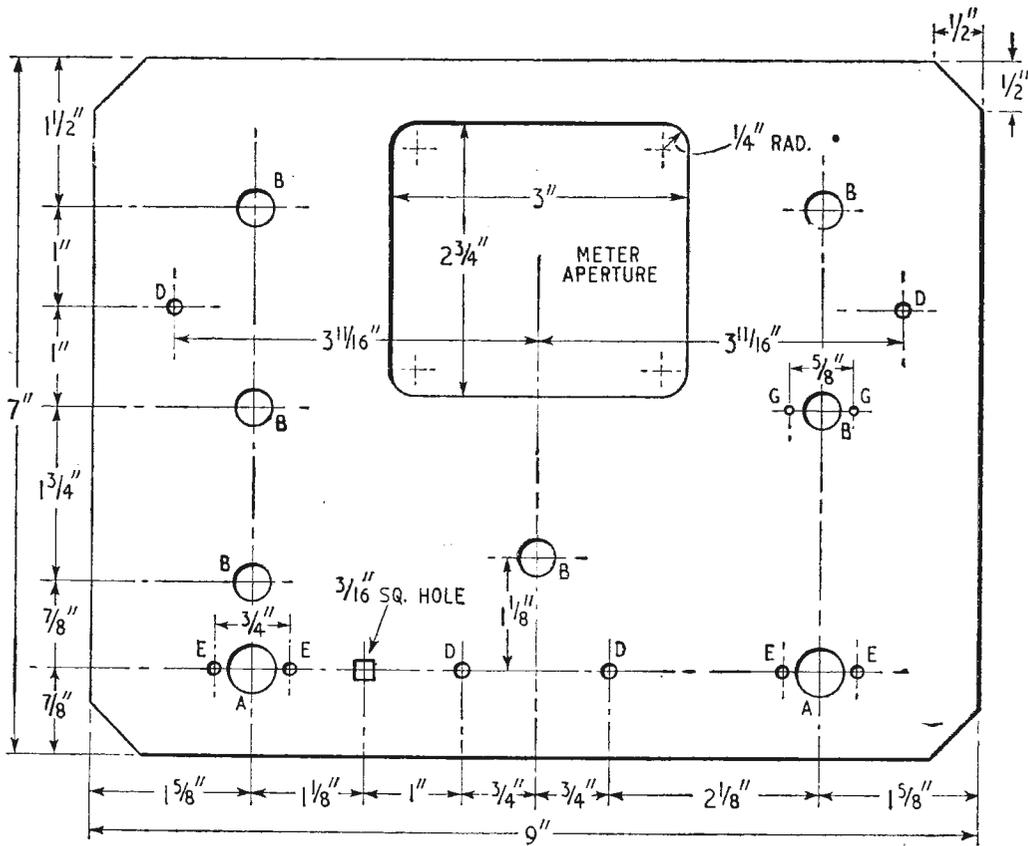
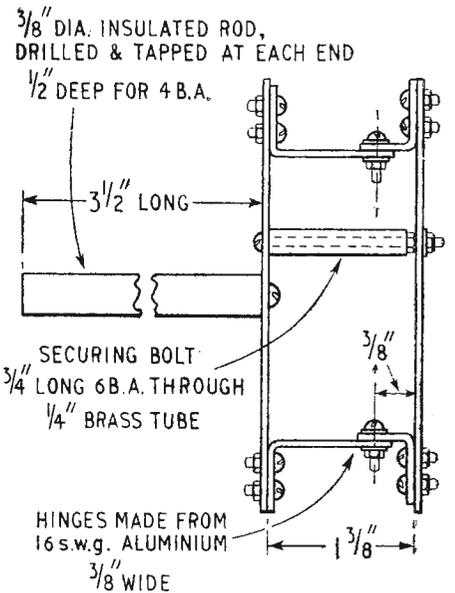
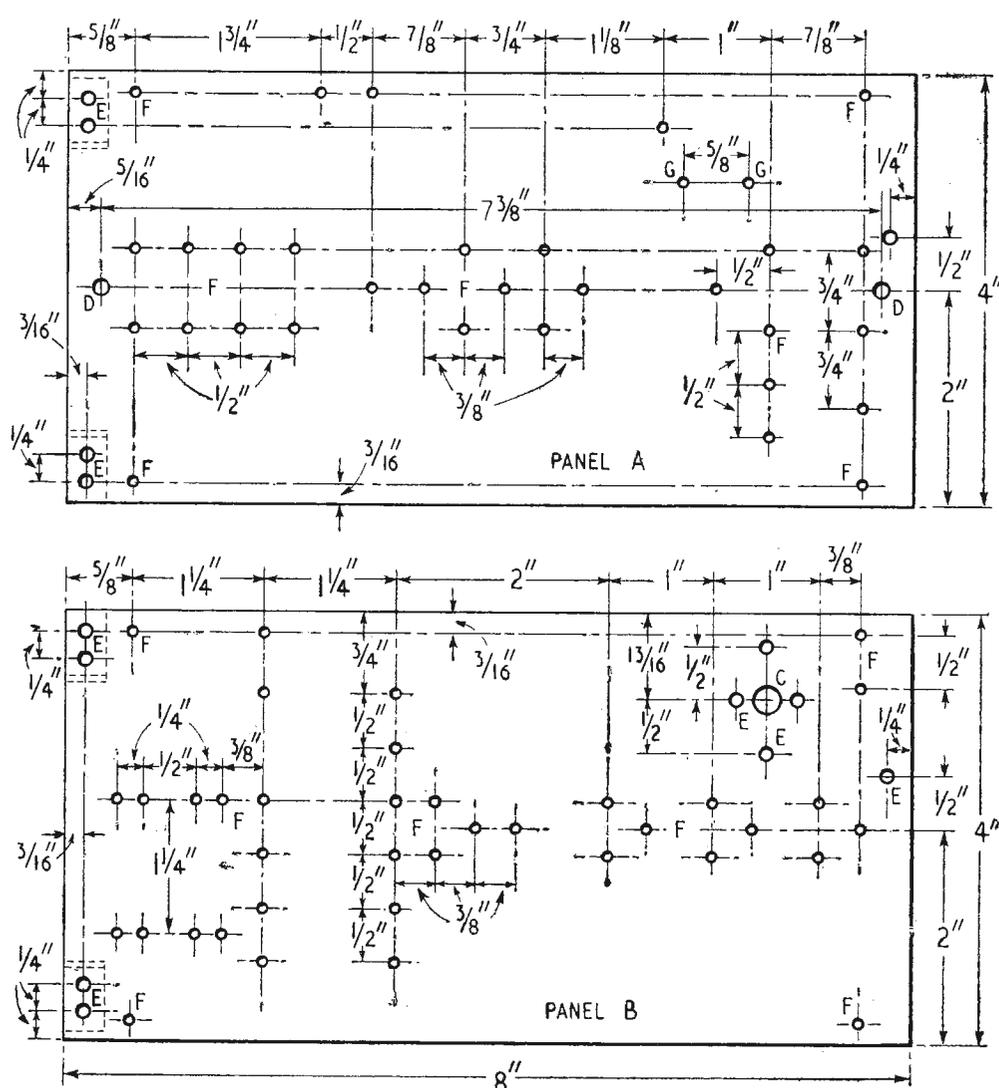


Fig. 12. Front panel drilling. Formica or Waverite gives an elegant finish. Meter hole is for Z. & I. meter.

Fig. 13. Component boards made from 1/8 in Paxolin. Boards are viewed from rear (turret tag side). Board A is nearest front panel.



**DRILLING FOR ALL PANELS**

- A — 1/2" DIA.
- B — 3/8" "
- C — 1/4" "
- D — 5/32" "
- E — 1/8" "
- F — 3/32" " FOR TURRET TAGS
- G — 3/32" "

Schmitt trigger, the output being a 6-V p.p. square wave, with a rise-time of 0.15  $\mu$ sec. The circuit operates over the whole range of the oscillator and is useful for many applications, apart from audio testing.  $C_{18}$  is adjusted to give neither an overshoot nor an "undershoot" on the positive-going edge. The output impedance is 2k $\Omega$ .

The square wave is amplified by TR8 and used to operate the frequency-meter circuit.

**Frequency Meter**

This part of the circuit is effectively an f.m. discriminator which needs no lining up. It has been used for a good many years in telemetry and instrumentation, and has also been used in f.m. tuners. The output of the square-wave amplifier is differentiated by one of the capacitors  $C_{22}$ - $C_{25}$  and  $R_{42}$ , the result being a series of positive and negative spikes corresponding to positive and negative-going edges of the square wave. Negative spikes are suppressed by  $D_2$ ,

and we are left with a series of positive spikes, of similar shape and energy content, which vary their spacing with frequency. The average voltage level of the spikes is now linearly dependent on frequency, and is applied to the meter which is calibrated 0-10, corresponding to the frequency ranges 10c/s-100c/s, 100c/s-1kc/s, 1kc/s-10kc/s, 10kc/s-100kc/s.  $D_1$  helps to discharge the capacitor between pulses.

### Power Supply

Batteries are built into the instrument although, as explained earlier, a common power supply will be described at some future date to power the range of test gear. If it is desired to run this instrument for long periods near a mains outlet, it will probably be found better to substitute a small mains supply for the batteries. A small transformer, silicon or metal rectifier and RC smoothing circuit would take up less room than batteries and would only cost about £2.

It will be seen that the square-wave shaper and frequency-meter circuit run from a Zener-diode-stabilized supply. The oscillator gives a reasonably constant output over a wide range of supply voltages and its supply is not stabilized.

### Metering

The meter is employed in three functions. Primarily, it indicates frequency, as already described. Secondly, on the "Check IV" position, it enables the input to the attenuator to be set to 1V r.m.s. Its third function is needed only occasionally and is therefore selected by a biased push-button switch, when the battery voltage is displayed.

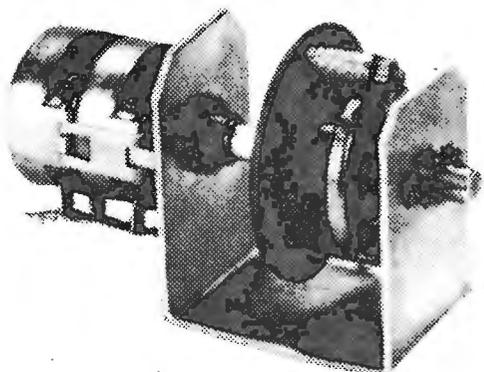


Fig. 14. Slow-motion drive assembly.

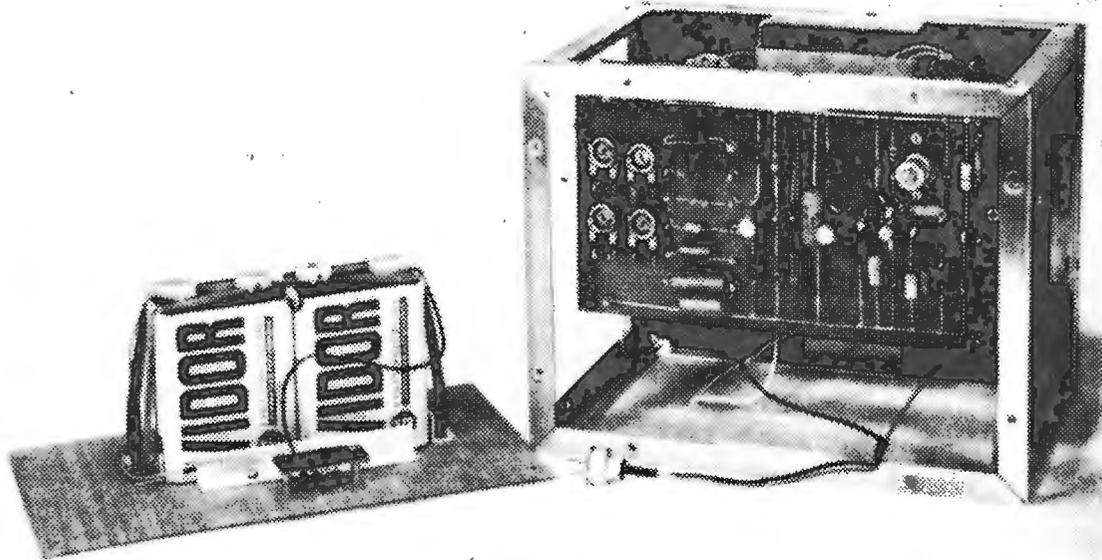


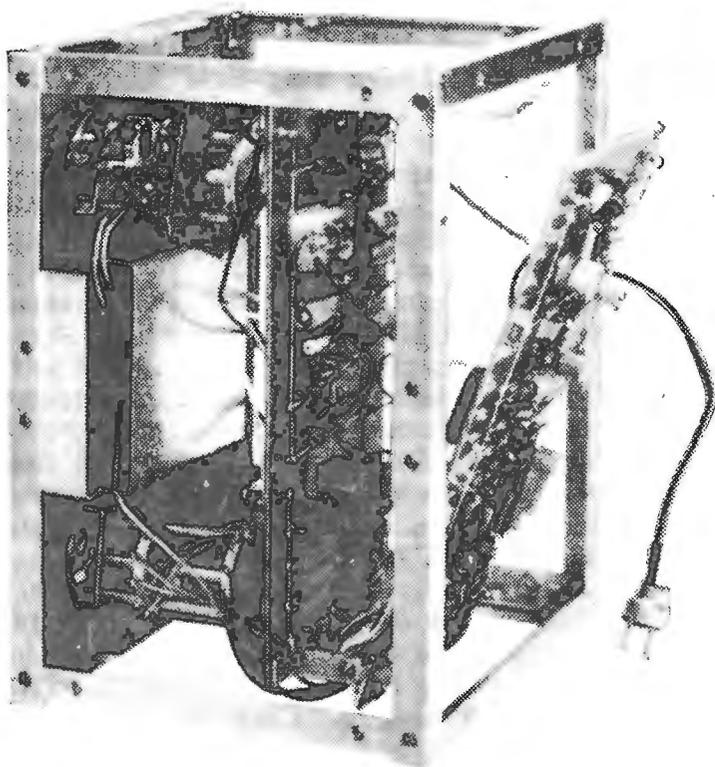
Fig. 15. Rear view of instrument, showing battery mounting. Rubber band holds batteries in place.

### Calibration

As regards frequency, calibration is simplicity itself. The top range, 10kc/s-100kc/s, is calibrated by comparison with the 200kc/s long-wave Light Programme transmission from Droitwich. With the oscillator set to "Sine + Square," take a lead from the square wave output terminals to somewhere near a radio receiver, and adjust the oscillator for zero beat in the loudspeaker.  $VR_8$  should then be adjusted to make the meter read "10."

The 1kc/s-10kc/s range is best calibrated by comparing it with the 10.125kc/s of a locked television line timebase. It is possible that, on some sets, a loop of wire connected to the frequency meter and held near the television line-output transformer will provide a suitable signal, but we found that the waveform gave misleading results. To overcome this, a parallel-tuned circuit should be made up to filter out harmonics of 10kc/s, the inductance acting as pick-up loop. Our tuned circuit was 31mH tuned by  $0.01\mu F$  and  $0.04\mu F$  in series, the output being taken across the  $0.04\mu F$ . The circuit can be adjusted by connecting it in the lead from the wiper of  $VR_3$  to  $C_{12}$ , switching to "CHECK IV" on the range 10kc/s-100kc/s, and obtaining a null on the meter when the frequency of the oscillator is set to 10kc/s. (This range should be calibrated first.) As a matter of fact, our inductance took the form of a  $\frac{1}{4}$ lb. reel of 32 s.w.g. double-silk-covered wire! Hold the loop near the line output stage, with the instrument set to "Frequency Meter," and adjust  $VR_7$  until the meter reads "10.1".

The next range is 100c/s-1kc/s and here the 440c/s B.B.C. tuning note is used. This is transmitted for a few minutes before the opening of Home, Light and Third Network programmes, the latter being most convenient. In this case, the tone is transmitted from Zero-30 minutes to Zero-15 minutes and from Z-5 minutes to Z-3min. 20sec. The signal across the loudspeaker terminals or from the detector should be applied to the frequency meter and  $VR_6$  adjusted until the meter reads "4.4". The lowest range, 10-100c/s, relies on the frequency of the mains. The output of a 6V heater transformer is fed to the "Frequency Meter Input" socket via a potentiometer, and with the instrument set to "Frequency Meter"  $VR_5$  is adjusted until the meter reads "5".



▲  
Fig. 16. Top view. Rear panel (B) is normally held in place by nut.

### Amplitude Calibration

To calibrate the "Check IV" level, an a.c. meter is required. The output of a 6V heater transformer is "potted down" by means of a 10k $\Omega$  potentiometer until the voltage on the wiper is 1V r.m.s. This voltage is then applied to C<sub>26</sub>, having first disconnected it from C<sub>14</sub>, and the resistor in series with the meter selected so that the meter reads a convenient figure. "5" is the 1V level on our meter. This point on the meter scale can then be marked "SET LEVEL" if desired. To set up the level when the instrument is in operation, turn S<sub>3</sub> to "CHECK IV," set VR<sub>3</sub> (OUTPUT CONTROL) to maximum, and adjust VR<sub>1</sub> (SET IV) until the meter reads "5." VR<sub>3</sub> is calibrated by simply dividing the track into 10 equal-resistance divisions by means of an ohmmeter and marking them 0-10. R<sub>5</sub> should be selected to give a full-scale reading of 20V, when the "Battery Check" button is depressed. The meter, it will be seen, is a 50 $\mu$ A type, and this caused some worry, as not everyone can afford to take the obvious and easiest course of ordering from the makers' current catalogues at up to £3 a time. We did, however, locate a source of cheaper instruments. Z. and I. Aero Services Ltd., of 14 South Wharf Road, London, W.2, are able to supply meter movements at £1. These were originally used as Röntgen-hour indicators and need a new scale, which is best done by comparison with a test meter, keeping the scale vertical. This is the type of meter in the prototype instrument.

### Construction

The drawings and photographs are self explanatory. The layout of the components is not critical, and almost any other form of construction would be equally suitable. Printed boards would be ideal, but the turret-tag method gives similar benefits and is probably easier to make. The slow-motion drive

is not essential, but was included in the prototype partly for its ease of adjustment and partly because it reverses the rotation of the potentiometers, so that clockwise rotation of the knob increases the frequency.

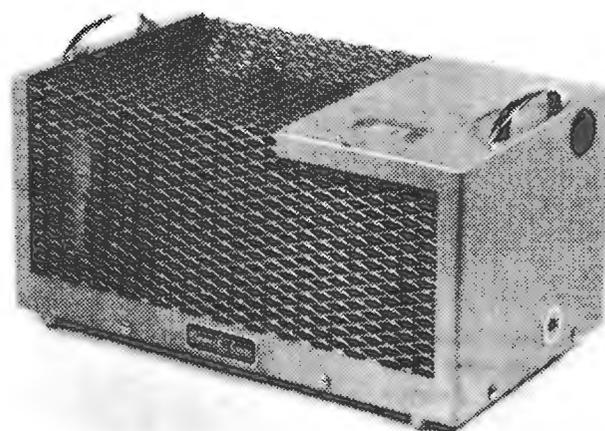
If only the sine wave output is needed, it is possible to simplify and cheapen the instrument considerably. All the circuitry associated with TR5-TR8 can be eliminated, together with the discriminator diodes. The meter, metering circuit and switch can be dispensed with if the constructor is willing to accept the small change in amplitude with frequency. The oscillator can be powered by the batteries directly, neglecting the Zener diodes Z<sub>1</sub> and Z<sub>2</sub>. A calibrated dial would be used mounted on the slow-motion drive, a hole being cut in the front panel. Access to a signal generator will now be required, and if one calibration scale is to be used, close-tolerance components will be needed for C<sub>1</sub>-C<sub>8</sub>. If an oscillator is already available, it will be found that the circuit of TR5-TR7 forms an effective squarer in its own right.

Additional layout and wiring diagrams will be given next month, together with some suggestions for the use of the instrument in amplifier testing, and photographs of amplifier waveforms.

## Voltage Stabilizer

THE range of voltage stabilizing and regulating equipment manufactured by Claude Lyons Ltd., Valley Works, Hoddesdon, Herts, has been extended by the introduction of the BTR-5 series of a.c. electronic voltage stabilizers. The circuit principles of the established BAVR series are retained, but distortion has been reduced and solid-state circuitry used. At a power factor of 1.0 the distortion is no greater than 6%, this is reduced to 2% by the use of a filter. (Filters are fitted in the BTR-5F models). The output voltage is adjustable from 200 to 254V. The input arrangement permits three selections by link adjustment, these are -15% to +5%,  $\pm 10\%$  or -5% to +15% relative to the output voltage setting. The maximum output is 5 amps. The output stability is  $\pm 0.3\%$  from zero to full load, this too, is improved in the BTR-5F version, the time constant is 0.1 second. The units can be supplied with or without filters and either rack or cabinet versions can be obtained. Overall dimensions and prices vary with the version required. The whole unit including terminal access and input range selector is enclosed in a metal case.

2WW 321 for further details.



Claude Lyons voltage stabilizer Type BTR-5.

A forty-page quick reference guide to **Mullard Components** is now available from the Components Division of Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.  
2WW 302 for further details.

**Ferralon Plastics.**—W. W. Chamberlin (Associated Companies) Ltd., of Sartoris Road, Rushden, Northants, have issued a loose-leaf catalogue illustrating the plastic covering materials they manufacture for the radio industry. Some 300 finishes with several types of backing are available, and a representative selection of actual samples appear in the catalogue.  
2WW 303 for further details.

**Television downlead cables** are described in a recent leaflet from British Insulated Callender's Cables Ltd. Technical details including constructional data and curves showing levels of attenuation, in dB's per 100ft, through Bands 1 to V are included. Copies of this publication are obtainable from 21 Bloomsbury Street, London, W.C.1.  
2WW 304 for further details.

A brochure describing the transistorized American Daystrom "**non-contact**" **wire gauge** is available from Daystrom Ltd., Bristol Road, Gloucester. This instrument can handle products with diameters within the range of 0.001 to 0.750in,  $\pm 0.0001$ in.  
2WW 305 for further details.

**American Valve Guide.**—The Metropolitan Supply Co. of 443 Park Avenue South, New York 16, have sent us a price catalogue of the American valves and tubes they handle. Called "**Buyers Guide**" it includes some 3,000 types.  
2WW 306 for further details.

Two **dual concentric loudspeakers** are described in a leaflet from Tannoy. Both speakers have a frequency response of 25 to 20,000 c/s and the larger of the two, the "Fifteen" has a power handling capacity of 50 watts. The other speaker, called the "Twelve", is rated at 30 watts. Copies of this leaflet are obtainable from Tannoy Products Ltd., West Norwood London, S.E.27.  
2WW 307 for further details.

The microwave and electronic instrument division of Elliott Brothers (London) Ltd., have produced a catalogue on their **transistor curve tracer**. This instrument can generate the data necessary to trace and display the characteristic curves of semiconductor devices on any general purpose oscilloscope. Copies of this publication are available from Elstree Way, Borehamwood, Herts.  
2WW 308 for further details.

**Radio receivers, radiograms and tape recorders** manufactured by the German organization Loewe Opta are described and illustrated in a 24-page brochure available from Highgate Acoustics, 71-73 Great Portland Street, London, W.1. The publication is in English.  
2WW 309 for further details.

Aerialite Ltd. have revised their "**Aerials and Accessories**" wall chart to include their new range of "Golden Gain" u.h.f. aerials and accessories. Copies are available from their head office at Castle Works, Stalybridge, Cheshire.  
2WW 310 for further details.

Decca Radar Ltd., Decca House, Albert Embankment, London, S.E.1, have just released a brochure on a range of manual and automatic (electro-mechanical) **waveguide switches** for use in microwave systems, laboratory measurements and test circuits. The outstanding characteristic of these switches is that their isolation is greater than 100 dB over the whole waveguide band.  
2WW 311 for further details.

Publication AEP.25-7 from the Westinghouse Brake and Signal Company Ltd., 82 York Way, King's Cross, London, N.1, is of particular interest to designers and engineers requiring **encapsulated rectifier units** in bridge, centre-tap or voltage-doubler arrangements. Among those described are potted versions with current ratings from one to four amperes having voltage ratings up to 420V.  
2WW 312 for further details.

A fixed station **v.h.f. radiotelephone** Type FM120 is described in a leaflet from Hudson Electronic Devices Ltd., of 4 Sydenham Hill, London, S.E.26. These single-channel equipments, which, to special order, can be modified for seven-channel operation, employ f.m. modulation and have minimum outputs of 50 watts (de-rated to 25W in the U.K.) throughout the frequency range 71-175 Mc/s. A technical specification is included.  
2WW 313 for further details.

A leaflet describing a new **vacuum tweezer system** from the scientific division of the American Schueler & Company is now available from Schuco International London Ltd., 46 Ravensdale Avenue, London, N.12. The system is completely self-contained and the vacuum pencil tweezer, which has five different vacuum pick-up tips, operates from a 220-240V a.c. vacuum generator.  
2WW 314 for further details.

Société Européenne des Semiconductors of 41 rue de L'Amiral-Mouchez, Paris have produced a 12-page catalogue, in English, covering their comprehensive range of silicon and germanium **semiconductor devices**. These are listed in tabular form and include construction, absolute maximum ratings and typical characteristic details. Separate sections are given for various types of transistors, diodes, rectifiers and microminiature logic blocks. They have also prepared an English wall chart for their diodes and rectifiers, and another for transistors.  
2WW 315 for further details.

Literature describing the complete lines of standard products of the scientific quartz and metals division is available from General Technology Corporation, 3510 Torrance Boulevard, Torrance, California. Leaflet 7100 describes **standard quartz and pyrex accessories** used for diffusion, doping and heat treating operations in the semiconductor industry. The division's line of standard tungsten, molybdenum and tantalum filaments, used for dielectric coating, metalizing of plastics, etc. are described in leaflet 7200.  
2WW 316 for further details.

A 576-page booklet listing and illustrating the products of **Precision Instrument Components**, which range from anti-backlash gears and ball-bearing to universal multi-ratio gear boxes and worm and wheel assemblies is now available in the sterling area from the manufacturing licencees and distributors Reliance Gear Company, of Almondbury, Huddersfield. Other things of interest, include instrument differentials with less than 10 minutes of arc lost motion, breadboard development parts, helical gear assemblies and servo gear boxes. The Reliance Gear Co., who already have an extensive range, have informed us that the American tie-up has increased their stock range by some 20,000 items.  
2WW 317 for further details.

Plastiglide's comprehensive range of **swivelglides, plastic guides and ferrules** specially designed for the furniture and radio and television industries are listed in a new 80-page publication from Plastiglide Products Ltd. of 58 Birmingham Road, Stratford-upon-Avon.  
2WW 318 for further details.

Imhofs have just issued a booklet describing their range of over **seventy standard handles**—many of which are listed for the first time. Full dimensional details are given, together with illustrations of each type of handle. Also listed in this booklet is a wide range of miscellaneous accessories including hinges, locks, catches, castors, etc. Copies of this publication are available from Alfred Imhof Ltd., Ashley Works, Cowley Mill Road, Uxbridge, Middx.  
2WW 319 for further details.

The International Nickel Company (Mond) Ltd. have published a new leaflet entitled "**The properties of the platinum metals**." This gives the latest published data on the basic properties of the six metals in the group and covers the principal characteristics, which make platinum metals so important to industry. The other metals in the group—palladium, rhodium, ruthenium, iridium and osmium which possess individual characteristics—are also described in the publication. Copies are obtainable from the publicity department at 20 Albert Embankment, London, S.E.1.  
2WW 320 for further details.

# NEW LOW-NOISE TRANSISTOR CIRCUIT FOR ELECTROSTATIC MICROPHONES

By P. J. BAXANDALL, B.Sc.(Eng.)

## *Amplitude-modulated R.F. Bridge Method with Many Advantages*

**T**HE conventional way of using an electrostatic (or condenser) microphone is shown, in its simplest form, in Fig. 1. The resistance  $R$  is made so large that, even at low audio frequencies, insufficient current can flow into or out of the microphone capacitance  $C$ , during one audio cycle, to cause a significant alteration in the stored charge  $Q$ . Since  $Q=CV$ , it follows that if  $Q$  is kept constant, the voltage  $V$  across the capacitance must vary when acoustic pressure causes  $C$  to vary. With the values shown, the response will be 3 dB down at about 30 c/s. From the point of view of signal-to-noise ratio, however, it is advantageous to use an even higher value of

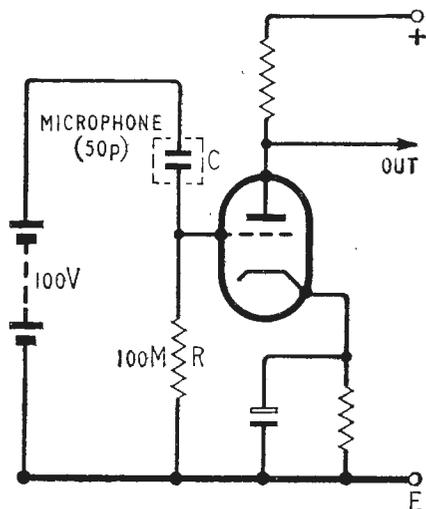


Fig. 1. Conventional electrostatic microphone circuit.

resistance than that dictated by the required low-frequency response.

When, in 1957, the writer first considered the problem of using an electrostatic microphone with purely transistor circuitry, it was quite obvious that the impedances involved in a circuit of the Fig. 1 type were far too high for it to be practicable simply to replace the valve by a transistor.\*

However, by operating the electrostatic microphone element in a radio-frequency circuit, so that its capacitance variations are caused to modulate an r.f. carrier, the above-mentioned high impedances

are completely avoided and a very good performance can then be obtained with semiconductor circuits.

The general idea of using radio-frequency circuits for electrostatic microphones is, of course, quite old, and both frequency modulation and amplitude modulation have been employed.

F.m. systems have the disadvantage that random noise f.m. on the oscillator output inevitably gives rise to noise at the audio output terminals. Since the wanted f.m. is usually of quite small deviation, this noise f.m. can prevent the overall noise performance from being up to the highest professional standards.

In an a.m. system, however, by using a balanced bridge circuit, random noise modulation of the oscillator may be prevented from reaching the audio output terminals, and it was mainly for this reason that the author rejected f.m. systems right at the beginning and concentrated on a.m. bridge circuits—and if a bridge was to be used, then there was everything to be said for employing the transformer ratio arm principle first proposed by A. D. Blumlein.

### R.F. Bridge Circuit

The broad outline of the system adopted is, then, to have a radio-frequency oscillator with a centre-tapped output winding, the microphone element and a capacitor of equal value being connected in series across this winding, forming a bridge network. An r.f. out-of-balance voltage is then obtained between the junction of the capacitances and the winding centre tap, of magnitude dependent on variations in the microphone capacitance with acoustic pressure. This amplitude-modulated r.f. voltage is subsequently demodulated to recover the wanted audio signal.

In the first experiments, the centre tap of the oscillator winding was earthed and the bridge output was tuned to parallel resonance by an inductor to earth from the junction of the capacitances. This output was fed straight to a diode detector, the bridge being set slightly out of balance to give some carrier output and thus ensure linear demodulation. Quite encouraging results were obtained, though it was found important to select the right type of diode if excessive detector-circuit noise was to be avoided. Ordinary point-contact diodes were hopelessly noisy, but G.E.C. EW78 silicon junction diodes (now obsolete) gave consistently good results (10 samples tried), the noise output then being only slightly above the thermal noise level.

It was soon realized, however, that by employing a proper phase-sensitive detector and operating the

\* It is interesting to reflect, however, that the notion of transistorizing the Fig. 1 circuit now seems to be much more nearly a satisfactory practical proposition than it did in 1957. This is because some types of silicon planar transistor are now available which will operate satisfactorily, in very high impedance circuits, at collector currents of a small fraction of a microamp.

Whilst the signal-to-noise ratio obtainable when using such a transistor in the Fig. 1 type of circuit would probably be rather inferior to that given by a valve, there are signs that other amplifying devices may in due course become available which will overcome this limitation. One such device is the insulated-gate field effect transistor (ref. 1) and another is the insulator valve (ref. 2).

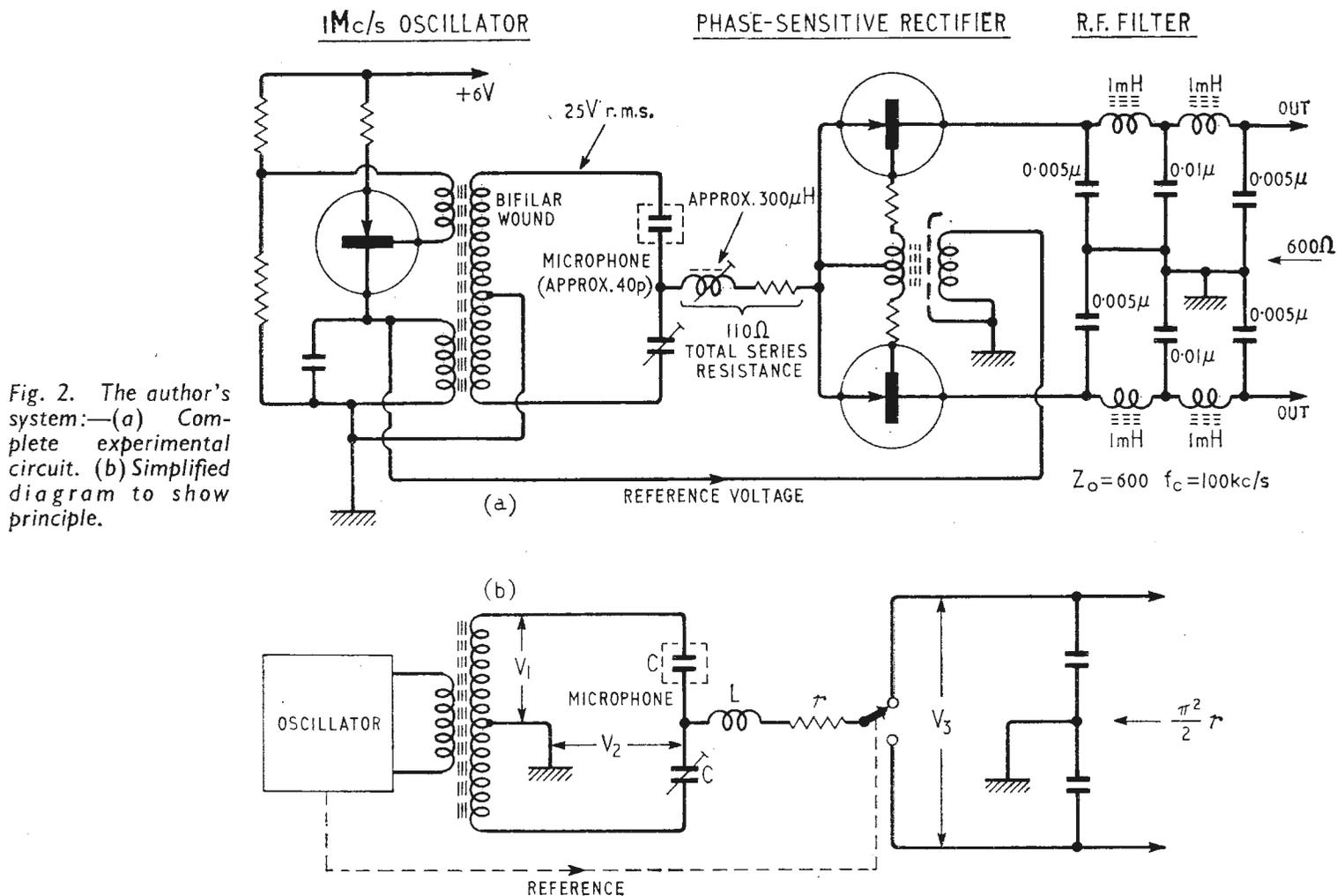


Fig. 2. The author's system:—(a) Complete experimental circuit. (b) Simplified diagram to show principle.

bridge in a nominally balanced state, larger long-term drifts in the bridge balance could be tolerated and the possibility of degradation of the noise performance by oscillator noise would be reduced.

It was further realized that by using series instead of shunt tuning of the bridge output, and by employing transistors as low-impedance switches in the phase-sensitive rectifier, the output impedance could be made low (e.g., 600 ohms), and balanced, without the need for an audio transformer in the microphone. Also it was expected that the noise performance would be excellent. For these reasons experiments on circuits using diode detectors were discontinued.

Fig. 2(a) shows the essential features of the circuit finally adopted. This circuit was first successfully demonstrated in July, 1959, and is the subject of British Patent Application No. 6118/61.

Starting at the left-hand side, there is a single-transistor 1-Mc/s oscillator. This circuit was chosen as being the simplest that would do the job. It takes about 5 mA at 6 volts, and operates in class B. By using class C operation, the efficiency could have been improved, but an extra capacitor would have been required in the emitter circuit—and one of the considerations is that every component saved is a help when it comes to building the circuit inside a small microphone casing.

The output winding of the oscillator is bifilar, so as to obtain very tight coupling between the two halves and thus to ensure that the voltages at the two ends will be very accurately in antiphase. The two halves of this winding form two arms of a bridge, the microphone and an air-dielectric trimmer forming the other two arms.

If the bridge is slightly unbalanced, owing to a change in microphone capacitance, a small 1 Mc/s

sine-wave voltage will appear at the junction of the capacitances, and will have a magnitude proportional to the change in microphone capacitance. The phase of the voltage will change by  $180^\circ$  as the bridge swings through the balanced condition. Thus, assuming the bridge to be perfectly balanced initially, the output waveform will be that of a suppressed carrier radio transmission when the microphone is acted upon by sound waves.

A very important point is that, looking back into the bridge output, the above modulated r.f. waveform comes from a source of quite low internal impedance, i.e., the reactance of the two capacitances in parallel, which is about 1,500 ohms—very different from the values of many megohms associated with conventional circuits.

**Advantages of Tuning the Bridge Output:**—By series tuning the bridge output by means of the inductor shown, the impedance seen looking into the right-hand terminal of the inductor is made even lower—Q times lower, in fact—but the bridge output e.m.f. is the same as before. Now, for a given e.m.f., the lower the internal impedance of the source of the e.m.f., the greater is the available power. The fact that in this system the tuned bridge, regarded as a source of modulated r.f. output signal, has such a low internal impedance, is the main reason for the excellent signal-to-noise ratio obtainable.

Of course, if there were no resistive losses, that is if the Q were infinite, the internal impedance of the tuned bridge would become zero, and infinite signal power would theoretically be available, at least for very slow changes in microphone capacitance.

In a practical microphone system the Q of the

series tuned circuit must not be made too high, otherwise the response of the system at high audio frequencies will be reduced, owing to sideband cutting, just as in a radio receiver. The resistor shown in series with the tuning inductor limits the Q to an appropriate value, in the region of 15.\*

The rest of the circuit is concerned with the demodulating process, which is carried out by a simple phase-sensitive rectifier employing two junction transistors.

These transistors are used simply as on-off switches, which are operated by a reference voltage derived from the oscillator and fed in between their bases and emitters through the transformer shown. When a transistor is driven "on" at its base, it becomes capable of passing current in either direction between emitter and collector, or, in other words, it can function as a *bidirectional switch*. This is a great advantage possessed by transistors, as compared with valves.

Thus the two transistors, driven alternately into conduction by the 1 Mc/s reference voltage, per-

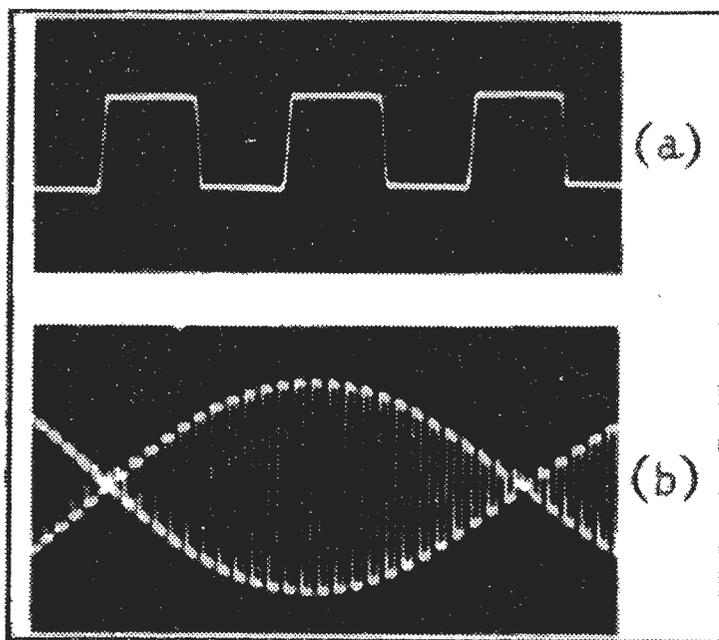


Fig. 3. Phase-sensitive-rectifier emitter-voltage waveforms:— (a) 1.5 V d.c. applied to output terminals. (b) 20 kc/s sine-wave voltage applied to output terminals.

form the same function as the two-way switch shown in the simplified diagram of Fig. 2(b).

Consider one instant of time at which current is flowing from left to right in the inductor of Fig. 2(b), the switch being supposed, at this instant, to be in the position shown. Then, while this condition holds, the tendency will be for the top plate of the top reservoir capacitor to be charged positively. During the next half cycle current will be flowing from right to left, but the switch will have changed over to the lower contact, so that the tendency will now be to charge the lower plate of the lower reservoir capacitor negatively, and so on.

\* If the microphone amplifier input impedance is high compared with the output impedance of the microphone, then the resistor may be omitted without loss of h.f. response and with an improvement in signal-to-noise ratio. The d.c. input resistance of the amplifier is likely to be almost zero, however, owing to the input transformer, and if the damping resistor is omitted, a very small amount of unbalance of the bridge will give a large rectified current. For this reason it is considered better to retain the damping resistor even if an amplifier with a high a.c. input impedance is used.

Thus, all the time, the action of the circuit will be to tend to make the top output terminal positive with respect to the bottom one. It is easy to see that, if the bridge is unbalanced in the opposite direction, giving 180° difference in the phasing of the inductor current with respect to the operation of the switch, then the opposite polarity of d.c. output is produced.

**Some Practical Points:**—During most of the experimental work the circuit was exactly as shown in Fig. 2(a). No special arrangements were made for adjusting the phasing of the signal and reference in the phase-sensitive rectifier, though a slight phase adjustment is available by slightly detuning the series tuned circuit.

Later on, to improve the linearity of the demodulation process, the drive voltage to the base of each of the switching transistors was increased by about a factor of two, up to 3.5V r.m.s. This exceeds the base-to-emitter voltage rating of the transistors used, so two miniature point-contact diodes were added to prevent driving the bases too far positive. Small capacitors were shunted across the base resistors, now 4.7kΩ, to give a small reference-phase correction, thus allowing the series tuned circuit to be set exactly at series resonance. These measures improved the linearity at the expense of a small loss of signal-to-noise ratio. The measured results given later in this article were obtained with these modifications present, but the simpler arrangement is thought more appropriate for general use.

It may well be asked why the oscillator frequency was made 1 Mc/s, and several considerations were, in fact, involved. The frequency must be high enough to give a good noise performance and a conveniently low output impedance. A high frequency also makes r.f. filtering easier—the filter must have negligible attenuation at the highest audio frequency and 100 dB or so at the carrier frequency. On the other hand, the higher the carrier frequency the more difficult it becomes to get a really clean performance from the switching transistors. One has a natural bias towards round numbers and 1 Mc/s seems about as good a choice as can be made.

The procedure adopted for setting the circuit up correctly is the following. A 0-1 mA meter is connected across the phase-sensitive rectifier output, and the bridge is set slightly unbalanced to give a small reading on this meter. The slug of the series tuning inductor is then adjusted for a maximum milliammeter reading. Finally the bridge is balanced for zero reading.

**Sensitivity of Microphone Circuit:**—With reference to Fig. 2(b), the no-load r.f. output voltage of the bridge is given by:—

$$\hat{V}_2 = \frac{\hat{V}_1}{2} \times \frac{\delta C}{C} \dots \dots \dots (1)$$

where  $\delta C$  is the amount by which the microphone capacitance departs from its balanced value.

With no audio load on the final output terminals, no power can be supplied to the input of the phase-sensitive rectifier, since there is nowhere for it to go. Consequently  $V_3$  must be such that the peak value of the fundamental component of the square wave on the switch is equal to  $\hat{V}_2$ , thus giving zero

current in  $L$  and  $r$ . This leads to the result:—

$$V_3 = \frac{V_1\pi}{4} \times \frac{\delta C}{C} \dots \dots \dots (2)$$

In this equation  $V_3$  may be regarded as the peak audio output e.m.f.,  $\delta C$  being the peak value of the capacitance variation.

**Audio Output Impedance:**—It is interesting to consider what will be the audio output impedance seen looking back into the output terminals of the phase-sensitive rectifier. All we need to do is to determine how much direct current flows in the output leads as a result of applying a direct voltage,  $V_{dc}$ , to the output terminals. The ratio of the voltage to the current will be the output impedance, at low audio frequencies at least.

With  $V_{dc}$  between the two switch contacts (Fig. 2(b)), the waveform on the moving contact of the switch will be a square wave of peak-to-peak value  $V_{dc}$ . Owing to the selectivity of the r.f. tuned circuit, only the fundamental component of this square wave will be significant in causing r.f. current to flow in the tuned circuit, and the peak value of the fundamental component of a square wave is  $4/\pi$  times the peak value of the square wave itself.

Thus we can calculate the current flowing in the series tuned circuit, and the power dissipated by it in the series loss resistance. This power must be supplied by the d.c. source connected to the output terminals, and there is nowhere else where the power supplied can be dissipated. Thus, by equating  $V_{dc} I_{dc}$  to the power dissipated in the series loss resistance of the tuned circuit, we may find  $I_{dc}$  and hence the output impedance. Doing this in detail gives the result:—

$$[Z_{out}]_{LF} = \frac{\pi^2}{2} r \dots \dots \dots (3)$$

where  $[Z_{out}]_{LF}$  is the output impedance at low audio frequencies and  $r$  is the total series loss resistance of the tuned circuit.

At higher audio frequencies things are more complicated, because the sidebands are then well separated from the frequency to which the tuned circuit is tuned (1 Mc/s), and the current in the tuned circuit is affected by its reactance as well as by the series loss resistance. Allowing for this, the total output impedance looks like a resistance of  $\frac{1}{2} \pi^2 r$  in series with an inductance; the reactance of this inductance is equal to the resistance at an audio frequency equal to half the bandwidth of the tuned circuit. The inductive component is fairly

negligible, even at 15 kc/s, in the design adopted, owing to the low  $Q$  of the tuned circuit.

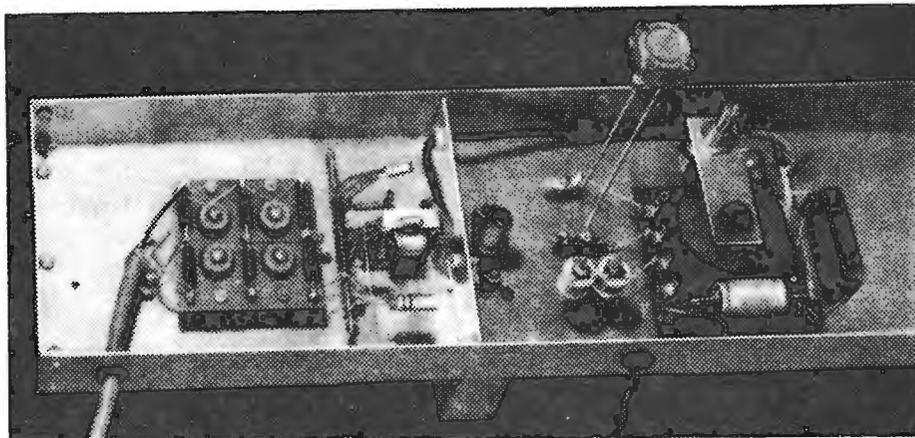
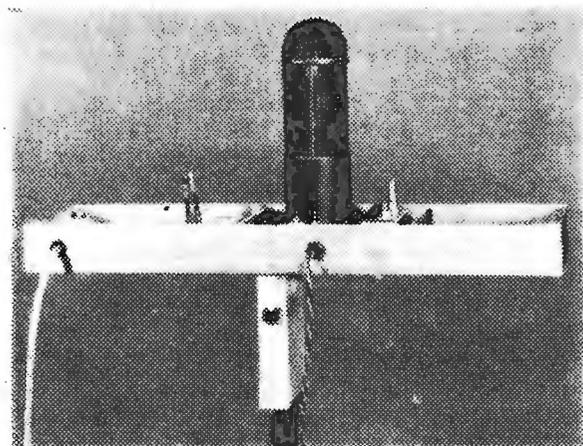
Provided sufficiently fast transistors are used in the phase-sensitive rectifier, the measured sensitivity and output impedance agree quite closely with the calculated values. Semiconductors Ltd. surface-barrier transistors, type SB240, were chosen. OC44s were used in the earliest experiments, and whereas these did produce results, the waveforms were far from the simple theoretical ones which would be produced by an ideal switch, and the output impedance was considerably lower than the calculated value.

The photographed waveforms shown in Fig. 3 show that quite fast switching action occurs. For these waveforms the tuned circuit was disconnected from the input terminal of the phase-sensitive rectifier and a high-speed oscilloscope was connected to this input point. The top waveform, a 1 Mc/s square wave, was obtained with a 1.5 V dry cell connected to the output terminals of the phase-sensitive rectifier. For the lower waveform, the dry cell was replaced by a 20kc/s sine wave from an oscillator.

**Low-pass Filter:**—Referring to Fig. 2(a) again, it will be seen that a low-pass filter is included between the phase-sensitive rectifier and the outgoing microphone line. This is to prevent r.f. currents getting out onto the microphone cable, and to prevent r.f. signals from elsewhere, picked up by the cable for example, getting back into the microphone circuits. This filter is very necessary, as otherwise objectionable heterodyne whistles could be generated under some conditions. The design of the filter is, however, very uncritical—it must have little effect on the audio-frequency response, but must have a very large attenuation at 1 Mc/s and above. The cut-off frequency has been made 100 kc/s, and no close-tolerance components are required. The attenuation at 1 Mc/s is about 100 dB, which is comfortably sufficient. The inductors were wound on  $\frac{1}{2}$  in outside diameter ferrite toroids, and have so few turns that they can be quickly wound by hand, whilst the capacitors are small metallized paper ones, the maximum value being 0.01  $\mu$ F.

### Constructional Aspects

For the experimental work on this system, the circuit was built in the manner shown in the accompanying photographs, no attempt being made to produce a compact layout. All the components



Two views of the microphone with its associated oscillator, phase-sensitive rectifier and r.f. filter.

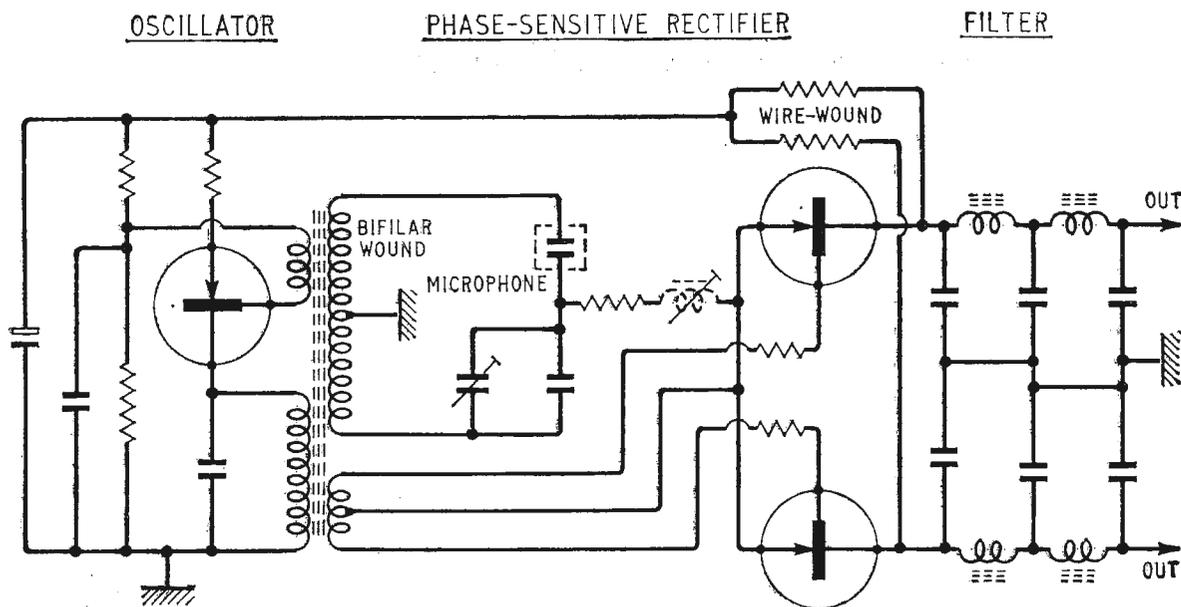
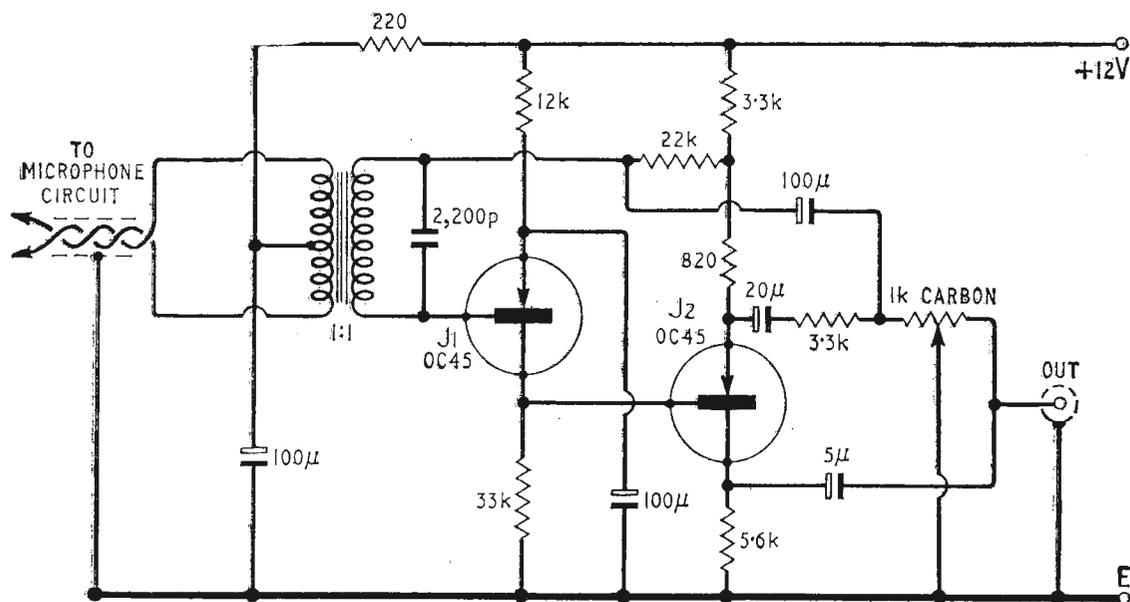


Fig. 4. Final microphone circuit.

Fig. 5. Microphone amplifier.



employed can be of very small physical size, however, thus permitting the final version to be built inside a microphone casing  $\frac{3}{4}$  in diameter and 6 in long. The smallest size of Mullard "red series" Vinkor is very satisfactory for the oscillator coil.

**D. C. Supply via Signal Cable:**—In the early stages of the work, the d.c. supply for the oscillator was fed in along a separate pair of wires from those used for conveying the audio-frequency output—the wires may be seen in the photographs. More recently, however, the d.c. supply has been fed in along the audio frequency cable, the necessary arrangements for doing this being shown in Figs. 4 and 5, for the microphone circuit and the microphone amplifier circuit respectively. The amplifier is that described in reference (3), suitably modified to apply the required d.c. voltage to the incoming line. The amplifier will give an output of 10 mV r.m.s. for any input between 0.15 mV r.m.s. and 150 mV r.m.s., the harmonic distortion being under 0.2% throughout the whole of this 60 dB range.

With this scheme the only microphone cable required is an ordinary twisted and screened pair, such as might be used, say, with a moving-coil microphone—and it may be made up to at least 100 yards long if required with no appreciable difference in performance.

It will also be seen, in the Fig. 4 circuit, that the

separate transformer originally used for feeding the reference voltage to the phase-sensitive rectifier has been eliminated, an appropriate centre-tapped winding being added to the oscillator transformer.

(To be continued)

#### REFERENCES

1. "Nanowatt Logic Using Field-effect Metal-oxide Semiconductor Triodes" by F. M. Wanlass & C. T. Sah (Fairchild). 1963 International Solid-State Circuits Conference Digest, p. 32.
2. "Non conductor Valves" by "Cathode Ray." *Wireless World*, March 1963, p. 145.
3. "Low-distortion Amplifiers (Part 2)" by P. J. Baxandall, *Journal of the British Sound Recording Association*, Nov. 1961, p. 246.

#### "Wireless World Diary"

THE answers to 1,001 technical and general questions (from addresses of U.K. and overseas organizations to television standards and from u.h.f. television frequencies to valve and transistor connections) will be found in the 80-page reference section of the 1964 "Wireless World Diary". Now in its 46th year of publication the Diary—giving a week to an opening—is published by T. J. & J. Smith Ltd., and is available from newsagents and booksellers or direct from this office. It costs 5s 6d in rexine or 7s 6d in morocco leather, including purchase tax. Overseas prices are 4s 8d and 6s 5d and postage is 4d.

# WESCON 1963—This Year's Electronics Exhibition in San Francisco

**C**OLD statistics do little to convey the impact of the Western Electronic Show and Convention on a European visitor. In the rambling halls of the Cow Palace at San Francisco jostle 850 manufacturers of electronic equipment, occupying some 1,200 "booths"—a description which aptly conveys the rectangular, regimented units which make up the stands, markedly in contrast to the imaginative jumble of European shows. Over the four-day period of Wescon some 35,000 engineers, technicians and buyers passed through the Cow Palace, and at the twenty technical sessions over seventy-eight papers were read.

Wescon is a national exhibition, but due to its location at either San Francisco or Los Angeles is supported principally by West Coast manufacturers. As a result, the exhibition tends to reflect the West Coast preoccupation with the aerospace programme and its peripheral industries. Technically there are no startling advances to be reported from this year's Show, and the general mood appeared to be one of consolidation rather than spectacular gain. In answer to increasing competition many major manufacturers are diversifying into new product areas in an effort to keep up expansion rates. Texas Instruments for example stressed the output of its apparatus division and materials and control division at the expense of semiconductors, traditionally their strong line. They introduced their Model 659A semiconductor integrated circuit tester. This has a capacity of 36 tests on devices with up to 14 terminals with test times variable from 30msec up to 5 sec, making it possible to perform 36 tests in 1.5 sec. Also from Texas was an automatic transistor switching time test system, which will record switching time from 1nsec to 10 $\mu$ sec. This company also demonstrated their Model 2505 variable rise and fall time pulse generator, with repetition rates up to 25 Mc/s, pulse widths from 40nsec to 1 $\mu$ sec and rise/fall times from 20-500nsec.

Fairchild Semiconductors also showed an integrated circuit tester which tests both logic functions and input-output conditions on d.c. integrated circuits. Other Fairchild products shown included two semiconductor test systems, the Series 250 "go-no-go" multi-parameter tester and the Series 900 card-programmed data logger.

Hewlett-Packard showed increased diversification of not only instruments but also, via HP Associates, at Wescon for the first time, semiconductor products including step recovery diodes and fast switching diodes.

**High-frequency Semiconductors:**—Solid state devices for use in the microwave region will shortly be a reality, as semiconductor manufacturers become increasingly aware of the potentially large market in microwave equipment. V.h.f. transistors, varactors and tunnel diodes operating in the v.h.f.-u.h.f. range are now commonplace, and form the basis for a new family of devices. These will, according to some observers, eventually replace valves, ferrites and mechanical devices now used in radar and microwave communication systems.

Philco, for example, introduced a tunnel diode amplifier which is reported to provide a maximum noise figure of 4-5 dB and 18-20 dB of gain over bandwidths up to 20%. Current work at Philco includes microwave switching with diodes in the range 2,000 Mc/s to 20,000 Mc/s.

Motorola introduced an integrated circuit linear amplifier for r.f., i.f. and wideband applications from

d.c. to 300 Mc/s. This consists of a matched transistor pair interconnected with a diffused silicon bias resistor and a silicon oxide bypass capacitor.

Sylvania exhibited a series of p-i-n microwave switching diodes and a line of silicon epitaxial diodes for applications in the v.h.f.-u.h.f. region. Also on show was a diode switch with a turn-on time of 5nsec at 4,300 Mc/s.

Westinghouse were showing three new fast switching diodes and have a family of experimental high-frequency high-power devices at the laboratory stage.

Silicon planar transistors are now moving into the v.h.f. and u.h.f. bands. Powers of 10 to 30 watts were commonplace and the best of the v.h.f. power transistors with cut-offs of 100 to 700 Mc/s can produce around 6 dB gain at 100 to 200 Mc/s and oscillate up to 500 Mc/s. This order of performance seems to be achieved by variations on the "interdigitated" approach. In this technique, the emitter island is given a winding coastline to provide a large periphery, and in effect amounts to paralleling many high-speed geometry transistors. Thus the power-handling capability can be increased at no sacrifice to frequency response. Some of the manufacturers in this field were Bendix, Fairchild, Texas, Motorola and Clevite.

**Microcircuitry:**—These techniques formed a significant area in the semiconductor field, no fewer than 33 firms showing integrated circuits, not to mention the thin film exponents. Though techniques are advancing steadily here, low yield seems to plague silicon planar integrated circuits, most manufacturers considering a 10% yield better than average. General Electric were showing a simple reference amplifier series, RA1 to RA3, comprising two active elements, a transistor and a Zener diode. GE report superior temperature stability and economic advantages over conventional devices for this unit. Fairchild were showing their epitaxial micrologic elements designed for digital computer logic applications. These comprise, among others, buffer elements, flip-flops, gates, half-adder elements and half-shift registers. Fairchild claim that using a modified form of NOR logic, this family of elements permits the synthesis of all computer logic functions. Westinghouse (Molecular Electronics Division) were offering a custom-built integrated circuitry facility. This organization is capable of designing and fabricating "molecular" block functions using the customer's circuit as an analogue. Active equivalents available include diodes and field effect transistors using the silicon planar epitaxial technique. Signetics Corporation offered custom-built integrated circuits of a more limited nature in that customers could choose variations on a series of basic integrated circuit dice.

The thin-film solution to the microcircuit problem still has advantages over integrated circuitry in some applications and several firms were showing flip-flops and other logic elements.

**Laser Techniques:**—Lasers were well represented at Wescon, no fewer than 23 manufacturers showing their versions of these devices. The trend here is to make lasers commercially available (as distinct from laboratory devices), many firms quoting deliveries of 60 to 90 days. The RCA Lasecon (laser detector and converter) tube uses periodic permanent-magnet focusing and has a

semi-transparent photo cathode. Nominal frequency range (modulation) of the Lasecon with an L-band helix is from 1 to 2 Gc/s but, by using r.f. mixing, it can detect modulation from 0 to 4 Gc/s. RCA's GaAs laser, providing an emission wavelength of 8,400 angstroms, is also available. General Telephone and Electronics were showing their GaAs laser system. The type SL-6320 produces a coherent radiation at 8,450 angstroms when operated at 77°K. General Telephone and Electronics also had an interesting demonstration of laser communication possibilities. This was a system which achieved simultaneous transmission of two stereophonic radio channels over a single laser beam. Information is impressed on the carrier by duplex polarization of the light beam. The Perkin-Elmer Model 5200 gas laser is designed for both laboratory research and systems applications. Standard wavelength with the mirrors supplied is 6,328 angstroms, but it can also generate 1.15 or 3.39 microns. Light output of this device is polarized and in the fundamental mode the unit delivers 0.5 milliwatts. The Hughes Model 202 designed for experimental use in the laboratory or in industry, emits at 6,943 angstroms; total beam energy of 1 joule minimum, with 750 joules input and a nominal beam width of 10 milliradians. TRG Inc. reported that its Model 104 laser is being made commercially available. This pulsed ruby laser system is capable of outputs up to 3 joules at 6,943 angstroms.

**Computers:**—Though not catering specifically for the computer industry, Wescon attracted a representative selection of manufacturers in this field. The accent generally was on low cost general purpose computers with wide industrial as well as scientific applications. Digital Equipment Corporation for example had an interesting application for their PDP-5, said to be the most economical computer using a ferrite core memory. Allied to a pair of Nuclear Data analogue-to-digital converters, the PDP-5 was shown operating as an extremely flexible pulse height analyser. The usual disadvantages of a special-purpose analyser is inflexibility of its wired programme; the PDP-5 overcomes this to a large extent and has the additional advantage of being useful for a wide range of computation tasks when pulse height experiments are not being run. Having a memory cycle of 6 microseconds the PDP-5 can use some 3,800 of its 4,096 memory locations as channels and, since two A-to-D converters are used, multi-dimensional studies are quite feasible. Also from Digital Equipment Corporation, the PDP-4 was illustrated as an automatic checkout for digital modules. Shown with a Tektronix 567 oscilloscope, this computer was capable of performing an a.c. test such as rise-time, fall-time, pulse height, etc. in 100m sec, and a d.c. test in 50msec. A typical programme would run through 45 tests in less than 6 seconds. The LGP-30 computer, being shown by General Precision was oriented to the small organization, low volume application in business or engineering. Also having a memory of 4,096 words, the LGP-30 employs a magnetic-drum memory and has a minimum access time of 6msec. More ambitious, the Packard-Bell PB 440 computer has a memory capacity of 32,000 words and a 5µsec cycle time of its ferrite core memory. Among the peripheral devices available from Packard-Bell were their M20 and M21 analogue-to-digital converters. Having a pure binary or BCD output, the M21 is capable of 70,000 conversions a second with a conversion time of 1.2µsec.

**Instruments:**—Electronic test and measuring equipment formed a large part of the Show and here also the

mood was one of steady advance rather than startling innovation. Electro Scientific Instruments demonstrated a genuinely new range of instruments. Their new Model 120 Double Ratio Set was particularly impressive. Capable of 0.2 parts per million resistance comparison, this direct-reading double ratio bridge makes 1:1 or 10:1 resistance comparisons and eliminates lead and connection resistance errors by the use of the Wenner balance technique. The Model 701 capacitance measuring system features one part per million resolution (with direct readout in capacitance deviation) and an overall accuracy of 0.01%. The 242 resistance measuring system has been married to a punched tape data logging system giving an integrated systems capability with 0.01% accuracy. Mikros, a subsidiary of ESI, were showing for the first time their EM-20 electrostatic electron microscope. This has 10 to 40kV accelerating voltages, automatic vacuum system and built-in camera, as well as interchangeable lenses. Maximum resolution of this microscope is around 35 angstroms.

Atomic frequency standards have moved out of the research area into general engineering applications as demonstrated by Space Technology Laboratories. The products division of S.T.L. was showing its portable rubidium frequency standard Model 1000B. Having a short-term stability better than 1 part in  $10^{11}$  and long-term stability 1.5 parts in  $10^{11}$ , this unit obtains its stability by utilizing the atomic resonance of rubidium 87.

Tektronix showed a new addition to their oscilloscope range, the Model 647. Fully transistorized and meeting severe environmental specifications, it accepts plug-in pre-amplifiers which give it a bandwidth of z.f. to 50 Mc/s at 10 mV/cm, as well as sweep delay facilities. Hewlett-Packard's Model 140A is a versatile general purpose z.f. to 20 Mc/s oscilloscope accepting a wide variety of plug-in units in both axes. The Type 1415A plug-in unit was particularly interesting in providing pulse reflectometer facilities in the time domain. The Analab dual-trace storage oscilloscope uses a truly integrating storage tube as distinct from the bi-stable variety. The model 1220 will store images for several months and will store repetitive signals up to 100kc/s. The Singer-Metrics Panoramic SPA-12 spectrum analyser operates from 10 Mc/s to 64,000 Mc/s. Having sensitivities varying from -105 dBm at S band to -45 dBm at 64 Gc/s, the SPA-12 has a wide dynamic range, a precise 0-40 dB i.f. attenuator and a 5-inch c.r.t. The same firm was also showing a portable fully transistorized spectrum analyser. The TA-2 accepts plug-in modules and with the AR-1 unit has a frequency range of 20 c/s to 35,000 c/s; maximum sensitivity being 30µV full scale. E.H. Research showed a range of pulse generators including the new solid state Model 123. This pulser combines a maximum repetition rate of 20 Mc/s with rise-times of 5n sec and a 25-W average power pulse train. John Fluke, exponents of differential voltmeters, were demonstrating their new 831A Microvolt Potentiometer. Basically a Lindeck type potentiometer with built in null detector, the 831A extends the measurement capability of a differential voltmeter to 5µV full scale to an accuracy at  $\pm 0.05\%$ . Full scale ranges go from 5µV to 50mV and input impedance is infinite at null.

The Exact Electronics Type 200 is an interesting solution to the problem of waveform synthesis. With this instrument it is possible to build up a complex repetitive or transient waveform which is composed of 50 individual segments directly and independently controlled in amplitude, slope and time duration. A family of plug-in generators provides a selection of the controlling parameters for each increment.

D.L.

# LETTERS TO THE EDITOR

The Editor does not necessarily endorse opinions expressed by his correspondent.

## Transistor Cut-off Frequencies

THE purpose of this letter is to draw attention to some errors in the article under the above title in the September 1963 issue.

The significance of, and inter-relationship between the various cut-off frequencies has been discussed by a number of writers. Perhaps the most classical treatment is that of Hyde (ref. A). Some other relevant references are included in the review paper (ref. B) quoted below. This latter article, while not being a substitute for the accurate, formal treatments of Hyde and others, presents

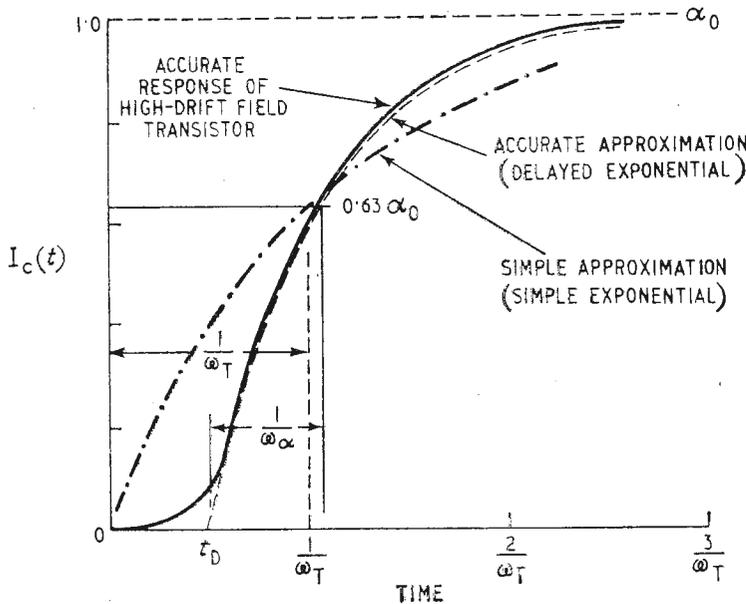


Fig. 1.

the following useful interpretation of the significance of the various cut-off frequencies.

For an ideal, intrinsic transistor, with or without a drift field, the collector current response to a unit step in emitter current has the general form shown by the heavy line in Fig. 1. This waveform may be determined, with difficulty, by analysis or, more easily, by direct measurements on an analogue. Experimental observations on actual, rather than ideal, transistors show similar collector current waveforms.

Subsequent mathematical manipulations may be simplified by the use of simple functional approximations to the time waveform:

An *accurate approximation* is to use the delayed exponential shown by the dashed line. This approximation is very accurate for times greater than  $t_D$  plus some small fraction of  $1/\omega_\alpha$ . The corresponding frequency variation of  $\alpha(j\omega)$  includes the time delay as an excess phase term, viz.:

$$\alpha(j\omega) = \frac{\alpha_0}{1 + j\omega/\omega_\alpha} \exp(-j\omega t_D) \quad \dots \quad (1)$$

for all frequencies up to a few times  $\omega_\alpha$ . Obviously, from equation (1),  $\omega_\alpha$  as defined in the time waveform is identical with the  $\alpha$  cut-off frequency as defined by Tilsley.

A *simple approximation* is to use the non-delayed exponential shown by the dotted line. This approximation may be written, for a unit step in emitter current, as

$$I_c(t) = \alpha_0 [1 - \exp(-\omega_T t)] \quad \dots \quad (2)$$

where  $\omega_T$  has a value such that the total charge  $Q$ , which must be stored in the transistor to allow a given output current to flow, is the same for both the accurate and the approximate case (see Fig. 2).

It is but a short step to show that  $1/\omega_T$  may be identified

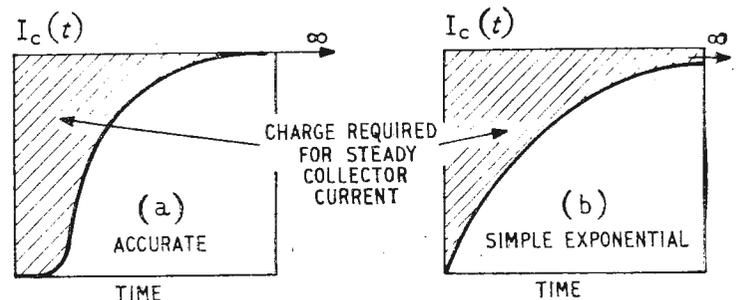


Fig. 2.

with the d.c. transit time,  $Q/I_c(\infty)$ , and that this approximation for  $\alpha(j\omega)$ ,

$$\alpha(j\omega) = \frac{\alpha_0}{1 + j\omega/\omega_T} \quad \dots \quad (3)$$

can be given an RC significance in equivalent circuits.

Now, for an ideal transistor,

$$\beta(j\omega) = \frac{\alpha(j\omega)}{1 - \alpha(j\omega)} \quad \dots \quad (4)$$

and if either the accurate approximation for  $\alpha(j\omega)$ , eq. (1), or the simple approximation, eq. (3), is substituted into eq. (4), the magnitudes are identical in the vicinity of  $\omega_\beta$  (the  $\beta$  cut-off frequency) and for a decade or more beyond  $\omega_\beta$  (see Fig. 3).

Further insight into the relationship between  $\omega_\alpha$  and  $\omega_T$  may be obtained from an accurate polar plot of  $\alpha(j\omega)$ . As shown in Fig. 4  $\omega_\alpha$  is the frequency at which the  $\alpha(j\omega)$  locus cuts the 3dB circle, whereas  $\omega_T$  is the frequency at which the real part of the  $\alpha(j\omega)$  locus is 0.5.

From these and other considerations the following detailed criticism of Tilsley's work emerges.

(1)  $f_\alpha$ ,  $f_1$  and  $f_T$  are not "all virtually the same fre-

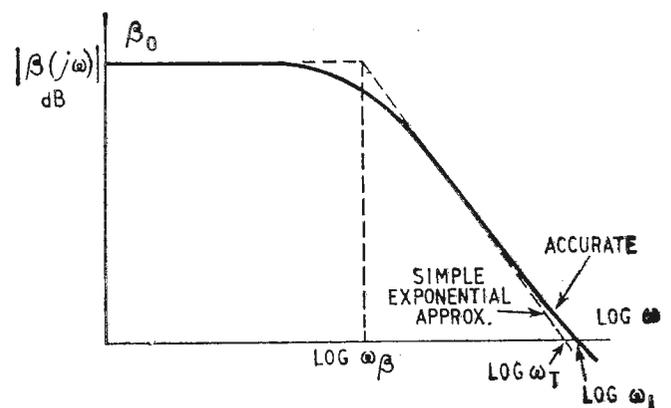


Fig. 3.

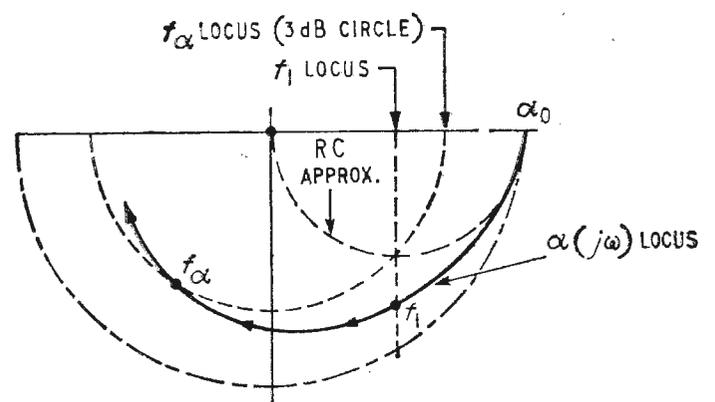


Fig. 4.

quency." The frequency  $f_\alpha$  always exceeds  $f_1$ ; the discrepancy is 22% for low-drift transistors and may reach 100% for high-drift-field transistors.

(2)  $f_\beta$  is related simply and directly to  $f_1$  and not  $f_\alpha$ , viz.

$$f_\beta = f_1/\beta_N$$

(3) The relationship (by eq. 4) between  $\alpha$  and  $\beta$  involves vectors and Tilsley's calculation of a  $\beta$  magnitude of 2.3 when  $|\alpha|$  is 0.7 is erroneous.

(4) The derivations given in the article are based on the simple RC approximation to  $\alpha(j\omega)$  (shown by the dotted line in Fig. 4). It is certainly not valid to use this low-frequency approximation to establish relationships between high-frequency parameters. As an exercise in circuit theory, Tilsley's equation

$$f_1 = f_\alpha \sqrt{2\alpha_0 - 1}$$

is quite correct, but this circuit theory is applied to an inaccurate physical model and the result just cannot account for the observed differences between  $f_1$  and  $f_\alpha$ .

(5) It might be argued that the foregoing comments are somewhat academic, and that even a 100% discrepancy between  $f_1$  and  $f_\alpha$  is not large in comparison with the spread in cut-off frequencies for any given transistor type. However, from a purely applications viewpoint, Tilsley's misconception on the significance of  $f_\beta$  is of vital importance. While admitting that the gain-bandwidth product is  $f_1$  (actually it is  $f_T$ ), he suggests that the bandwidth of both common emitter and common collector stages is limited to  $f_\beta$ . This figure only holds for the completely unrealistic case of a current source feed; for practical wide-band amplifiers relatively low source impedances are used and the stage bandwidth is much greater than  $f_\beta$  and can approach  $0.5f_T$ .

(6) A final comment concerns the use of the symbols  $\omega_T$  and  $\omega_1$ . In this letter I have adopted Tilsley's convention but my personal preference, and a convention adopted by some other writers, is to use  $1/\omega_1$  as the transit time for an ideal transistor and  $1/\omega_T$  as the transit time for an actual transistor.

Harwell, Berks.

D. E. HOOPER

Electronics Division, U.K.A.E.A.

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(A) Hyde F., "The Current Gains of Diffusion and Drift Types of Junction Transistors." *Proc. I.E.E.*, Vol. 106, B Supplement, 17th March 1960, p. 1046.

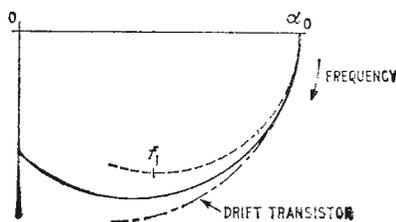
(B) Hooper, D. E., and Turnbull, A. R. T., "Applications of the Charge-Control Concept to Transistor Characterization." *Proc. I.R.E. (Aust.)*, Vol. 23, March 1962, p. 132.

#### The author replies:

Other letters have been received, and in replying to Mr. Hooper, I hope that I am answering other correspondents.

The article was intended as an introduction to the difficult subject of the high-frequency behaviour of transistors and since it catered for readers unfamiliar with this subject, it is almost inevitable that those who have made a special study of this field would find it oversimplified and to that extent inaccurate.

(i) Perhaps the central point is my assertion that  $f_\alpha$ ,  $f_1$  and  $f_T$  are all roughly the same frequency. If  $\alpha$  is plotted as a complex quantity at different frequencies, then a curve of the form  $\alpha = \alpha_0 \operatorname{sech} \sqrt{j\omega\tau_D}$  is obtained for the internal current gain, where  $\alpha_0$  is its low frequency value, and  $\tau_D$  is the minority carrier diffusion time constant across the base region. This is shown in the diagram. In the article I was simplifying this to the dotted semicircle, and this is equivalent to taking only the first two terms of the expansion of  $\operatorname{sech} \sqrt{j\omega\tau_D}$  in series



form. It is true that drift transistors deviate even further from the semicircle and perhaps I should have mentioned that then my approximation would be a very rough one. At normal frequencies of operation, and up to  $f_\alpha$ , I maintain that this semicircular approximation is permissible as a first approach, and with this simplification  $f_\alpha$ ,  $f_1$  and  $f_T$  are indeed identical. I consider that the more refined theory which gives  $f_\alpha = 1.22f_1$  more suitable for an advanced treatment, and for this Mr. Hooper's own paper in *Proc. I.R.E. of Australia* is excellent.

(ii) Since, in the approximation I have used,  $f_1$ ,  $f_\alpha$  and  $f_\alpha$  are taken as the same frequency, it is immaterial whether one writes  $f_\beta = \frac{f_1}{\beta}$  or  $f_\beta = \frac{f_\alpha}{\beta}$

(iii) In the  $f_\beta$  section of the main text of the article (as distinct from the "Derivations" section at the end), I purposely avoided any  $j$  terms which might not have been understood by all readers. My sole intention here was to show by using nothing more than simple arithmetic that  $\beta$  will fall off much more rapidly than  $\alpha$ , and that it is not unreasonable for  $f_\beta$  to be about  $\frac{f_\alpha}{\beta}$ .

In the "Derivations" section, which I hoped would be read by those wishing a somewhat fuller treatment, I presupposed a knowledge of  $j$  and gave the correct proof. (But this, of course, also assuming a semicircular locus for  $\alpha$ ).

Mr. Hooper may consider this oversimplification to be wrong, but I hope he does not think that I didn't know any better!

(iv) The expression  $f_1 = f_\alpha \sqrt{2\alpha_0 - 1}$  is also based on the semicircular locus, which Mr. Hooper considers to be founded on an inadequate physical model. Here again I must stress that I was reducing the subject to its very simplest terms consistent with obtaining useful results for those approaching the subject for the first time.

(v) Mr. Hooper is quite correct. I was considering the case of current-fed stages, which is a common assumption in elementary treatises. As he says, wide-band amplifiers fed from low source impedances can give much higher gain-bandwidth products.

I feel that the differences between the results obtained from the greatly simplified approach I adopted and those obtained from the fuller and more exact treatment Mr. Hooper proposes, are of importance only to those who already have a good understanding of this subject, and to whom the article would be quite superfluous anyway.

I would prefer readers to understand an approximate treatment than to be unable to follow a more exact one.

This one can find in any good text-book.

D. N. TILSLEY

## Noise in Audio Amplifiers

I FEEL there are certain false approximations and surmises used by Mr. Tharma ("Noise in Audio Amplifiers," Sept. issue) which can influence some of his conclusions.

In order to obtain data on tape noise spectrum he has adapted curves given in his reference 2, which relate to measurements taken with full track system at a tape speed of 15 in/sec and equalized to N.A.B. standards, which he has merely bodily lowered by 10 dB in order to compare results with a  $\frac{1}{4}$  track system at 3.75 in/sec.

First, the reduction in output e.m.f. produced by quartering the track width will be 12 dB (actually this will be more since  $\frac{1}{4}$  track standard is less than this fraction of  $\frac{1}{4}$  in tape) and not 10 dB as estimated. The reduction in tape speed has no effect on the head output e.m.f. for the same recorded low frequencies. From Tharma's reference 4 (page 193) the output e.m.f. of a magnetic head is given by:—

$$V = 4.44 \Phi f N \text{ (Volts)}$$

where  $\Phi$  is the total useful flux;  $f$  = frequency and  $N$  the number of turns in the head windings.

Secondly, the reduction in tape speed will lower the pass band of the system and would thus alter the "character" of the noise spectrum. Fig. 8 and Fig. 10 show the

noise spectrum extending to beyond 15 kc/s which is applicable to the original reference at the higher tape speed but can be considered to exceed normal performance at 3.75 in/sec.

Thirdly, the derivation of the head output e.m.f. for a 2H head by use of the expression  $V_s = 3 \sqrt{L_s}$  mV at 1 kc/s, seems vague in the lack of including any known magnetic tape flux value. Reference is made to "full modulation on tape" but this has not been defined. If full modulation means a system in which all the parameters have been adjusted for maximum output (at the stated frequency) i.e. maximum sensitivity for a particular tape medium, then the figure of 4.2 mV for a 2H head seems unduly low.

Fourthly, the reference data on tape noise spectrum was originally subjected to N.A.B. equalization of 50  $\mu$ sec (turnover point 3.2 kc/s, where the ear is most sensitive) and cannot therefore be used to give a true comparison with a 3.75 in/sec system the equalization of which is normally 140  $\mu$ sec to 200  $\mu$ sec (1.3 kc/s—800 c/s).

Finally, the reference tape noise spectrum was obtained with a particular tape (Irish 211) which was subjected to a bias level corresponding to "peak output for a 1kc/s signal." The resulting data is therefore only applicable to "zero modulation noise" and it specifically excludes "modulation noise" which exists only in the presence of a signal and is a function of the instantaneous amplitude of the recorded signal. The data, therefore, cannot be used to arrive at a dynamic signal-to-noise ratio, but would be applicable for an assessment of a basic background tape noise during modulation pauses. If a "zero modulation" tape noise quantity is shown as a ratio of a signal at maximum recording level, a typical figure will be 60 dB. However, for the same medium a "modulation noise" ratio carried out to DIN 45 519, sheet 2, will indicate a "signal-to-modulation" noise ratio of only 35 dB.

London, N.W.7.

R. G. T. WARREN

*The author replies:*

Mr. Warren's comments are very interesting, but these do not affect our conclusions.

Inaccuracies of a few dB in the tape noise spectra are not significant as the noise spectra of the amplifiers are about 15dB below tape noise.

The differences between the spectra with AC107 and EF86 do not depend on the actual signal output from the head. So our conclusions are valid, irrespective of whatever heads or signal levels are chosen.

Obviously, as the amplifier noise is well below tape noise, it is also very much below modulation noise.

P. THARMA

## Tape Guides

HAVING read with interest the recent correspondence on materials for tape guides, I'd like to suggest an explanation.

Although ideas in electrostatic forces have been introduced it seems probable that such forces would still be quite small compared with the simple mechanical friction, and it is thermal conductivity rather than electrical conductivity which may influence the result. Similar effects are well known to mechanical engineers in relation to bearing metals.

When tape is driven past a tape guide, work is done in overcoming the force of friction between the two materials. The work done is equal to the distance moved by the tape and the friction force opposing the motion. This work is converted into heat in the small areas of contact which rise in temperature until equilibrium is reached between heat generated and heat dissipated. Because the contact areas are small the temperature rise may be sufficient to melt the contact "peaks" on the tape guides. The corresponding area of tape involved is so much greater that heat is more

readily dissipated and melting is much less likely to occur and even more less likely to be detected.

This phenomenon of local melting, followed by adhesion and tearing is commonly observed in metal bearings which have been overloaded or underlubricated. The lubricant in well-designed bearings not only increases bearing support area and substitutes fluid friction for friction between solids, but also helps greatly to conduct the heat away without excessive temperatures. Lubricants are not easily applicable to tape guides. The high temperatures generated by rubbing solids is well known by the famous method of starting a fire by rubbing dry sticks together, dry sticks are poor thermal conductors.

If the above ideas apply, one would expect that the most suitable materials for tape guides would have a high melting point and preferably a high thermal conductivity as well as low coefficient of friction. The familiar highly polished, heavily chrome-plated metal guides satisfy this requirement well. Glass apparently succeeds, despite poor thermal conductivity, because of its high melting point compared with synthetic materials like p.t.f.e.

When local melting of tiny rubbing areas on tape guides takes place, irregular adhesion is likely to follow. the irregular dragging force in the tape would then be expected to cause elastic oscillations or flutter in the tape movement as has been observed.

London, N.W.10.

W. G. EALY

## Electrostatic Attraction

BEFORE we spend time pondering upon the scientific implications of the tingling sensation experienced by Mr. Priestley (p. 501, Oct. issue), when he touched his wife's hand, could he please confirm that he was not on his honeymoon at the time?

Send, Surrey.

P. J. LEE

## N.T.S.C. Colour

MAY I "rise to defend" the N.T.S.C. colour system, as used in my country for some years, especially to correct what I regard as a few misconceptions as expressed in the article in the September issue of W.W.? For one, the service problem: having recently had occasion to make a survey along these lines in connection with my own work, I can report that the unanimous opinion of dealers' service managers, and independent technicians, is that colour sets require "far less service than black-and-white"! (Direct quote from several.) This may be due in part to somewhat more careful construction, or closer quality control inspection, but it is a fact. My own experience verifies this.

As to assorted distortions and differential fadings, etc., I may hold the world's record for continuous long-distance colour TV reception; my best colour station is over 200 miles from my home in the Arkansas Hills. During more than eight years of every-day observation, I have had very little trouble with colour, *per se*; in fact, one of my favourite "prop stories" concerns the time when a signal faded completely out, leaving a Cheshire-cat-like bright red sweater worn by a lady as the only distinguishable object on the screen! Experimentally turning the colour off eliminated this, leaving nothing but snow! There have been difficulties, of course, but no more than in black and white, and very few of them attributable solely to colour. Colour transmissions have, in general, been of excellent quality, especially the live shows. There have been some difficulties on the taped shows, but the consensus of opinion among transmitter engineers seems to be that this is due mainly to inexperience on the part of network operators, and not to any basic faults in the equipment. Tape transmissions, as of now, are generally slightly inferior

in quality to live transmissions, but this can, and undoubtedly will, be remedied in the future.

I favour the inclusion of what we call "Color" (intensity of colour, or saturation of colour) and "Hue" (the actual "colour of the colour" or tint) controls, for customer operation. Just as brightness and contrast controls allow for an infinite range of adjustment on B/W pictures, from very pale to very dark, so do these controls allow the user to set up the picture to suit his own individual ideas! This, I should say, makes for better customer satisfaction with the whole idea. I've seen, in making service calls and demonstrations, how wide the range of "proper adjustment" can be! One will set up the screen with colours barely visible; another to what your author describes quite aptly as rude almost indecent health!

The only difficulty I've encountered, in actual field work, is of the type I ran into when setting up a colour TV for one married couple whose contentiousness was known far and wide. I set up the screen according to my own ideas. He promptly said, "It's too blue"; she replied, "No, too green!" So I tried to find a compromise setting. No luck. Finally, in desperation, I showed them both how to work the colour controls, and said quietly, "There it is—from now on you can set it up to suit yourself!" and disappeared into the wood-work! So they argued happily all that winter about whether the faces were bluish or greenish! This was not as bad as it sounds, as they had about run out of fresh subjects for argument anyhow, and they are now getting along better (outside of viewing hours) than ever before!

A final word as to cost. From what I have seen of the prices, we can expect to see colour TV sets ranging from \$400.00 upwards. Most manufacturers use the same chassis in all models, the sole difference being the cabinetry used. Motorola is in production on the new 90-degree rectangular colour picture tube, using a modification of a previous chassis aside from the special circuitry required to attain good convergence in the corners; most others use the original R.C.A. shadow-mask tube. As far as I can gather, aside from these, there are no plans to produce in commercial quantities any types of colour sets other than these two. Set-makers are still busily conducting colour schools for servicemen, and these are well attended. Dealers are reporting greater colour sales than ever, and one large dealer actually had more colour TV sets on his sales floor than black and white!

Mena, Arkansas, U.S.A.

JACK DARR

## Wireless Telegraphy in the Royal Navy

WHILE supporting the principal contention of "Free Grid" in your issue of April 1963 ("Unbiased," p. 203) that wireless telegraphy was used by the Royal Navy for several years before the first installation in a merchant ship, I feel that he tends to overstate his case when he claims "the R.N. was using wireless . . . in 1893." It is true that Sir Henry Jackson probably already had the idea of wireless telegraphy in 1893 (a good many people had); he was unable to put the idea into practice for at least two years.

My researches into this period are, as yet, not sufficiently complete to give an exact date to the first R.N. experiments, but we already know the year from Sir Henry's own statement: "In 1895, systematic experiments were commenced by me with a view to utilizing the effect of Hertzian waves on imperfect electrical contacts, for naval signalling purposes." (*Proc. Roy. Soc.*, Vol. 70A, p. 254: 1902.) This means that the first trials were about a year later than those of Lodge and roughly contemporary with those of Marconi.

Nevertheless, the Royal Navy was the pioneer of maritime radio, and not only on a basis of early experiment. The practical value of wireless telegraphy at sea was demonstrated as early as 1899, when Marconi sets were installed in three cruisers for the annual manoeuvres

(see G. Marconi "Wireless Telegraphy" *Nature*, Vol. 61, pp. 377-380: 1900). This is approximately two years before the first Marconi installation in a merchant vessel.

Scampton, Lincoln. ROWLAND F. POCOCK

## Television in Hospitals

THE regulations governing the hiring of television receivers make special provision for the short-term needs of patients in private rooms. It would not be illegal for me to hire a television set for my wife, who will be in hospital for the next fortnight, although I may not hire one for myself for less than three months.

I am concerned, however, with the possible, not the permitted. One large hiring service will not consider contracts below three months, another quotes a minimum charge of £8. I have been urged to have a 625-line set, although it was admitted that I should then have to pay for an aerial. It is not certain whether a receiving licence would also be needed: if so, the total cost amounts to roughly £1 a day, even without the pleasure of watching Band IV test programmes.

Surgical cases are usually adequately identified: after all, the surgeon does not want them to disappear without paying his fee. Since even the Board of Trade has shown some consideration for hospital patients, could not the rental companies risk a few portable sets for the prudent sick who have insured themselves against the long wait for the public ward.

London, W.8.

THOMAS RODDAM

The arrangement to which Mr. Roddam refers is not inherent in the regulations, but is a concession granted at discretion to local dealers who must themselves apply to their regional office of the Board of Trade.—ED.

## RADIO COMMUNICATIONS EXHIBITION

THIS year's International Radio Communications Exhibition, previously known as the Radio Hobbies Exhibition, which opens at the Seymour Hall, Seymour Place, London, W.1 on October 30th for four days, is the sixteenth in the series sponsored by the Radio Society of Great Britain. The show will be officially opened by F. C. McLean, B.B.C. Director of Engineering, at 12.0 on the first day.

The R.S.G.B. will be operating two stations at the show one using the Society's headquarters call GB3RS and the other using GB2VHF. The latter call has been granted by the Post Office especially for use at mobile rallies, etc. As this is the jubilee year of the Society a display of historic equipment is included.

As will be seen from the following list of exhibitors there are a number of "users"—both professional and amateur—as well as manufacturers and suppliers of equipment taking part.

A feature of the exhibition is the annual competitions for home constructed and commercial equipment. On the W.W. stand will be demonstrated some of the recently described pieces of equipment including the W.W. oscilloscope, stereo balancer and audio signal generator.

Admission to the show, which opens daily from 10.0-9.0, costs 3s.

Aveley Electric.  
Amateur Radio Mobile  
Society.  
British Amateur Television  
Club.  
B.B.C.  
Daystrom.  
Electroniques (Felixstowe).  
Enthoven Solders.  
G.P.O. Engineering Dept.  
Green & Davis.  
Hammarlund.  
J-Beam Aerials.  
K.W. Electronics.  
Minimitter Co.  
Philpott's Metalworks.

R.S.G.B.  
Ralfe Radio.  
Roding Boys' Society (Radio  
Group).  
Royal Air Force.  
Royal Navy.  
Royal Signals—Special T.A.  
Communications Regt.  
Salford Electrical Instruments.  
Selray Book Company.  
*Short Wave Magazine*.  
Stern-Clyne.  
Webbs Radio.  
Withers Electronics.  
*Wireless World*.

## U.K.-Eire Section of I.E.E.E.

THE Institute of Electrical and Electronics Engineers, formed by the amalgamation of the American Institute of Electrical Engineers and the Institute of Radio Engineers, is a "non-national" society with interests in all parts of the world. The European Region 8 is regarded as being bounded by the Urals and the north coast of Africa and already includes sections in the Benelux countries, Egypt, France, Israel, Italy, Norway and Switzerland. The formation of a United Kingdom and Eire Section is now announced with headquarters at 2 Savoy Hill, London, W.C.2, where the I.E.E. has offered facilities for meetings, and office assistance. Officers of the new Section are Dr. R. C. G. Williams (chairman), Sir Harold Bishop and Sir John Hacking (vice-chairmen), Dr. R. L. Smith-Rose (treasurer), F. S. Barton (secretary) and R. C. Winton (assistant secretary/treasurer). Pending the establishment of an executive committee, an advisory committee drawn from the power and electronics sides of the profession will act on behalf of the I.E.E.E. Board of Directors. Its constitution is as follows: Dr. T. E. Allibone, Sir Edward Appleton, Sir Noel Ashbridge, Prof. H. E. M. Barlow, S. L. M. Barlow, F. S. Barton, P. A. T. Bevan, Sir Harold Bishop, C. O. Boyse, Dr. R. C. Cuffe, B. Donkin, Dr. P. Dunsheath, B. de Ferranti, Sir Archibald Gill, Sir John Hacking, D. P. Sayers, Dr. R. L. Smith-Rose, Dr. R. C. G. Williams (chairman) and A. J. Young.

Membership of the new Section is approximately 1,100. Total membership of the I.E.E.E. is 160,000 and of the I.E.E. 50,000.

## Compatible S.S.B. Modulation

THE B.B.C. are to test compatible single sideband (c.s.s.b.) modulation equipment developed in the Eindhoven research laboratories of the Philips Group. If these laboratory tests prove satisfactory, the B.B.C. may apply to the P.M.G. to operate an experimental c.s.s.b. transmitter in the h.f. band.

This method of modulation, which basically, is an amplitude modulation system having the advantages of s.s.b., yet can be detected with a conventional envelope detector (as in a domestic receiver) without introducing distortion, has been known for a number of years. Probably the best known of the earlier systems, which have been developed for h.f. and m.f. applications, is that of Leonard R. Kahn and a paper by him titled "A compatible single sideband modulation system" appeared in the *Proceedings of the Radio Club of America* in March, 1958. The system the B.B.C. is to test, which has the same objectives as the Kahn system although it makes use of some different theoretical principles, is described in the paper "A method for obtaining compatible single sideband modulation" by van Kessel, Stumpers and Uyen in the February, 1962, issue of the *E.B.U. Review* (No. 71A).

The Netherlands radio authorities have already undertaken some experimental transmissions and it seems to be clear from these and other experiments that the system has several advantages over the conventional amplitude modulation systems. These include a better signal-to-noise ratio for an identical transmitter power (and will therefore increase the service area of the transmitter) and a reduction in adjacent channel interference (assuming the correct sidebands are chosen and the transmitters are strategically placed).

The results of the B.B.C.'s tests will be made available to the C.C.I.R.

## COMPAC Complete

ON the 10th October the final splice in the 8,700-mile Commonwealth Pacific telephone cable (COMPAC) was made off Leeward, Oahu, one of the Hawaiian Islands in the Pacific. Extensive testing and "lining up" of the cable and the shore-based stations, which control the repeaters, is under way and the system is expected to come into operation early in December, linking Canada with New Zealand and Australia. This is the second phase in the U.K. to the Far East telephone link and, using the transatlantic cable CANTAT—which was commissioned in December 1961—and a new 3,000-mile microwave link spanning Canada, will provide 80 simultaneous telephone channels between the U.K. and Australia. London and Sydney telephone operators will be able to dial right through to subscribers at each end of the link and any of the 80 telephone channels can carry up to 22 telegraph circuits.

The cost of COMPAC, which has been jointly financed and organized by Britain, Canada, New Zealand and Australia has been put at £26,000,000. The third phase of the project is the laying of the South-east Asia Commonwealth cable (SEACOM), which will connect Singapore, Hong Kong, North Borneo and New Guinea to Australia and is scheduled for completion in 1966.

## Modifications to Rugby GBR

TO improve the constancy of signals radiated by GBR (Rugby) at 16kc/s, modifications have recently been made to the aerial coupling circuit. Frequency is normally held to a few parts in  $10^{10}$  but changes of aerial radiation impedance due to icing, low clouds and movement in high winds can cause not only 50% fluctuation of radiated power but also changes of phase, amounting to as much as  $\pm 45^\circ$ .

Formerly, long-period changes have been compensated manually by adjustment of a variometer forming part of the aerial inductance. Now the variometer is servo-controlled, the phase of the aerial current being compared with a reference derived from the output of the final amplifier. The new system is capable of responding to changes of tune during a single telegraph element of 20msec and with a residual phase error of less than  $\pm 1^\circ$ .

To complete the stabilization the main aerial tuning coils, wound with 6561/36 Litz cable on 16ft-diameter wooden spiders, have been stiffened to overcome phase jitter caused by electromechanical vibration at about 3 to 5c/s during on-off keying.

The overall performance is now such that the aerial current is constant to 0.1% and the phase relative to the crystal drive is generally within  $0.5^\circ$  with occasional excursions to  $1^\circ$ .

The station is widely used as a frequency standard and for comparison of time signals.

**British Weeks in Europe.**—The Export Council for Europe has announced that next year's "British Weeks" are to be held in Düsseldorf (23rd-31st May) and Copenhagen (25th Sept.-4th Oct.). Comprehensive handbooks have been prepared and are available from the Export Council for Europe, 21, Tothill Street, London, S.W.1.

**B.C.A.C. changes to U.K.A.C.**—At the annual general meeting of the British Conference on Automation and Computation Council held in London on 9th October, agreement was reached to adopt the new name of United Kingdom Automation Council. J. F. Coales, O.B.E., Reader in Engineering at Cambridge University, was elected chairman of the Council in succession to Sir Walter Puckey. A list of the 33 professional institutions—including the British Computer Society, the Brit.I.R.E., the I.E.E., the Inst. of Physics & Phys. Soc., and the Society of Instrument Technology—which constitute the membership of the Council may be obtained from the honorary secretary, F. Jervis Smith, c/o I.E.E., Savoy Place, London, W.C.2.

**TV for Kuala Lumpur.**—A Band III 625-line television service is scheduled to start in Kuala Lumpur, Malaya, next month. This is the second city in Malaya to have television, as a service was started in Singapore last April, and is part of the first phase of the Malaysian Television Service. Pye T.V.T. Ltd. supplied and installed the Kuala Lumpur 5kW transmitter and E.M.I. Electronics Ltd. have been awarded a contract to supply £100,000 worth of studio and o.b. equipment. The transmission and studio equipment for the Singapore service, which now operates on two Band III channels, was supplied by the Marconi Company (reported in the April issue). The associated o.b. equipment is Japanese.

**African Communications.**—The International Telecommunication Union (I.T.U.) has sent a small mission to Addis Ababa to assist in establishing the future telecommunications network of Africa. The aim of the mission is to bring about increased direct communication facilities between African countries. The I.T.U.'s assistance was requested by the Executive Secretary of the United Nations Economic Commission for Africa.

**A.F.C.E.A.**—The new president of the London Chapter of the American Armed Forces Communications-Electronics Association is Capt. J. R. Penfold of the U.S. Navy. As the membership of the Chapter includes many British electronics engineers several members of the executive committee are British. H. Schwartz (Decca) is 2nd vice-president, and Sir Reginald Payne-Gallwey (consultant), L. T. Hinton (S.T.C.) and W. C. J. Nixon (G.E.C.) are associate vice-presidents.

**Apprenticeship Awards.**—At the M-O Valve Company's apprentices' open evening (4th Oct.) completed indentures were presented and also two special awards for the year's best apprentices—M. A. Corden (electrical) and C. R. Maund (mechanical). In addition to craft apprenticeships, which now also include glass engineering, the firm offers technician and student apprenticeships, the latter leading to the Dip.Tech. in applied physics or electrical or mechanical engineering.

**Schools Lectures.**—Among the series of lectures at the Royal Institution for sixth form boys and girls from schools in the London area is one by Sir Lawrence Bragg on electricity and magnetism. It will be given at 5.30 on 5th November and repeated on the 6th, 12th and 13th. Prof. R. L. F. Boyd will lecture on the exploration of the upper atmosphere by space vehicles on 26th November and again on the 27th and December 3rd and 4th. Applications for tickets should be made to the Royal Institution, 21 Albemarle Street, London, W.1.

The Electronic Engineering Association has now issued Section 2 of its "Guide for joints on electronic equipment" dealing with "crimped joints for general purpose electronic cables." Copies of this guide are available from 11 Green Street, London, W.1.

Total attendance at the **Berlin Radio Exhibition**, which closed on 8th September, was 417,500. At the last exhibition in 1961 there were 387,500 visitors.

**I.F.A.C. World Congress.**—The International Federation of Automatic Control held its second world congress in the Swiss Industries Fair building in Basle, Switzerland, over the period 26th August-4th September. J. F. Coales, from Cambridge University, has been appointed the new president in succession to Professor E. Gerecke, who retired at the congress on the completion of his term of office. The next I.F.A.C. Congress is to be held in London in June, 1966.

**U.H.F. Television Stations.**—According to the latest edition (No. 8) of the list of European television stations issued annually by the European Broadcasting Union there are now about 150 u.h.f. television stations operating in Western Europe. Over 90 of the stations are in the Federal Republic of Germany and some 50 in Italy. The publication, which lists the stations in all four television bands, is obtainable from the E.B.U., Technical Centre, 32, avenue Albert Lancaster, Brussels, price 50 Belgian francs, and includes six bi-monthly supplements.

The end-of-the-year vacancies on the board of the **I.E.E. Electronics Division** are being filled by the following: P. A. T. Bevan (I.T.A.) and Prof. A. L. Cullen (Sheffield Univ.) as vice-chairmen, and Dr. R. L. Beurle (Nottingham Univ.), H. V. Beck (Marconi Inst.), W. J. Bray (G.P.O.), E. M. Hickin (G.E.C.), Dr. D. W. Hill (Royal College of Surgeons), J. Redmond (B.B.C.), Dr. K. F. Sander (Cambridge Univ.) and S. G. Young (G.P.O.), as ordinary members.

*H.M.S. Leander* is the first of several vessels of the Royal Navy to begin testing a new anti-submarine device known as **Variable Depth Sonar**. This device is towed behind the ship and can be lowered to considerable depths to enable a sonar beam to be transmitted below the reflecting temperature discontinuity layers which often impede the passage of sonar transmissions from hull-mounted apparatus. The equipment, which was developed in Canada by E.M.I.-Cossor Electronics Ltd., in conjunction with the Canadian Defence Research Establishment, has proved very successful in trials undertaken by the Royal Canadian Navy.

**Another Anglo-American Link.**—The transatlantic telephone cable TAT-3, linking Britain to the United States, came into service on 16th October, just five weeks after *C.S. Long Lines*, the American cable laying ship, left Southampton with 1,700 n.m. of S.T.C. cable to complete the American end of the project. Details of TAT-3 were given in the October issue, p. 502.

**Band III B.B.C. Station.**—The B.B.C. is to build a Band III television station at Winter Hill, Lancashire, to reinforce the existing Band I service from Holme Moss. Temporary arrangements are being made to enable transmissions, on Channel 12, to start at the beginning of next summer and the permanent installation—which, incidentally, will share the same site as the present I.T.A. station—should be completed in 1965.

The **Electrical Research Association**, of Cleeve Road, Leatherhead, Surrey, has issued a booklet "E.R.A. Electronics" to show more clearly what the Association is doing in the electronics field. It describes briefly the work being done on the electrical properties of thin films, on component reliability, etc.

The third **Industrial Photographic and Television Exhibition** opens at Earls Court on 11th November, for six days. It is open daily from 9.30 to 6.0 (4.0 on Saturday).

**ILMAC 1966.**—The third international exhibition and congress of laboratory, measurement and automation techniques in chemistry (ILMAC) will not be held until 1966. The dates are 17th-22nd October and the venue Basle.

# NEWS FROM INDUSTRY

**International Computers and Tabulators Ltd.** have acquired the computer department of Ferranti for a consideration of £6.25M (1,900,000 fully paid shares and £1.5M in cash). The personnel of the Ferranti computer department, which total over 1,900, have been invited to join the I.C.T. organization. Basil Z. de Ferranti, M.P., who will remain a director of Ferranti, has been appointed deputy managing director of I.C.T. The digital systems department of Ferranti, at Bracknell and Oldham, which designs and manufactures digital and data-transmission equipment principally for military and other special applications, will not be transferred to I.C.T., nor will the industrial control systems department at Wythenshawe.

**Electric and Musical Industries Ltd.** have announced that their group profits for the year ended 30th June topped the £5M mark. Net profit amounted to £2,405,000 and showed an increase of £89,000 on the previous year's results. Incidentally, the directors said the electronics side of the business for the year had been very disappointing.

Net profit of **Telefunken G.m.b.H.** for the year ended 31st March amounted to £1,750,000 (DM 19,600,000) and represents an increase of £187,500 (DM 2,100,000) on the previous year's results. Sales compared with 1961/62 increased by 11% to £73,661,000 (DM 825,000,000).

Profits before taxation of **Decca Ltd.** and its subsidiary companies were slightly up this year (ended 31st March) at £2,958,000 as against £2,930,000 in the previous year. Net profits were, however, slightly lower at £1,444,000 as against £1,482,000 due to increased taxation.

**Waveforms Limited**, makers of the "Graph" range of oscilloscopes, has been acquired by the Metal Industries Group. The future activities of Waveforms are at present under review and for the time being all operations of the company will be conducted from the M.I. subsidiary Avo Ltd. of 92-96 Vauxhall Bridge Road, London, S.W.1.

**Anglo-French Agreement.**—The Marconi Company has signed an agreement with Compagnie Française Thomson-Houston to produce jointly a new secondary surveillance radar ground interrogator system. The equipment for this system, which is to be known as SECAR, uses transistors throughout, with the exception of the high-power output stage. Technical discussions between the two companies have been in progress since the end of last year and the main units are now in course of production.

**£1M Orders a Month.**—Sir Gordon Radley, chairman of English Electric-Leo Computers Ltd., has announced that his company has received orders at the rate of £1,000,000 a month since April this year when the company was formed, following the merger of Leo Computers Ltd. and the data processing division of English Electric.

A series of one-day exhibitions is being arranged by **Cossor Electronics Ltd.** to display their latest test gear, v.h.f. communications equipment, delay lines and other apparatus. The first two shows of the series are to be held at Queens Hotel, Manchester (13th November) and Grand Hotel, Bristol (26th November). Invitations may be obtained from the sales manager of the instrument division of Cossor Electronics Ltd., The Pinnacles, Harlow, Essex.

The **Solartron Electronic Group** have received an order to the value of £70,000 from the Air Ministry for six specialized direction-finding simulators. These simulators are to be used to train airfield controllers in the operational aspects of surveillance and secondary radar d.f. equipments. Solartron have also received an order from the Royal Navy for a "surface tactical and blind pilotage trainer," which has been designed to provide simulated radar information to several "model" ships simultaneously.

**Standard Telephones and Cables Ltd.** have been awarded a £200,000 contract for a new microwave telephone link between London and Bristol. The London terminal of the new link, which will operate in the 4,000Mc/s frequency band and provide 960 telephone circuits, will be the new Post Office radio tower.

**Kelvin Hughes** have installed one of their radar systems in the new British Railways ship *Avalon*. The complete installation comprises two independent, but switched, radar sets with 12in and 16in relative-motion or true-motion displays fitted in the ship's combined wheelhouse and chartroom plus an additional weather-proofed 12in relative-motion display on the flying bridge. Kelvin Hughes are also to supply twenty-five sets of radar equipment to Northern Trawlers Ltd.

The French Centre National d'Etudes Spatiales is to build **four satellite ground stations**. The control and tracking equipment for the stations, which will look like the American N.A.S.A. "Minitrack" centre, is to be supplied by C.S.F. (Compagnie Générale de Télégraphie Sans Fil), in conjunction with the electronics division of the aircraft engine company S.N.E.C.M.A. (Société Nationale d'Etude et de Construction de Moteurs d'Aviation), and C.F.T.H. (Compagnie Française Thomson-Houston).

Pye Ltd., in association with Technograph & Telegraph Ltd. (formerly Technograph Electronic Products Ltd.), have formed a new company, **Pye Printed Motors Ltd.** Its object is to manufacture permanent magnet servo motors, with printed circuit rotors, under licence from Société d'Electronique et d'Automatisme and Cie Electro-Mécanique of Paris.

To facilitate quick execution of orders from small electronics firms, maintenance departments, etc., **A. H. Hunt (Capacitors) Ltd.** have appointed a number of regional distributors. These are: Harper Robertson Electronics Ltd. (Glasgow); A. C. Farnell Ltd. (Leeds); Holiday & Hemmerdinger Ltd. (Manchester); Gothic Electrical Supplies Ltd. (Birmingham); Lugton & Co. Ltd. (London); Stewart Aeronautical Supply Co. Ltd. (Redhill); Wireless Electric Ltd. (Bristol). Bulk supplies will continue to be handled by the manufacturers.

Clyne Radio Ltd., Premier Radio, and Stern Radio Ltd., have amalgamated and are now trading under the name of **Stern-Clyne Ltd.** The company opened its seventh branch, at 26 Merchant Street, Bristol 1, on 12th October.

Television sales to retailers of the **Zenith Corporation** of Illinois topped the million mark in the first nine months of this year. This is the fifth successive year for Zenith to pass the million a year mark with television receivers.

The **English Electric Valve Co.** have appointed Max Paul Frey, of Berne, their exclusive agents for Switzerland.

The domestic range of radio and television receivers manufactured by **Bang & Olufsen** will in future be handled in this country by the Debendam electrical and radio division of St. Aldgate Warehouse Ltd., Innworth Lane, Gloucester. Aveley Electric Ltd., of South Ockenden, Essex, who have been handling some of these products, will continue to market the professional audio equipment of Bang & Olufsen.

**Constructions Radioelectriques et Electroniques du Centre (C.R.C.)** of France have appointed Claude Lyons Ltd., of 76 Old Hall Street, Liverpool 3 and Valley Works, Hoddesdon, Herts., exclusive agents in the U.K., Commonwealth, Republic of Ireland and South Africa for their precision electronic and nucleonic instruments, which include a.f. and v.l.f. generators.

The instruments division of **L.F.E. Incorporated** (Laboratory For Electronics), of Boston, U.S.A., who specialize in microwave test gear, have appointed James Scott (Electronic Engineering) Ltd., of Carntyne Industrial Estate, Glasgow, E.2, exclusive agents for the U.K.

**Dentronics Incorporated**, of Emerson, New Jersey, have appointed Coutant Electronics Ltd. sole U.K. agents for their range of strain gauges. Coutant Electronics are moving during the month from 711 Fulham Road, London, S.W.6 to 3 Trafford Road, Richfield Industrial Estate, Reading. (Tel.: Reading 55391).

Painton and Co. Ltd. of Kingsthorpe, Northampton, have signed a manufacturing and marketing agreement with the switch manufacturers **Donald P. Mossman, Inc.** of Brewster, New York. The agreement covers exclusive manufacturing-selling licences for the United Kingdom, the whole of Western Europe and Australasia.

Inspectron Ltd. of Empire House, Chiswick Road, London, W.4, have been appointed sole U.K. agents for **Sennheiser Electronics**, of Bissendorf, west Germany, who specialize in microphones and other audio equipment.

Dobbie McInnes (Electronics) Ltd., of 4 The Mount, Guildford, Surrey, have been appointed sole U.K. agents for the **Analac Company**, of Paris, whose products include a range of general purpose analogue computers.

**Aros S.p.a.**, of Milan, manufacturers of constant voltage transformers, have appointed Langbourne Consultants Ltd., of Barnet House, 120 High Street, Edgware, Middlesex, exclusive U.K. agents.

**Rank-Bush Murphy Ltd.** have been allocated a 30,000 sq ft factory at Camborne, Cornwall, by the Board of Trade. Production of television sub-assemblies and components, to feed their Plymouth factory, is expected to begin at Camborne before the end of the year.

**Cosmocord Ltd.** have completed a 5,500 sq ft extension to their factory at Waltham Cross, Herts. The floor area of the complete factory now covers 55,000 sq ft and the extension, which is to be used by the plastics division, includes a large pressurized "clean room."

**Farnell Instruments Ltd.** are transferring their instrument agency and manufacturing business to a new 20,000 sq ft factory in Sandbeck Way, Wetherby, Yorks, at the end of the month. The telephone number will remain Wetherby 2691.

## EXPORT NEWS

Ampex Great Britain Ltd. have received an order for about £250,000 worth of ferrite core memories from the **Swedish company** Standard Radio and Telefon AB, of Bromma. These components are to be used in a digital processing system which is being developed and manufactured for the Swedish government.

**Norwegian Tours.**—A new Kelvin Hughes demonstration van left the Hainault factory on 10th October to start a two-month tour of Norwegian seaports and fishing centres. This vehicle has been specially commissioned for demonstrations of marine navigational equipment and it is intended to follow up the present tour with similar tours in other European countries.

**Federal Germany's** Government Office for Weapons Technology and Procurement has signed a contract with Rank Cintel for the supply of four complete direction finding equipments for atmospheric together with accessories and spares. The present contract includes installation and is to be followed by a further contract for the development and supply of an automatic evaluation centre for atmospheric ranging. The total value of the contracts is in the region of £40,000.

As a result of a contract signed by Hifivox Production Barbieri of Paris and Garrard Engineering Ltd., some 65,000 Garrard record players and changers, to the value of over £160,000, are to be shipped to France during the next six months. Mr. A. E. Underwood, chairman of the company, has recently stated that his company exports over 70% of their total production, and during the past twelve months their overseas sales have risen by 42%.

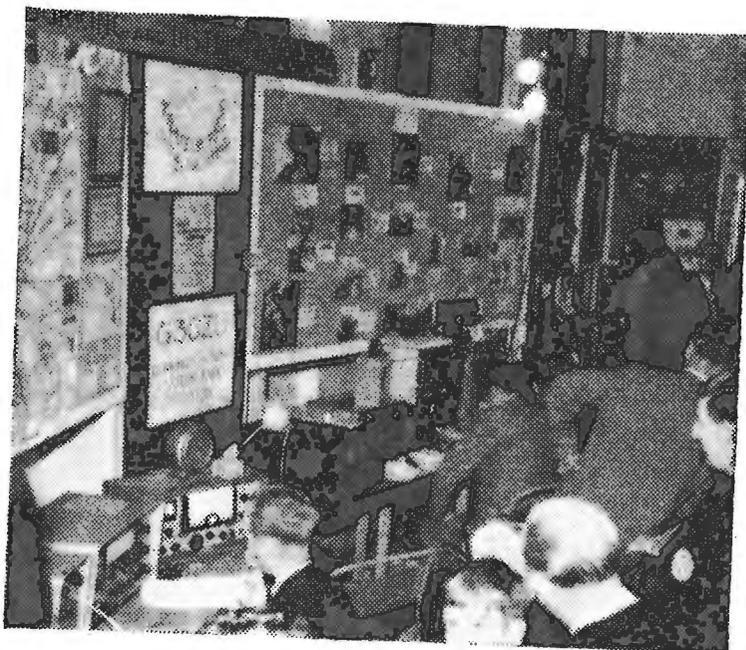
Decca Radar Ltd. have received from the **Royal Swedish Air Force** £1,000,000 worth of orders for transistorized radar display and data handling equipment in the last eighteen months.

## CLUB NEWS

**Edgware.**—Meetings of the Edgware and District Radio Society are held on the second and fourth Mondays of each month at 7.30 at the John Keble Hall, Church Close, Deans Lane. At the meeting on 11th November R. F. Stevens (G2BVN) will discuss single sideband operation.

**Mansfield.**—Morse and technical instruction are given at the weekly meetings of the Mansfield Amateur Radio Society held on Friday evenings at the Hope and Anchor Inn, Union Street.

**Spen Valley.**—"The Electronic Marshalling Yard" is the title of the talk to be given by S. Jones of British Railways at the 14th November meeting of the Spen Valley Amateur Radio Society. On the 28th J. Spivey (G2HHV) will discuss "office electronics." Meetings are held at 7.15 at the Heckmondwike Grammar School.



The display of the Dorking & District Radio Society on their stand at the four-day Model Railways & Engineering Exhibition held in Dorking in October.

# PERSONALITIES

**J. Langham Thompson** is to be president of the British Institution of Radio Engineers in succession to **Earl Mountbatten**. Mr. Thompson, who is 57, has been a vice-president of the Institution for a number of years. He started his career with A. C. Cossor Ltd. in 1927 and seven years later joined McMichael Radio as chief engineer, where he remained until the outbreak of war. During the early part of the war he



served as officer i/c of the wireless section of the Inspectorate of Electrical and Mechanical Engineering and before forming his own company in 1946 he practised as a consulting engineer. Mr. Thompson last year relinquished the chairmanship and managing directorship of J. Langham Thompson and resigned from the board of Ether Langham Thompson. He is to deliver his presidential address on 27th November.

**J. E. Rhys-Jones**, M.B.E., M.I.E.E., has retired from the Plessey organization which he joined in 1933. Mr. Rhys-Jones, who is 62, has been concerned for the past 24 years with the setting up of small engineering units (remote from the main factories) for advanced development work. It was for his work on direction finding and navigation during the war that he was appointed an M.B.E. in 1946 when he was chief engineer of Plessey's communication receiver development. After studying at the Northampton Engineering College he started his career in the radio and electronics industry by joining S.T.C. at Colindale. He was also on the staffs of Marconiphone, Columbia Graphophone, H.M.V. and Kolster Brandes before joining Plessey.

**John Garland** retired last month after completing 47 years' service with the Marconi International Marine Company. Mr. Garland, who has been company relations manager for the past year, started his career as a seagoing radio officer in 1916. After representing Marconi Marine on many occasions overseas and founding Establecimientos Argentinos Marconi in Buenos Aires in 1935, he became general manager of the Marconi Group of Companies in South America at the end of the war. Four years later, he returned to the U.K. to become manager of the special products division of Marconi Marine; a position he held up to 1962.

**Eric Willis-Jones**, B.Sc.(Eng.), A.M.I.E.E., has been appointed commercial manager of A.E.I.'s valve and semiconductor factory at Lincoln in succession to **Dr. John Westhead**, who is at present on a course of business studies at Stanford University, California. Mr. Willis-Jones was previously based at A.E.I.'s London headquarters and held the post of manager, Southern Region Light Current.

**A. E. Cawkell** has relinquished his directorships of Cawkell Research & Electronics Ltd. and Dawe Instruments Ltd. and has joined Amplivox Ltd. as head of research and product development. After war service in the Communications Branch of the Royal Navy, Mr. Cawkell founded, in 1948, the company bearing his name which became part of the Simms group in 1960. Last year he contributed an article to *Wireless World* on the indexing of technical information.

**Oliver Simpson**, Ph.D., M.A., is to take up the post of superintendent of the basic physics division of the National Physical Laboratory next January. Dr. Simpson, who is 38, has been head of solid state physics at the Services Electronics Research Laboratory, Baldock, since 1956. After graduating from Trinity College, Cambridge, in 1944, he spent a year with the Admiralty Research Laboratory before returning to Cambridge to do research on photo-conductivity in semiconductors at the Cavendish Laboratory, first as a research scholar and later as Fellow of Trinity College. In 1949 Dr. Simpson was appointed an assistant professor of physics at the University of Michigan. At the S.E.R.L. he has been concerned with research on the electronic properties of organic semiconductors.

**Dr. H. E. M. Barlow**, F.R.S., Pender Professor of Electrical Engineering at University College, London, has been elected to the board of directors of Marconi Instruments Ltd. Professor Barlow, who is known for his work in the microwave field and in power measurement joined the faculty of engineering at University College, London, in 1925 and, apart from war service, he has been a member of the academic staff ever since. At the end of the war he rejoined University College as professor of electrical engineering and, a year later, he was awarded a fellowship. In 1949 he was appointed Dean of the engineering faculty. He is also a member of the B.B.C.'s scientific advisory committee and the Radio Research Board of the D.S.I.R.

**L. A. Thomas**, B.Sc., F.Inst.P., A.M.I.E.E., chief physicist of the Hirst Research Laboratory of the General Electric Company, and **Denis Taylor**, Ph.D., M.Sc., M.I.E.E., consultant to the Plessey Company, have just returned from the Soviet Union after visiting universities in Moscow and Leningrad. They were invited as members of a 15-strong delegation to see how the Russians co-ordinate their research efforts. The delegation, which was at the invitation of **V. Kuznetsov**, the director of the foreign relations department of the Soviet State Committee for the co-ordination of scientific research, was led by **R. J. Kerr-Muir**, the research director of Courtaulds.

**D. Gabor**, Dr. Ing., M.I.E.E., F.Inst.P., F.R.S., and **Colin Cherry**, D.Sc.(Eng.), A.M.I.E.E., have been granted Honorary Associateships of the City and Guilds of London Institute (A.C.G.I.) on the completion of five years as professors at the City and Guilds College. Dr. Gabor is professor of applied electron physics in the Department of Electrical Engineering where Dr. Cherry is professor of telecommunications.

**Douglas Fowler**, Assoc. I.E.E., has been appointed a director of Avo Ltd. Mr. Fowler came from Brookhirst Igranic, another subsidiary in the Metal Industries Group, to take up the appointment of Avo's works manager in 1961. After completing his apprenticeship with Brookhirst Igranic in 1932, he held several sales posts with the company and was subsequently appointed chief of organization and methods in 1957.

**J. A. Avery**, A.M.Brit.I.R.E., who has been chief inspector of Avo Ltd. since 1949, is to be chief engineer. Mr. Avery, who is 47, attained the rank of captain while serving with the R.E.M.E. during the war.

**Douglas A. Lyons**, for more than 30 years director of the Trix organization and a prominent member in the councils of the audio side of the radio industry, has resigned the managing directorship of Trix Electronics Ltd.

**Gp. Capt. C. Stephen Betts, C.B.E.**, who is now Officer Commanding the Ballistic Missile Early Warning Station (BMEWS) at Fylingdales, was deputy director of operational requirements at the Air Ministry from 1959 until his new appointment earlier this year. Gp. Capt. Betts, who is 44, joined the Technical Branch of the R.A.F. in 1941 after graduating at Cambridge and was on signals duties with Coastal Command throughout the war. In 1952 he became Command Signals Officer, Air H.Q., Iraq, and three years later was attached to the Guided Weapons Dept. of R.A.E., Farnborough. In 1958 he was appointed chief instructor commanding the Weapons Systems Wing at the R.A.F. Technical College, Henlow, Beds.

The United States Navy Letter of Commendation has been awarded to **Wing Cdr. R. I. Gray** for his meritorious service whilst on an exchange posting during 1960/63 as a staff member of the electromagnetic hazards division of the U.S. Naval Weapons Laboratory at Dahlgren, Virginia. The award is in respect of three inventions to improve the safety and reliability of electrically initiated weapons. The inventions have been introduced to minimize the risks of premature initiation of the weapons' explosive systems by spurious r.f. radiation. Wing Cdr. Gray is now at the Central Servicing Development Establishment, R.A.F. Swanton Morley, Norfolk.

Among the recipients of monetary awards for inventions to save time and money in the Royal Air Force are two civilian radio technicians. **D. F. Willies**, who is stationed at R.A.F. Neatishead, Norfolk, received £50 for his idea which led to the modification of the power amplifier circuit in the Type T217A/GR multi-channel u.h.f. transmitters, to save valves being damaged while the transmitters were being tuned. Mr. Willies, who is an amateur transmitter with the call G3HRK, is the Norfolk county controller of the radio amateur emergency network. The other award, of £45, was made to **J. C. Wilson** of R.A.F. Wartling Sussex, for re-designing a section of the modulator drive stage in the Mullard radar training control equipment Type 2293.

**A. H. Robinson, B.Sc.(Eng.), D.I.C., Grad. I.E.E.**, has been awarded the Oliver Lodge Scholarship by the Institute of Electrical Engineers to complete the final year in his investigations at Imperial College, London, into the possibilities for the bandwidth compression of video signals for transmission. He started this study in October 1961 under an award given by the Department of Scientific and Industrial Research.

**Harry C. Roberts** relinquished his position as managing director of the Cossor Valve Company, through ill health on 1st October, but he will continue in the capacity of a director and consultant. Mr. Roberts, who is 64, has been with the company since 1948 and was previously with Marconiphone and Mullard. He is succeeded by **S. D. Coode-Bate**, who was previously assistant to the managing director of Cossor Electronics Ltd.

**G. S. Westbrook** has been appointed group general manager by the Sealectro Corporation of Mamaroneck, U.S.A., and will be responsible for the British branch company at Hershams, Walton-on-Thames. Mr. Westbrook joined the Sealectro Corporation a short time ago after spending a number of years with Counting Instruments Ltd. in the capacity of director and general manager. Prior to this he held for six years a similar post with Electro Methods Ltd.

**D. H. Fisher, A.M.I.E.E.**, the manager of the recently formed colour television division of R.C.A. Great Britain Ltd., has announced that **E. A. Neaf** has been appointed the division's sales manager. Mr. Neaf was previously with the closed circuit television division of the Marconi Company. **P. Scadeng, A.M.Brit.I.R.E.**, the division's engineering manager, joined the company in April this year from Rediffusion.

**R. W. Sillars, B.A.(Cantab.), D.Ph.(Oxon), M.I.E.E., F.Inst.P.**, has been appointed manager of the A.E.I. Research Laboratory at Manchester. Dr. Sillars joined Metropolitan-Vickers (now part of A.E.I.) in 1932 and after two years as a college apprentice, he entered the research department. In the following year he went to New College, Oxford, as a Metro-Vick scholar and on his return in 1937 he re-entered the research department. Dr. Sillars' appointments include section leader of the semiconductor section in 1947, physics group leader in 1950 and leader of the electrical materials group in 1955.



Dr R. W. Sillars



Donald Scott

**Donald Scott, Assoc.I.E.E.**, has been appointed engineer-in-chief of Cable and Wireless Ltd. in succession to the late **C. J. V. Lawson**, who died in August. Mr. Scott, who is 60 and joined Cable and Wireless in 1919, has served in a number of overseas stations. He was appointed assistant e.in-c. in 1955 and deputy e.in-c. in March last year. Four further appointments have been made following Mr. Scott's promotion. These are: **Anthony S. Pudner, M.B.E., A.M.Brit.I.R.E., A.M.I.E.E.**, and **Denis G. Smith** as deputy engineers-in-chief, and **William A. D. Talbot, A.M.I.E.E.**, and **Dudley W. Weedon, B.Sc.(Eng.), A.M.I.E.E.**, as assistant engineers-in-chief.

## OBITUARY

**Eric Balliol Moullin, M.A., Sc.D.**, Professor of Electrical Engineering at Cambridge University until 1960, died on 18th September, aged 70. Dr. Moullin, who was the first occupant of the chair of electrical engineering established in 1945 at the University, was a Fellow of both King's College, Cambridge, and Magdalen College, Oxford. He was a lecturer at Cambridge from 1920 until 1929 when he became Donald Pollock reader in engineering science at Oxford, where he stayed until being appointed to the professorship at Cambridge. His research studies covered a very wide range of radio subjects and his books include "Principles of Electromagnetism" and "Radio Aerials." Dr. Moullin, who was for many years on the Editorial Advisory Board of *Wireless Engineer*, was president of the I.E.E. for 1949/50.

**Dr. Sisir K. Mitra, F.R.S.**, Professor Emeritus of the University of Calcutta, died in August at the age of 73. Prof. Mitra, who was elected a Fellow of the Royal Society in 1958 "for his researches in many branches of upper atmosphere physics," was professor of physics at the University for many years until his retirement in 1955. He was also head of the University's Institute of Radio Physics and Electronics. He received his D.Sc. from Calcutta University in 1919 after which he studied at the Sorbonne in Paris. Prof. Mitra was chairman of the Calcutta section of the Brit.I.R.E. for three years.

# MANUFACTURERS' PRODUCTS

## NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

### Travelling Wave Tube Power Unit

A LARGE variety of travelling wave tubes may be operated from a power unit Type 4580 manufactured by James Scott Ltd., Carntyne Industrial Estate, Glasgow, E.2. Supplies are available for helix, collector and second grid which are positive with respect to the cathode and a negative voltage for the control grid as well as a heater supply for the t.w.t. The unit is supplied for use with tubes which have the collector at earth potential, the earth connection being made in the power supply.

The helix supply is variable from 1 to 3 kV positive with respect to cathode at currents up to 2 mA and is stabilized to 0.1% for  $\pm 5\%$  variation in mains voltage. Both voltage and current is metered. The collector supply is obtained from a variable 0 to 500 V source which is added to the helix supply giving voltages from 1 to 3.5 kV; currents of up to 30 mA can be drawn.

Grid-2 supply provides 2 mA of current over a continuously variable range of voltage from 100 to 800 V. The grid-1 voltage is obtained from a neon-regulated supply and is variable from 0 to 150 V. A variable heater supply of 4 to 7.5 V a.v. is provided.

Other features of this instrument include a helix-current overload protection circuit, a stabilizer valve protection trip and an interlock system whereby the h.t. supplies can be applied only in the order collector-helix-grid.

The equipment measures  $21\frac{1}{2} \times 19 \times 18$  in. The cost is £735.

2WW 322 for further details.

### Multi-range Test Set

THE COMBINATION, with a high degree of portability, of a multi-range voltage and current measuring instrument and a chart recorder which also marks the measuring range automatically on the chart should prove valuable in continuous measurement applications. The "Multiscript 3" test set marketed by Smiths Industrial Division, Kelvin House, Wembley Park Drive, Wembley, Middlesex, employs a moving-coil movement with taut-

ligament suspension. The full-scale deflection time of the recorder is approximately 1.5 seconds and direct voltage measurement ( $20,000\Omega/V$ ) is possible up to 500V in eight ranges. D.c. measurements up to 1A can be made in seven ranges. Alternating voltages up to 500V in five ranges are possible and alternating currents can be measured up to 0.2 mA on one range. No ink is required for recording. The equipment weighs 5lb and the dimensions are  $245 \times 120 \times 90$  mm.

2WW 323 for further details.

### Laser Rods

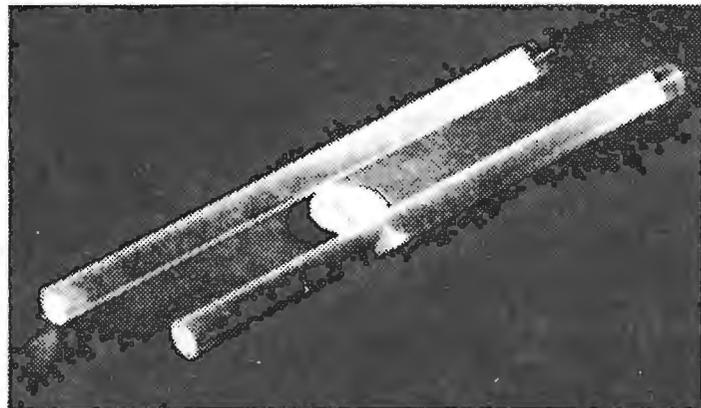
MACHINED laser rods are available from Stanley Sealey Instruments Ltd., Avery Hill Road, New Eltham,

London, S.E.9. Neodymium-doped glass rods can be supplied with ground and polished flat ends. Other end shapes can also be supplied. Optical systems and reflectors suitable for use with the rods can be produced to customer specification. The company also offer a laser rod machining service.

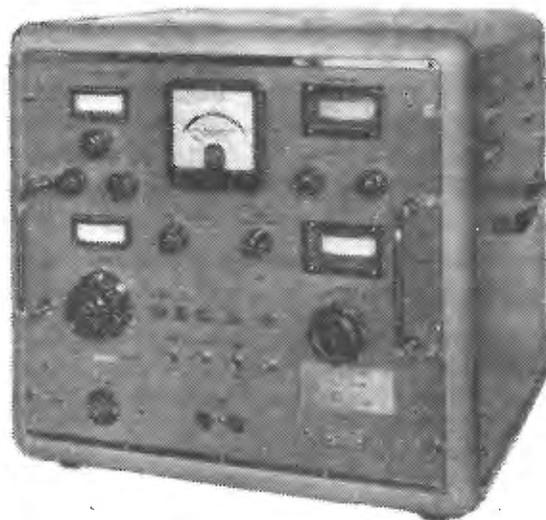
2WW 324 for further details.

### Standard Frequency Receiver

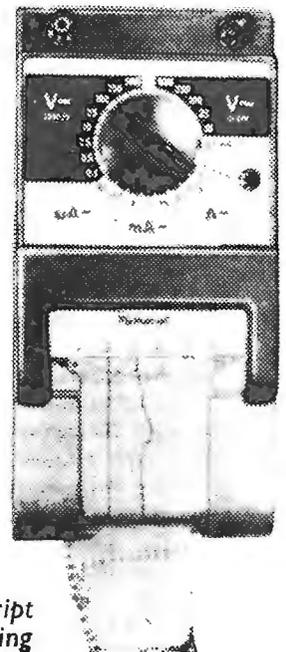
THE FIRST all-British product from Hewlett-Packard Ltd., Dallas Road, Bedford, has recently been announced. It is the 5090A Standard Frequency Receiver, which takes advantage of the recently improved stability of the Droitwich 200 kc/s



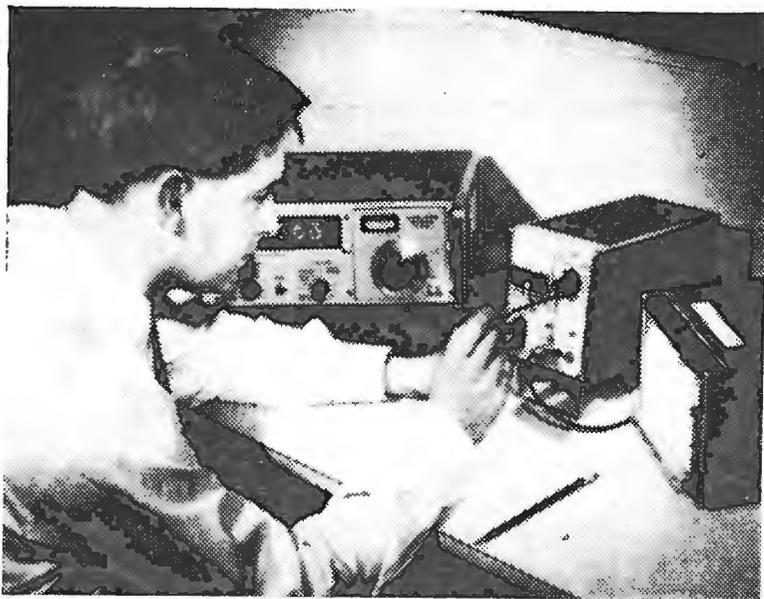
Laser rods machined by Stanley Sealey Instruments Ltd.



Travelling wave tube power unit manufactured by James Scott Ltd., of Glasgow.



Right: Smith's "Multiscript 3" measuring and recording test set.



A Hewlett-Packard engineer setting up the 5090A standard frequency receiver during field trials.

transmitter to provide a highly accurate signal for the operation of counters and calibration of instruments. Outputs are provided at 1 Mc/s and 100 kc/s, and a "fail safe" facility is provided whereby no output is available in the absence of a 200 kc/s signal. An internal 100 kc/s oscillator is phase-locked to the standard signal via a frequency doubler, the required narrow bandwidth (0.2 c/s) being obtained by means of an integrating amplifier. An additional phase detector is used to give an output 90deg out of phase with the main one, which is indicated on the meter. Any meter indication then means that the oscillator is locked. This output also drives the signal gate, so that in the absence of lock, no output is obtained. The gate may be bypassed if required.

Facilities are provided for comparison of external frequencies and the standard frequencies, a chart recorder output being provided for this purpose.

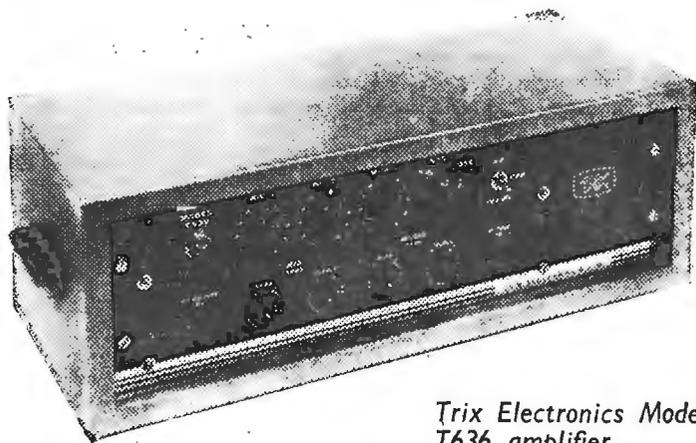
Long-term stability is that of the transmitter (5 parts in  $10^{10}$  per day,

reset monthly) although propagation effects at long range may influence this in the short term. Phase delays do not exceed  $1\mu\text{sec}$  over the range 0 to  $50^\circ\text{C}$ . Sensitivity is  $1\mu\text{V}$ .

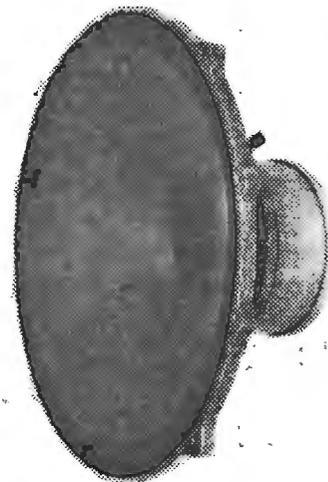
2WW 325 for further details.

### 30W Amplifier

ELEVEN transistors are used in the Model T636 amplifier manufactured by Trix Electronics Ltd., Maple Place, London, W.1. The equipment can be powered by a 12 V car battery or from an alternating mains supply (115 or 200-240V). Inputs are provided for two microphones and a music source. Separate tone controls are provided for the microphone and music inputs. All three inputs can be faded or mixed and a selector switch enables the music input to be selected from pickup, tape or radio. If the amplifier is used in a vehicle, adjustment for either a positive—or negative—earthed chassis is simple. The power output, with less than 5% total distortion is 30W. Output matching caters for



Trix Electronics Model T636 amplifier.



Mk. VII L.F. 15in loudspeaker (Kelly Acoustics Ltd.).

4, 8 and  $100\Omega$  lines. The overall dimensions are  $20\frac{3}{4} \times 9 \times 7$ in.

2WW 325 for further details.

### Loudspeakers

LOUDSPEAKERS recently designed by Kelly Acoustics Ltd., Enfield, Middlesex, are constructed to withstand transient peaks in excess of 100W without damage to the assembly. In these new units the voice coil is embedded in a laminated aluminium former with a polyester resin. The metal former is swaged to both sides of the cone. Of the five units so constructed, four are 12-in speakers (Marks III to VI) the other, the Mk VII L.F., has a 15-in diameter. The Mk III and the Mk IV have power ratings of 15W, the Mk V and Mk VI are rated at 35W. The 15-in unit has a power rating of 50W. A silver grey hammer finish is standard for all models.

2WW 327 for further details.

### Time Delay

A ONE-SECOND time delay unit suitable for use over a temperature range of  $-65$  to  $+70^\circ\text{C}$  and with d.v. supplies of 18 V to 29 V at 3 A is available from M. L. Aviation Co. Ltd., White Waltham, Berkshire. An

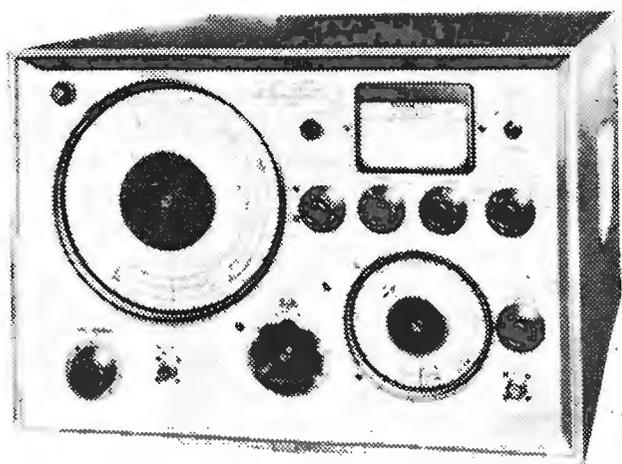
### INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 40 and 41.

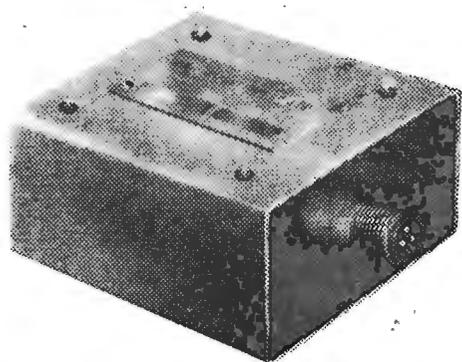
We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 2WW, and it is then necessary only to enter the number(s) on the card.

Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.



Marconi Instruments signal generator developed for television Bands IV and V test requirements.



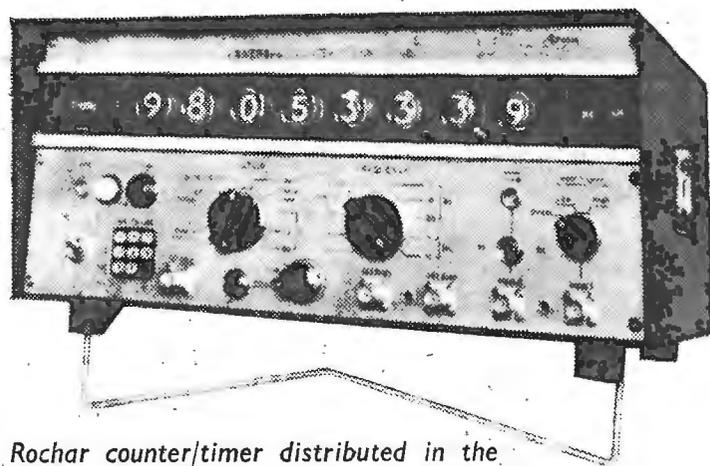
One-second time delay unit manufactured by M.L. Aviation Co. Ltd.

electromechanical relay is operated from a transistor delay circuit. The unit is housed in a hermetically sealed container. Power consumption with the relay energised is 7 W. The unit automatically resets when the power supply is broken. Delays up to 10 seconds can be achieved in alternative types manufactured for a.c. operation.

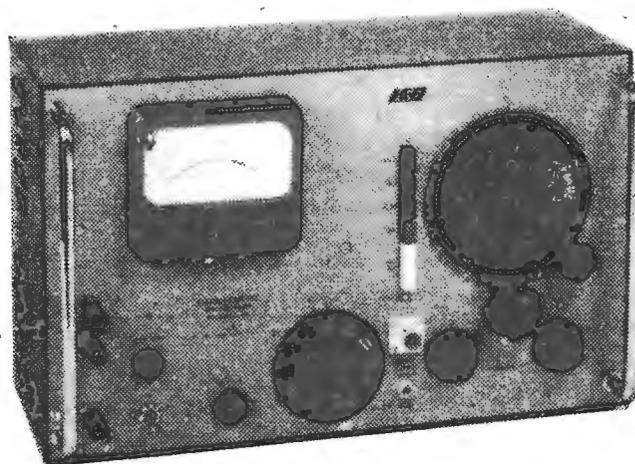
2WW 328 for further details.

### U.H.F. Signal Generator

**SIGNAL SOURCE** requirements for television Bands IV and V testing are catered for by the Marconi Instruments, St. Albans, Herts, TF1060/3 signal generator. The frequency range extends from 470 to 960 Mc/s and amplitude and frequency modulation facilities are available. A.m. is achieved by an internal 1 kc/s oscillator, the depth of modulation being maintained at 30%. F.m. is applied via variable-capacitance diodes from either internal or external sources and the deviation is variable in three ranges up to 300 kc/s. The maximum power output is greater than 1 mW at all frequencies rising to 25 mW at the higher end of the scale. The minimum output is 110 dB less than the maximum. The source e.m.f. and



Rochar counter/timer distributed in the U.K. by the Solartron Electronic Group.



L.E.A. distortion factor meter and millivoltmeter.

power (50  $\Omega$  load) are shown on a directly calibrated dial. Carrier level and deviation are indicated on a meter.

Basically, the instrument consists of a coaxial-line oscillator containing a disc-seal triode. Quarter-wave lines between anode and grid, and grid and cathode are tuned by annular plungers coupled to a front-panel control. Variable-capacitance diodes between anode and grid provide f.m. and fine frequency control. Two pick-up loops fitted on piston attenuators provide separate outlets to the monitor and front-panel socket. The equipment is available in bench or rack-mounting versions.

2WW 329 for further details.

### Counter Timer

**DIRECT** frequency measurements from z.f. to 22 Mc/s may be performed with gate times of 0.1, 1 and 10 seconds by the Rochar counter timer Type A1149. Distributed in the U.K. by the Solartron Electronic Group Ltd., Victoria Road, Farnborough, Hants, the instrument can also be used for pulse duration measurement, time interval measurement between two independent pulses, single and multiple period measurement and single and

multiple ratio measurements. Nixie tubes are used in the 8-digit, in-line display panel. The maximum sensitivity is 50 mV, but at this level only frequencies between 20 c/s and 22 Mc/s can be measured. Over the range z.f. to 22 Mc/s, the maximum sensitivity is 500 mV.

The oscillator uses an oven-controlled, 5 Mc/s crystal. Stabilities of either 1 part in  $10^5$  or 1 part in  $10^9$  per day can be ordered. The counter can operate over the temperature range 0–50°C. It can be supplied in 19in, rack-mounting form.

2WW 330 for further details.

### Distortion Factor Meter

A **DISTORTION** factor meter, Type E.H.D. 30, manufactured by L.E.A. of rue Jules Parent, Rueil Malmaison (S. & O.), France, is also capable of being used as a millivoltmeter. The fundamental frequency range of the instrument when used for distortion measurements is 25 c/s to 25 kc/s; harmonics up to 100 kc/s are measurable. The input impedance is 1 M $\Omega$  and voltage levels from 0.1 to 300 V are acceptable. Distortion from 0.2 to 100% can be indicated.

The instrument can be used as a

millivoltmeter over a voltage range of 3mV to 300V at a frequency of 25 c/s to 100 kc/s. The equipment can be rack mounted and its dimensions are 43×28×22 cm. The weight is 13.5 kg.

2WW 331 for further details.

### Modular Television Equipment

A NEW range of television special effects and test apparatus is being manufactured by Riker Industries Inc. The equipment uses transistors throughout and all the systems are built up from plug-in modules. The range includes mixers, amplifiers, sync-generators and multi-burst generators. The "special effects" generator has some noteworthy features. When required, further modules can be added to this equipment to increase its effects capability. The generator when using seven modules has facilities for wipes, fades and the positioning of circular, square and diamond patterns, etc. in any portion of the picture area. Twenty-nine standard wipes can be produced. In addition, combinations of these are possible. Generators can be obtained for use on both 625- and 405-line systems. The power consumption of the equipment using the 7 modules is 25W. The modules can be mounted in a rack with a frontal area of 3½×19in. Riker equipment is marketed in the U.K. by Livingston Laboratories Ltd., 31, Camden Road, London, N.W.1.

2WW 332 for further details.

### Anti-microphonic Cable

MINIATURE, anti - microphonic, p.t.f.e.-insulated coaxial cables are being manufactured by BICC Ltd., Bloomsbury Street, London, W.C.1. During the manufacturing process a layer of graphite is applied to the surface of the extruded p.t.f.e. This conducting layer neutralizes electrical charges that may be produced on the outer braid when the cable is subject to movement. Capacitive interference is minimized by the close contact of the graphite with the insulation. The cables can operate in the temperature range—75° to +240°C.

2WW 333 for further details.

### V.H.F. Transmitter

THE "Telecomm" v.h.f. transmitter Type TT20 is a transistor instrument designed for single channel operation in the frequency range 40 to 140 Mc/s. The internal

mercury cell allows approximately 40 hours continuous use. Provided with the transmitter are a lapel microphone and flexible aerial. The equipment is crystal controlled and suitable for use in 25 kc/s channel spaced systems. The peak power output is in the region of ¼W. The transmitter may be combined with the TR20 portable receiver, forming a radio telephone system. Both units are manufactured by The Radio Communications Company, 16 Abbey Street, Crewkerne, Somerset.

2WW 334 for further details.

### Bulk Eraser

SPOOLS of magnetic recording tape can be quickly and completely erased by the Weircliffe bulk tape eraser. The spools are inserted into a slot in the equipment. A system of guides and springs ensures that the eraser cannot be switched off before the tape is withdrawn from the eraser. Because of this arrangement, however, the unit must be switched on before the tape can be inserted.



V.h.f. single-channel transmitter (Radio Communications Company).

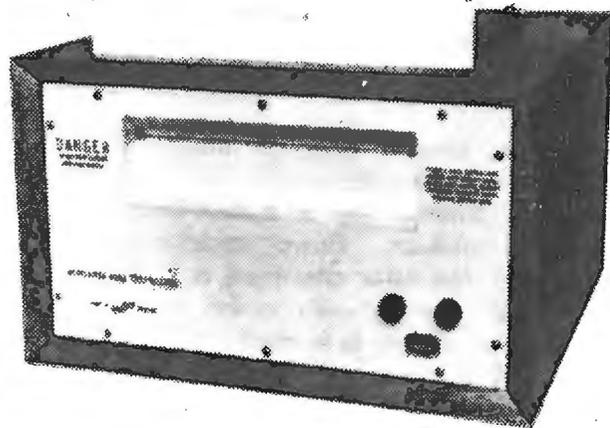
When the tape reaches the rear of the slot an amber light glows. Withdrawal is spring assisted.

Two models are available, Model 6 accepts up to 8¼-in diameter spools, Model 7 is designed for erasing 6¾×8-in continuous tape cassettes. A 200-240V 50c/s mains supply is required, but instruments can be manufactured to order for other mains voltages. The equipment weighs 33lb and the dimensions are 11½×12¼×7½in. The erasers are manufactured by Amos of Exeter Ltd., Weircliffe Court, Exwick, Exeter. The cost is £29.

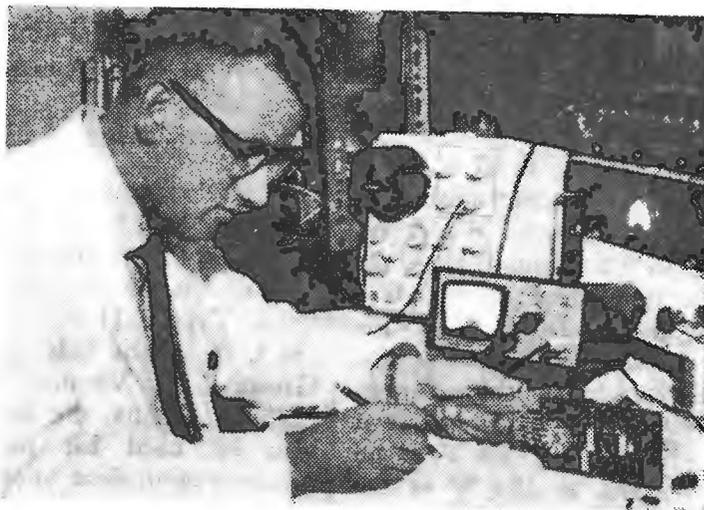
2WW 335 for further details.

### Milliammeter

THE MEASUREMENT of a.c. in transistor circuits is simplified by the use of the Hatfield Instruments Type LE60 clip-on milliammeter. The probe is clamped on to the conductor. Currents from 0.5 mA to 10 A over the frequency range 20 c/s to 2 Mc/s may be measured. A small slide-switch fitted on the



Weircliffe bulk tape eraser.



Hatfield Instruments LE60 a.c. clip-on milliammeter.

probe selects either the low-current ranges or the high-current ranges. These are 0 to 300 mA (in four further ranges, selected on the meter) and 0 to 10 A in three ranges. An output is provided on the meter front panel so that the waveshape can be displayed on a suitable oscilloscope. The impedance reflected into the circuit by the probe is less than  $50\text{m}\Omega$  in series with  $0.05\mu\text{H}$ . The instrument weighs  $6\frac{1}{2}\text{lb}$  and its size is  $6 \times 5\frac{1}{4} \times 7\frac{1}{2}\text{in}$ . When the conductor under test is carrying direct current, the a.c. calibration is unaffected for currents up to 1.5 A.

2WW 336 for further details.

### Electromechanical Counting Relay

A SINGLE-DIGIT counting relay, suitable for assembly into multi-digit arrays and having facilities for electronic readout and re-setting is announced by Radiatron, 7 Sheen Park, Richmond, Surrey. The unit must be powered by a 24 V d.v. supply and it will step at a maximum speed of 25 pulses per second. Each one has a digit indication of  $7 \times 4\text{mm}$  magnified by a cylinder lens. The relays are plugged into a multi-way socket and are held to a face plate by two screws. When assembled into a multi-digit combination, the relays can be reset individually or simultaneously. Each unit costs approximately £4.

2WW 337 for further details.

### Photocell

A HIGH current photocell, Type 9608, is announced by E.M.I. Electronics Ltd., Hayes, Middlesex. It is an opaque-cathode variety with a high-transmission mesh anode mounted close to the flat window and a few millimetres from the plane cathode. Peak currents up to 1A may be drawn. The tube is available with caesium antimony, bismuth silver caesium or silver oxide caesium cathodes.

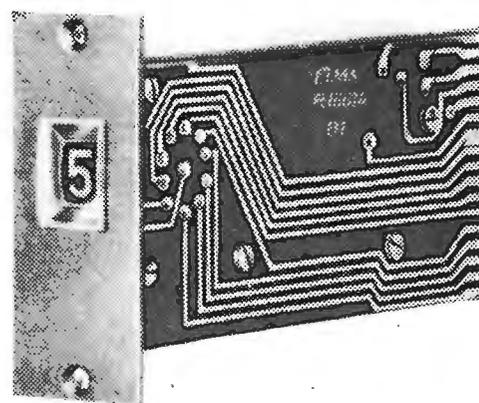
2WW 338 for further details.

### Transistor Power Supply

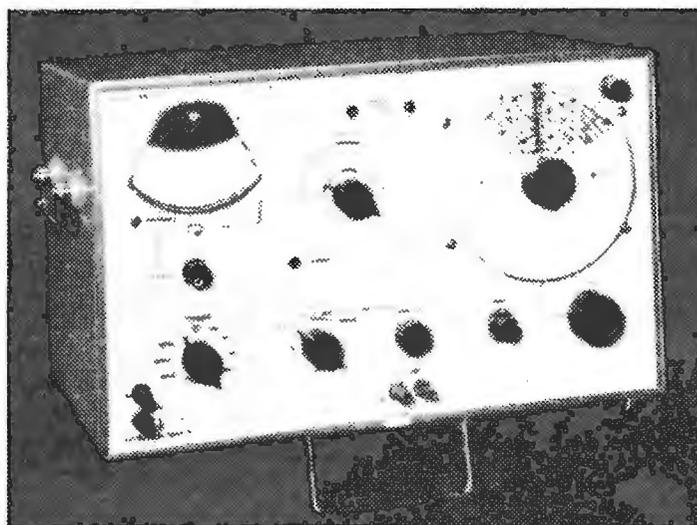
STABILIZED supplies over the range of 0 to 50V and up to 1A can be obtained from the Type L50 stabilized voltage supply unit manufactured by Farnell Instruments Ltd., Wetherby, Yorkshire. Course and fine output controls facilitate the setting of the voltage required. Output voltage and current can be monitored at two levels of sensitivity by the meter mounted on the front panel of



High current photocell Type 9608 manufactured by E.M.I. Ltd.



Electromechanical counting relay with direct indication.



Marconi Instruments wave analyser TF2330.

the equipment. The voltage ranges are 0 to 10V and 0 to 50V, while those of current are 0-100mA and 0-1A. A current limiting device protects the power supply in the event of a short circuit developing externally. On rectification of the fault the output returns automatically to its previous value. On the 0 to 1A current range an overload protection circuit can be set anywhere in the range 150mA to 1A. The price is £75.

2WW 339 for further details.

### Wave Analyser

HARMONIC distortion, noise and hum levels down to  $-75\text{dB}$  are among the measurements that can be made over the frequency range 20c/s to 50kc/s with the Marconi Instruments TF2330 wave analyser. An a.f.c. circuit can be selected to obviate the need for continual re-tuning. Signal amplitudes from  $3\mu\text{V}$  to 300V may be applied to the instrument. Two signal outputs are provided, a variable voltage at the frequency of the signal component under investigation which can be used for external monitoring, and a

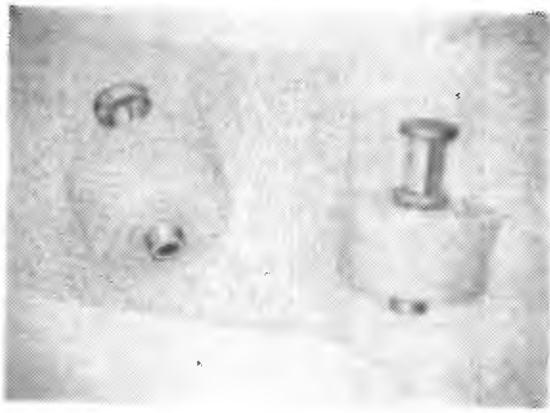
b.f.o. output the frequency of which being coincident with the voltmeter tuning. The level of this latter signal can be adjusted up to 1V across  $600\Omega$ . This output can be fed, via equipment whose frequency response is to be checked, to the input. Amplitude deviations due to the frequency characteristics of the equipment are then indicated on the voltmeter of the wave analyser. An external recorder may be connected in series with the voltmeter.

Semiconductor devices are used throughout the instrument, and the instrument can be energized by a wide range of mains and battery voltages. The weight of the equipment is 24lb.

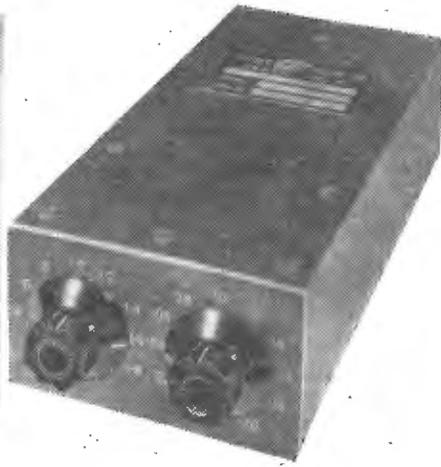
2WW 340 for further details.

### Wideband Voltmeter

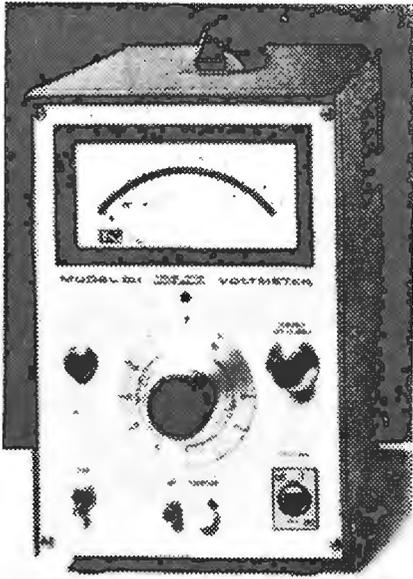
R.M.S. voltages, from  $100\mu\text{V}$  to 300V can be measured over a frequency range of 15c/s to 50Mc/s with the Keithley Instruments Model 121 wideband true r.m.s. voltmeter. The lowest full-scale range is 1mV. The measuring accuracies of the instrument are within  $\pm 1\%$  of full scale from 20c/s to 10Mc/s,  $\pm 3\%$  of full



"Press-Fit" Teflon terminals Type FT-SM-71-C10 (Sealectro)



Millisecond time delay unit manufactured by Vacuum Reflex Ltd. It has a delay range of 220 to 2,000 msec in steps of 20 msec, and can be triggered from either pulse or switch.



Model 121 voltmeter (Keithley Instruments Inc.).

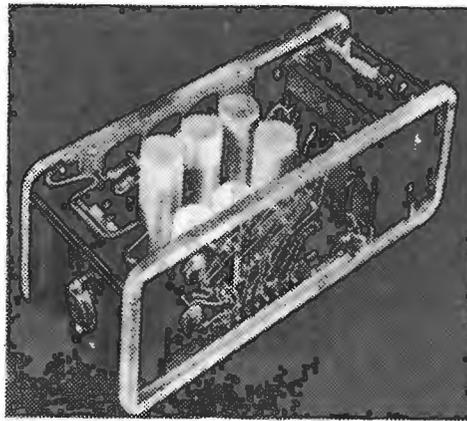
scale from 18c/s to 20Mc/s and  $\pm 5\%$  of full scale from 15c/s to 50Mc/s. The input impedance is  $1M\Omega$  shunted by 20pF. This can be increased to  $10M\Omega$  (15pF) for signals up to 300mV by using the Model 1201 cathode follower probe. The voltmeter may also be used as an amplifier. When so used, a gain of 100 and a risetime of less than 6 nsec over the frequency range 10c/s to 100Mc/s are achieved.

The price is £356 excluding duty, and the instrument can be obtained from Livingston Laboratories Ltd., Camden Road, London, N.W.1.

2WW 341 for further details.

### Feed-through Terminals

A NEW "Press-Fit" Teflon-insulated, feed-through terminal may be used in assemblies where height is limited. Designated the FT-SM-71-C10, the units have a body diameter of 0.264in and an overall height of 0.303in. Thus the large body diameter compensates for restricted height in providing flash-over protection. The maximum



Transistor voltage stabilizer Type PE4862 (Philips).

chassis thickness into which the terminals may be inserted is 0.060in, where it is recommended that a special insertion tool be used. Ten different body colours are available. The components are available from the Sealectro Corporation, Hersham Trading Estate, Walton-on-Thames, Surrey.

2WW 342 for further details.

### Process Control Timers and Relays

SOLID state techniques are used throughout a new range of process control timers and relays developed by Vacuum Reflex Ltd., Soho Street, London, W.1. The units in this series are claimed to give stable, accurate delays of long duration and are unaffected by wide ambient temperature changes. Delays of up to 5 minutes are possible. Modules can be connected in series however for longer delays or sequential switching operations. Encapsulated units can be supplied with an initial delay tolerance of  $\pm \frac{1}{2}\%$ , which is maintained over a temperature range

of  $-10$  to  $+55^\circ\text{C}$ , and supply voltage variations of  $\pm 10\%$ .

A typical unit is a time delay relay where the output contacts close after continuous application of a given input voltage for 60 seconds; if the input voltage is removed for more than 100 msec the timing sequence is re-initiated. The output contacts are rated at 240 V 2 A. Other applications of units in the range are switch control with reset facilities, automatic recycling and single shot operations initiated by working contacts and the opening or closing of control contacts. Models having either switched or continuously variable delays are available. Typical of this series is the unit having a maximum delay of 2 seconds, switched in steps of 20 msec.

2WW 343 for further details.

### Transistor Stabilizer

A DIRECT voltage stabilizer intended for building into other equipment has been introduced by Philips. Designated the Type PE4862, these units can be obtained in the U.K. through Research and Control Instruments Ltd., King's Cross Road, London, W.C.1. The output voltage can be preset anywhere in the range 1 to 30 V. At 24 V, 1.3 A may be drawn. A differential amplifier ensures that with mains fluctuations of  $\pm 10\%$  the output does not change by more than 0.001 of its nominal value. The internal resistance is less than  $0.01\Omega$ . The unit can be used in temperatures of up to  $45^\circ\text{C}$ . If so required, versions are available as rack-mounting units with mains switch and indicator lamp. A cabinet version is also being manufactured.

2WW 344 for further details.

### Servo Motor

A SERVO motor of the permanent magnet type, instead of a conventional wound rotor, embodies a disc-shaped printed circuit. Features of this motor make it particularly advantageous for use as a servo component. It has low inertia and extremely smooth torque down to zero speed. Gearless drives are possible thus eliminating backlash and improving the response rate of the load. The manufacturers are Pye Printed Motors Ltd., Cambridge, and the motors are made under licence from Société d'Electronique et d'Automatisme and Cie Electro-Mécanique of Paris. Four different sizes are available.

2WW 345 for further details.



## FIRATO 63 IN AMSTERDAM

**T**HE 13th International exhibition organized by the F.I.A.R. association of Dutch manufacturers, importers and agents in the field of radio and electronics was held for the second time in the large new RAI exhibition buildings in the Europaplein in Amsterdam. It was evident after the first essay into these new premises in 1961, that the character of the exhibition, which had been established by the late Mr. Kazemier in the post-war years, had entered on a period of transition and that the foundations of the organization would have to be extended to carrying the expected future expansion. Accordingly an agreement was made with the owners of the building (the R.A.I. motor industry organization) for substantial backing; and the Netherlands Television Service also participated on a much increased scale.

Firato is the oldest established international radio exhibition in Europe and has been consistently supported by American, Belgian, Danish, French, German, Italian, Hong Kong, Japanese, Swedish and Swiss manufacturers. This year the British participation was considerably strengthened by the Audio Manufacturers Group of B.R.E.M.A. who staged a combined exhibit and laid on a representative demonstration of high-quality sound reproduction which, in spite of the small size of the listening room, reached a standard which obviously impressed our Dutch friends favourably—and even satisfied your reporter. The advance hearing of the master tape of Decca's new stereo recording of "Carmen" was particularly impressive.

Next to the British Audio Group was an educational exhibit. "The Electron" contributed to by the Dutch Post Office, Armed Services, Broadcasting Union (N.R.U.), Philips, N.V. Electrologica and the Technical High School at Enschede.

This was arranged to take visitors in sequence from working models and diagrams of electronic structure in matter, valves, semiconductors and typical circuits to the more advanced communications and radar applications. A description of this exhibit would require a separate article, but we were particularly interested in the replica of a listening post at Scheveningen Radio PCH—a station which was working (on spark) in 1904 and is now one of the busiest coastal radio stations in the world with transmitters and receivers spread over the whole of Holland (4 medium-wave for telegraphy and 8 medium-wave and 5 short-wave transmitters for telephony). The central control office is at IJmuiden. The PTT exhibit also included demonstrations of the Mobilfoon telephone service to cars and of the unique Simafoon service of narrow-

band code signalling (described in this journal in January 1963) and now renamed Semafoon to avoid confusion with the products of another telephone manufacturer of world renown. The television wire relay experiment in The Hague, using normal quad telephone wiring for distribution, is still running successfully, and plans are afoot to extend the "experiment" to give a choice of three television and 12 v.h.f. sound programmes in about 6,000 homes. Modulation of foreign TV programmes will be converted where necessary so that viewers will not have to buy "universal" sets.

This year the professional electronics sector was segregated in the North Hall of the exhibition. Admission was by invitation (and free) and there was a separate entrance so that visitors need not pay the normal exhibition admission charge. Nevertheless, most customers, having concluded their business in the electronics section, paid to see "how the other half lives." The electronics sector was not so heavily dominated by the American big battalions as in some earlier Firato's though they were, of course, in evidence. Many leading British component manufac-

*The group exhibit of nineteen British audio equipment manufacturers, was a prominent feature of this year's Firato.*





Push-button picture enlargement is a feature of the Erres TV5639 receiver.

turers e.g. Painton, McMurdo, Widney-Dorlec were well represented and appeared to be doing good business. Kerry's gave demonstrations of ultrasonic drilling and Imhof's, as usual, had driven their touring showroom into the hall and were using it as their stand. On the large Philips stand in this hall, many new instruments and components were being shown, notable examples being the GM2308 wobulator and GM5600 and 5601 oscilloscopes for television servicing and the PM5320 f.m./a.m. generator—all good-quality medium-priced instruments. New transistor TV monitor units included EL8100 (6½in) and EL8105 (8in), and there was a new series (PM1000) of high-quality industrial cameras with 8Mc/s  $\pm 0.5$ dB response and gamma correction. A camera head with 50mm, f0.75 lens is available. The PM1051 with Schneider motor-controlled iris and automatic tube voltage control can be adjusted to give constant output, either on peak white or average illumination over a range of light intensity of 1:300,000.

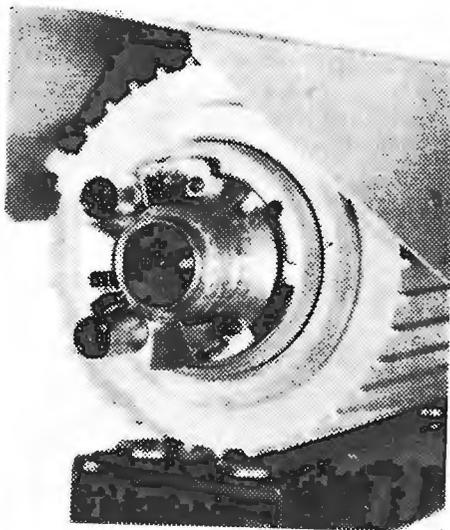
Philips were showing many new components including a range of 10-pin valves for television sets, a travelling wave tube (YH1030) for the 5.9-7.2 Gc/s band, new 21 cm and 36 cm 90° monitoring tubes, a ½ watt, 180 Mc/s transmitting transistor (AFY19) and a range of thyristors (s.c.rs.).

Domestic television receivers in Holland look much the same as those in other European countries, but they include multi-standard types which make our dual-standard sets seem relatively simple. The sets are designed to receive not only the

Dutch but, in the South of Holland, the French, Belgian and German transmissions. In the Philips 23TX380A receiver the line frequency and modulation polarity, formerly selected by separate switches are now automatically coupled with the channel selector switch. This is a feature also of the latest Erres (TV9645) set, which now makes no secret of the fact that its chassis is made by van der Heem and that the commercial backing comes from Stokvis. These sets, like most other models, make provision for u.h.f. reception as well as v.h.f. One Erres set, the TV5939, incorporates the novelty of push-button picture enlargement, whereby a central area of the normal scan is pulled up to full screen size (and down to the much-maligned 405-line standard, of course).

The Japanese flair for miniaturization, seen already in pocket-transistor sound receivers, is now being applied to television. Two makes—the Sony 5-303E "Micro TV," and the Hayakawa TRP-601 "Sharp"—gave 6-inch gems of pictures with no apparent line structure. At the other end of the scale was to be seen the "Beamscope" (also of Japanese origin), which is a Fresnel-type lens in thin plastic material giving up to 50% magnification when placed in front of a normal set. It has concentric prismatic grooves at ¼ mm spacing impressed in the front surface. These are normally not visible, but they refract light as a thick spherical lens might do. The price in Holland was equivalent to £12 10s.

The Bell Telephone Manufacturing Company (I.T.T.) were showing a very wide range of domestic television and radio receivers. These are being made in Antwerp for the

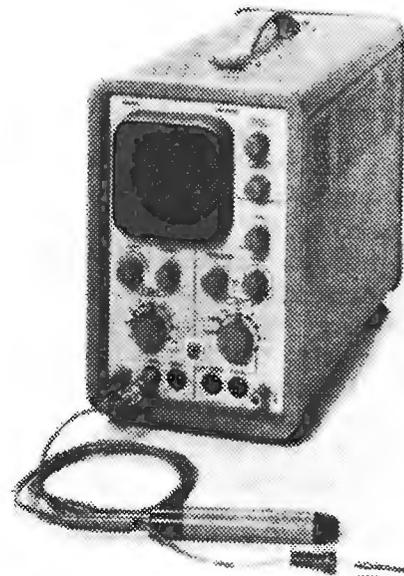


Schneider lens and motor-controlled iris in the Philips PM1051 heavy-duty automatic industrial TV camera.

European market, and were shown by Holland-Impex N.V.

Most of the Dutch manufacturers as well as the leading German firms who were in the exhibition were demonstrating stereo radio receivers. These were working on signals in the hall radiated from a low-powered transmitter which was specially licensed for the duration of the exhibition. Other radio receivers which attracted attention were the amateur radio equipment made by the Italian firm of Geloso and the Eddystone communications receiver with panoramic unit which was seen working on the stand of J. J. de Kort of Hilversum.

In the East Hall of the RAI building the NTS (Netherlands Televisie Stichting) were operating the largest studio so far put into service in



Philips Type GM5600 service oscilloscope.

Holland and were making the most of the experience as a prelude to the move from the present small studios in Bussum into the new Television Centre now under construction near Hilversum. To Amsterdam they had transported scenery, O.B. vans and all the paraphernalia of dressing rooms, canteens, etc., which go to the making of live TV programmes and were putting on five shows per day, each to an audience of 1,000. Those who were unable to get seats could watch the show from a promenade overlooking the stage, well provided with monitoring screens for those not fortunate enough to get near to the glass.

Thus the Firato provides something for everybody and all may follow their interest with comfort and convenience. Whatever may be the future of national and international exhibitions we have a feeling that this show, as at present organized, will always have a place in the calendar.

# Genoa Fair 1963

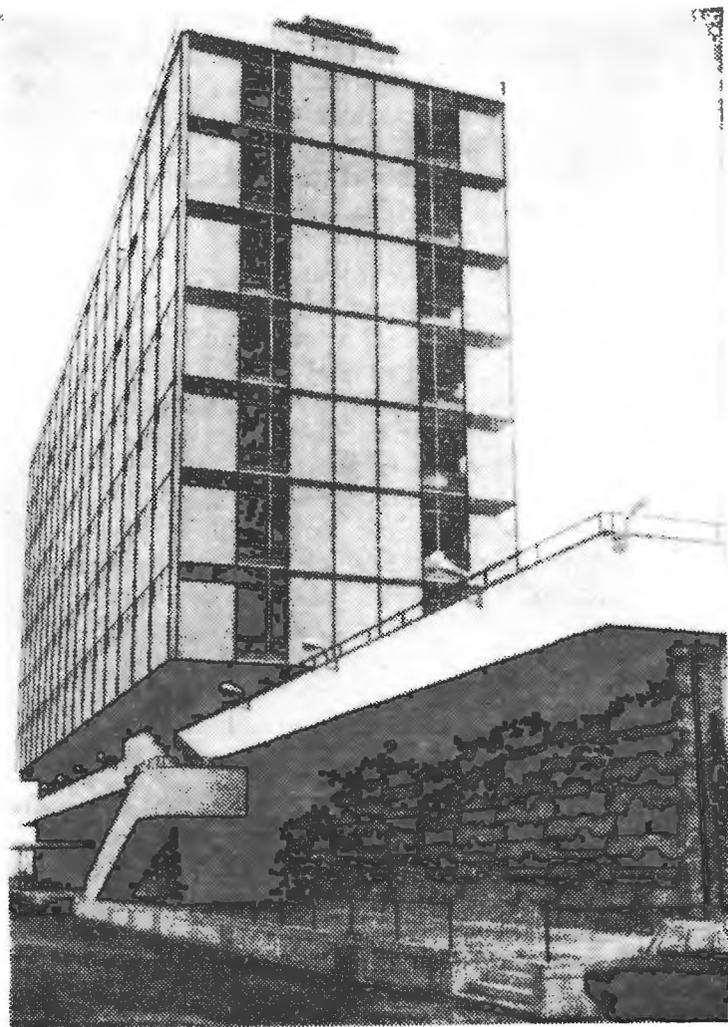
## TELECOMMUNICATIONS FOR SHIPS AND AIRCRAFT

**A**N effort is being made at Genoa to provide an annual exhibition of equipment used in marine communication, air communication and telecommunications. On the telecommunications side the organizers expect the fair to provide manufacturers with a place to show their equipment to a wide range of operators of ships and aircraft as well as to engineers of telecommunications organizations.

Genoa is in the booming Turin-Milan-Genoa triangle and this, together with the aircraft exhibition, the international meeting on communications and the international meeting of port authorities which were held at the Fair from the 5th to 20th October ensured a substantial number of the right kind of visitors.

Viewing conditions are very different from those one finds at British and most other exhibitions. The fair is held on land reclaimed from the sea in the best part of Genoa harbour. The telecommunications building is the tallest in the fair and the first five of its ten floors were used for this, the first exhibition. Dividing the exhibition up into five sections in this way seemed to produce far less tiring conditions than at the long, wide, one floor exhibition one is accustomed to. Strips of floor-to-ceiling glass windows placed every few yards provided views of the Mediterranean. A tour of the telecommunications exhibits could be interrupted half way and a trip taken across the harbour in a launch provided by the Fair authorities to see the aircraft on show at the Cristoforo Colombo airport. All this in sunny weather superior to the best we have had this summer in the U.K.

Of the Italian companies exhibiting, Telettra of Milan, who have been having increasing export success in recent years, were showing new microwave link equipment and test instruments. Their H22 FM link system is designed to operate in the 10,700 to 13,250 Mc/s band. With one klystron the tuning range is 500 Mc/s. Peak deviation is 6 Mc/s and the equipment can handle one 525 or 625 monochrome or colour TV channel, or one closed circuit TV channel with one facsimile channel, or 120 p.c.m. channels. Also shown was their DT24 system, a time division pulse-code-modulation multiplex equipment suitable for the establishment of medium-capacity telephone links in place of conventional v.f. systems. Intended to be used with their H22 radio system, it is practically unaffected by noise produced on the physical circuit. A useful range of measuring instruments for the audio, carrier and low radio frequencies was on show. This part of the frequency range is not particularly well covered by the commercial instrument manufacturers and some of Telettra's instruments seem to fill gaps in the range of commercially available instruments. Selective voltmeters covering the frequency range 20 kc/s to 6 Mc/s and 50 c/s to 15,000 c/s are



available. The first of these voltmeters has a sensitivity of from  $10 \mu\text{V}$  to 3 V with a minimum reading of  $2 \mu\text{V}$ , and the other one has a sensitivity of from  $10 \mu\text{V}$  to 100 V with a minimum reading of  $1 \mu\text{V}$ .

A swept frequency selective amplifier voltmeter covering the frequency range 200 c/s to 1300 kc/s has recently been introduced. Used with either a sweep oscillator or a manually tuned generator it provides a measurement range of +22 dBm to -98 dBm, with a minimum reading of -115 dBm. The 3 dB bandwidth is  $\pm 100$  c/s. As a logarithmic voltmeter the range is 60 dB. A prototype of the Janus system of collision avoiding radio equipment was on show. This is a shipboard equipment designed for bridge-to-bridge working. Information on the ship's course, whether or not at anchor, and if at anchor the ship's position is transmitted regularly and automatically. Manual signalling and voice communication facilities are also fitted.

Medium and high frequency marine radio telephones were shown by Societa Italiana Radio Maritima. One transmitter/receiver, the Mizar 63, which measured  $39 \times 17.5 \times 36$  cm had a power output of 70 watts. The transmitter is designed to operate on spot frequencies in the 1600 to 2850 kc/s, and 8 to 9 Mc/s bands and the receiver provides continuous coverage from 500 kc/s to 3 Mc/s and 8 Mc/s to 9 Mc/s.

Selenia of Rome showed their Meteor 200 model RMT-1C weather radar. A large order for this equipment has recently been received from Sweden. It is an X-band, 200 kW peak power radar with a p.r.f. of 1200 or 240 at pulse widths of  $0.5 \mu\text{s}$  and  $0.3 \mu\text{s}$ . Maximum range is 250 miles and p.p.i. and r.h.i. presentations are available. Iso-echo facilities can be switched on on both types of display. The company, a member

of the Raytheon group, were also showing marine radars and microwave relay systems designed and built in Italy.

Litton Industries, the American company were showing inertial navigation equipment and electronic test equipment in the aircraft exhibition. This equipment has been shown before but they did announce that the depth of their range of 10 to 1 potentiometers has been reduced to half an inch.

A number of British, European and American companies had stands. Solartron and EMR, both members of the same group each had a stand, and a wide selection of equipment was shown by Philips of Eindhoven. A particularly impressive display of measuring instruments was seen at the Marconi Instruments stand. All the instruments on show had been seen at other exhibitions this year, but advance information on new additions to their range of modular electronic instruments was available in their new catalogue which had just been printed.

The Marconi Instruments stand formed part of the luxurious Marconi Italiana stand. The Marconi Company of Chelmsford also had space on this stand. A

great deal of interest was shown in the Marconi Italiana all-transistor multichannel radio link equipment, Type MH141. Designed to work in the 5925 to 8500 Mc/s band, the frequency deviation is 200 kc/s per channel and the capacity is 300 to 400 channels.

While discussing colour television systems with engineers from Radiotelevisione Italiana at their stand it very rapidly became clear that their choice for the European standard was PAL. This preference was stated most emphatically. Very different from the way B.B.C. engineers expressed themselves in July during the demonstration to the E.B.U. *ad hoc* colour group.

While there were very few visitors on the first day of the fair the grounds were crowded on the 2nd day, and after a fall in numbers on the third and fourth days the number of visitors, particularly the technically qualified, began to rise very substantially. A slow start was perhaps to be expected at an exhibition lasting so long—fourteen days—but to judge by the way the numbers had increased by the fifth day the total over the period will be very substantial.

R.B.

## BOOKS RECEIVED

**Essays in Electronics**, by "Cathode Ray". A collection of twenty-two articles previously published in *Wireless World*. This book is complementary to "Second Thoughts on Radio Theory" and is the author's own selection from his writings during the past eight years. Pp. 301. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. Price 42s.

**British Standard 1991: Part 6: 1963**. Recommendations for letter symbols, signs and abbreviations in electrical science and engineering, including electronics and telecommunications. Pp. 51. British Standards Institution, 2 Park Street, London, W.1. Price 12s 6d.

**Batteries**. Edited by D. H. Collins. Proceedings of the 3rd International Symposium held at Bourne-mouth, October 1962. The full papers and discussions recording developments in primary and secondary cells, solar batteries and fuel cells. Pp. 464. Pergamon Press Ltd., Headington Hill Hall, Oxford. Price £6.

**Der Transistor**, by H. Salow, H. Beneking, H. Krömer and W. v. Münch. Volume 15 in the series *Technische Physik in Einzeldarstellungen*. Reviews (in German) the physical basis of transistor action, the technology of production, general circuit theory and a final chapter on special types, including tunnel diodes, phototransistors, unipolar and double base diodes. Pp. 426. Springer-Verlag, Berlin/Göttingen/Heidelberg. Price DM82.

**Ultrasonic Delay Lines**, by C. F. Brockelsby, B.Sc., A.R.C.S., A.M.I.E.E., J. S. Palfreeman and R. W. Gibson, B.Sc. (Eng.), Grad.I.Mech.E. Surveys the development and gives the basic design principles of liquid, solid (including wire) and other forms of electroacoustic time delay devices used in radar, colour television and correlation techniques. Pp. 297. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. Price 65s.

**Les Fonctions de la Variable Complexe**, by A. Kaufmann and R. Douriaux. Advanced mathematical textbook (in French) on the theory and applications of complex quantities and functions in engineering, including electrical networks. Pp. 427. Editions Eyrolles, 61 Boulevard Saint-Germain, Paris V<sup>e</sup>. Price NF81.60, by post.

### B.B.C. Engineering Division Monographs.

No. 47. "Vertical Aperture Correction Using Continuously Variable Delay Lines", by D. Howorth, B.Sc. Tech., Grad. I.E.E.

No. 48. "The Development of B.B.C. Internal Communications", by J. M. Chorley, A.M.I.E.E., and J. S. Norwell.

No. 49. "Apparatus for Measurement of Non-linear Distortion as a Continuous Function of Frequency", by H. D. Harwood, B.Sc., A.Inst.P., A.M.I.E.E., includes some interesting results from the application of this method to loudspeaker testing.

The prices of the above, which are obtainable from B.B.C. Publications, 35 Marylebone High Street, London W.1, are 5s each by post.

### Printed Wiring and Printed Circuit Techniques.

Survey of the materials, processes and recommended standards involved in production. Pp. 49. Prepared by the Electronic Engineering Association and printed by Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. Price 5s (5s 5d by post).

### INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 40 and 41.

We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 2WW, and it is then necessary only to enter the number(s) on the card.

Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.

# First International Telemetry Conference

LONDON, 23RD TO 27TH SEPTEMBER 1963

**S**INCE 1950 when the first joint meeting was held in Philadelphia, proponents of both the military (largely "aerospace") and the industrial sections of the art have met in the U.S. in the National Telemetry Conferences. This year a major step forward was taken with the inauguration of the International Telemetry Conference in London. This was sponsored in America by the Institute of Aeronautics and Astronautics, the Instrument Society and the I.E.E.E., and, in the U.K., by the Brit. I.R.E. and the I.E.E. The I.E.E. were the "host" organization, the Conference being held in the Institution building at Savoy Place.

**Scope of the Conference:**—Because of the many technologies involved telemetry is a wide and complex subject. Also, because of the way in which these technologies interlock, it is not easy to arrive at clear-cut divisions for discussion. This occasion was no exception, and it was evident that the joint programme committees had encountered this problem which had been made more difficult by the need to compress a total of 59 papers into what was effectively a period of only three and a half days.

Nevertheless the original conception of two main types of telemetry was brought out from time to time, particularly in connection with what was perhaps the most controversial issue raised during the Conference—Has telemetry reached maturity?

As with all good debating points, a considerable number of arguments were put forward on both sides, one outcome of which was to enable a picture to be obtained of the relative state of development reached in specific areas. Thus it became clear that, defining maturity as a state of complete development, this was much more likely to be achieved with public utility telemetry (i.e. pipe line control and electricity distribution systems) than with systems for aerospace vehicles. Public utility requirements and hence telemetry design can be frozen at an early stage, whereas aerospace vehicles and their instrumentation systems are almost invariably under continuous development. For public utility and similar applications telemetry systems have been produced which could be described as mature at the time they came into use.

The last point was brought out clearly in "Thirty Years of Grid Telemetry" by Mr. P. F. Gunning. Equipment described in this paper gave the performance demanded of it and did not have to be replaced by new systems until fresh operational requirements arose. For instance the "phototelemeter," introduced in 1935, remained in service for nearly 20 years. This and other grid telemetry systems associated with the 30 years period covered by Mr. Gunning were shown working in their original form in the conference exhibition at Savoy Place.

**Technical Thought and Practice:**—The speakers whose names have already been given were those

who set the scene in the opening session of the Conference. From there on presentation was in the hands of rapporteurs with the object of giving the maximum possible time to discussion.

Most of the American papers were concerned with aerospace matters, notable exceptions being papers on oceanographic and biomedical telemetry, and a description of a supervisory control system for a large natural gas pipeline network stretching from the Mexican border to the eastern seaboard of the northern States.

## Working Speeds

The last system was of particular interest in that it was the first of its kind in the United States and had only been brought into use comparatively recently (installation was in 1962). Although not operating in the 150,000 bit/sec range of the Goddard Data Central scheme, this pipeline telemetry system was entitled "high speed" by virtue of its working speed of 1,000 bauds (bits per sec). Several speakers remarked on this value and contrasted it with the much lower speeds adopted in the past for many public utility applications, especially for the main electricity supply links in the United Kingdom. Obviously speed of operation is limited by the bandwidth which is available. This clearly has an economic aspect—cost increasing with the bandwidth which is made available. However it was stated in the paper that in 1960 the Bell System Dataphone provided a data handling facility with a system rate 80 times that of an ordinary telegraph circuit at only four times the cost, and that overall the "per-bit rate" became cheaper with increase in bandwidth.

In the circumstances therefore the fact that a contract was awarded to a British company in 1960 to supply a 1,200 baud system for a pipeline in Asia became significant. The main features of the system were outlined by a representative of the firm concerned (Serck Controls Ltd.) during the discussion period.

This account was followed by one from Ferranti (Edinburgh) of an X band microwave radio link using pulsed magnetrons operating directly from digitally coded telemetry signals. The link had been supplied for another Serck Controls installation—for the Das Island offshore oil project—and all the equipment from both firms had had to be designed to withstand the extremely adverse environmental conditions of the Arabian Gulf. A set of demonstration equipment was shown in operation at the concurrent International Telemetry Exhibition at the Hilton Hotel. This set incorporated a representative selection of Serck Controls telemetry equipment working in conjunction with Ferranti radio link units of the Das Island type.

At this point it is apposite to consider the position

reached with "public utility" telemetry in Europe, and in the United Kingdom in particular, and—in the light of comment at the Conference—to compare it with that in north America. More than one speaker from the U.S. did not hesitate to say that "power industry" telemetry systems in the U.K. and Europe were ahead of their American counterparts. This situation was also evinced by the Hilton Hotel exhibition where all the British and European firms in general were concentrating to a great extent on industrial telemetry in one form or another, whereas the American exhibitors were concerned more with aerospace techniques and equipment.

There will, of course, always be a number of fundamental differences between the two fields. Nevertheless, there is an increasing tendency for many basic techniques to become common to both.

### **P.C.M. and T.D.M.**

One of the most outstanding examples of this trend is the adoption of pulse code modulation and time division multiplexing for telemetry systems for American aerospace vehicles such as the Minuteman missile, and, in parallel, for the more sophisticated industrial telemetering and telecontrol systems. The main differences lie in the degree of complexity of the individual pulse group "words" together with the redundant pulses (e.g., parity bits) included in them for error checking, recognition, etc., and in the methods used for scanning synchronization.

Thus the p.c.m. code used for the Minuteman missile is based on a 27-bit word. The last three bits of the 27 are used to give word identification; as for instance in the "telemeter word" where two 8-bit analogue data blocks converted into digital form are separated by an 8-bit digital block containing guidance and control data. For the Compagnie des Compteurs system for electric power networks a 25-bit word is used, but in this case 9 bits are utilized for checking—5 bits (numbers 9 to 13) for the complementary value of the address, itself sent as a 5-bit group, and 4 bits (numbers 22 to 25) for transmitting in natural binary code the number of "ones" in the word. It is of interest that the code structure adopted for the U.S. high-speed pipeline system is considerably more complex than this, two 36-bit words being contained within an 82-bit message block. The actual information is carried by the first 36-bit word and the second consists of the same number of bits to give a complement check of the information word. The remaining 10 bits are spaced on each side of the two main groups to provide 5-bit start and 5-bit stop signals. It will be appreciated that such a large amount of redundancy should provide the high degree of system integrity which is considered necessary for this type of application. It was stated that "no information was preferred to bad information," i.e., the latter is rejected whenever errors are detected, a measure which is usually provided for in most public utility supervisory schemes.

The other main element of time division multiplexing, namely, synchronization, is achieved either as a direct locking action or by some form of "start-stop" or periodic correction applied at the receiving end. A method which appears to fall in the first category is employed in the Westinghouse binary-coded decimal ("Westronic") system in which a master generator at the central control station drives transistor scanning systems at both master and out-

stations. This equipment was shown at the I.T. Exhibition, where it was intimated that this was a three-frequency system in that the synchronizing drive signals were transmitted on a "middle frequency." The other two frequencies are used to transmit information by conventional two-tone methods, signals being held in a temporary store or register at the receiving end from which they are transferred to the final (control) register through standard gating circuits, provided synchronism over the scan period has been "proved" and parity checking has been carried out satisfactorily. System operating speed lies between 100 and 250 bauds, the upper limit being extended to 350 bauds when required subject to the additional communication bandwidth being available.

The G.E.C. (Electronics) "Teledata" equipment is typical of frequency division multiplexed systems designed to work over G.P.O. or equivalent circuits. The gear is fully transistorized and its working range of  $-10^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$  may be taken as being representative, somewhat higher figures being given for the transmitter section and for storage and transportation. In its standard form the system provides 24 basic channels, demultiplexing being carried out by conventional bandpass filters.

One system of interest, described at the Conference, had been developed by S. Smith and Son specifically for use in coal mines, and to meet the requirement for intrinsic safety. The intelligence which has to be passed from the working areas to a central control station on the surface may either be in analogue or on/off form, and time division working using a solid state multiplexing switch was adopted. Solid state devices are, in fact, employed throughout, their low working power level making a significant contribution to satisfying the intrinsic safety criterion.

In the equipment shown a relatively small number of data channels—six—were provided; transmitting units and receiver being linked through a phantom transformer arrangement in order to economize in the number of conductors required. Power supply to the remote units, and their signals in the reverse direction, are carried over this common cable network. The phantom transformer system is stated to give the necessary d.c. isolation between the receiving equipment and the underground units. Construction of the underground transmitter units is based on plug-in printed circuit boards contained within  $\frac{1}{4}$  in thick steel cases. External connections are made through waterproof plugs and sockets specially developed for this project, and having extremely low contact resistance and extraction force.

### **Mechanical Engineering**

An outstanding paper falling in the "Industrial System" category was concerned with the telemetering system evolved by the Central Electricity Research Laboratories for the study of the vibration behaviour of steam turbine blades under working conditions.

Several unique problems were encountered during the development of the steam turbine telemetering equipment, particularly with regard to the high temperatures ( $150^{\circ}\text{C}$ ) and accelerations (5,000 g) and the presence of steam and water. The "capsule"

*(Continued on page 567)*

sender units are mounted in the grooves provided in the turbine blade discs for balancing purposes. Power is conveyed into the capsule by induction transfer between a stationary primary winding and a number of secondary pick-up coils on the rotating disc. A gap of  $\frac{1}{4}$  in or more exists between the two winding cores, and a nice design compromise was required between the low coupling factor due to the gap demanding a high frequency and the increase in eddy current loss with frequency. A frequency of about 50 kc/s has been adopted; with three capsules an input of 70 W is necessary to feed them with a total supply of  $4\frac{1}{2}$  W. The modulated radio signals are picked up in a comparable fashion. Designed for a nominal frequency of 30 Mc/s, a small output loop in the outer face of the capsule transmits to the stationary transmission line coupling loop. This ingenious parallel line feeder/aerial system is terminated by its characteristic impedance, and gives uniform pick-up sensitivity over its whole circumference except at the termination. This particular difficulty was overcome by placing a compensating capacitive pick-up at the receiving end termination.

In operation, capsule lives in excess of 2,000 hours have been shown to be possible. Trouble due to "temporary g" failures—temporary fade-out of signals—has occurred. The mechanism involved is not clear, but an explanation was put forward by Mr. M. K. Kingery, of the Arnold Engineering Development Center. The experimental programme undertaken in this connection was, in effect, to "squeeze potted transistors", which resulted in their characteristics being "destroyed" for the time being, but recovering after an appreciable hysteresis period.

The paper on piston engine research telemetering, by Associated Engineering Limited, showed how development had gone along parallel lines to those adopted by C.E.R.L. The sender, working at 86 Mc/s, is small enough to be fitted inside the piston of a standard 4-cylinder 1,500 c.c. petrol engine, is encapsulated, and supplied from a mercury cell mounted on the gudgeon pin so that the acceleration forces are across the width of the cell and the plate faces and not perpendicular to them. The cells are constructed with high temperature seals; despite the high acceleration and temperature conditions an operating life of 5 hours is obtained.

With a much more severe radio propagation problem than C.E.R.L., fluctuations in signal strength are countered by the employment of a very wide, fast-acting a.g.c. system which has to cope with the 60 dB change which occurs between the two extreme positions of the piston relative to the crankcase aerial. In the receiver the Foster-Seeley discriminator covers a bandwidth of 400 kc/s with a constant slope, while a high gain a.f.c. system is provided which has a range of some 5 to 6 Mc/s.

### Biomedical Telemetering

The paper on biomedical telemetering by Professor Mackay of the University of California was of considerable value on several counts. Not the least of these was the comprehensive list of references beginning with his original contribution (with B. Jacobson) "Endoradiosonde", published in *Nature*, June 15, 1957.

Professor Mackay indicated that work on the "radio pill" had been going on for over ten years.

The first experiments were carried out with "passive transmitters" in the period before suitable transistors became available. By using a resonant combination of an inductive pick-up and a condenser, variations in the resonant frequency due to changes in the physical quantity being measured could be detected as with the grid-dip wavemeter, and these instruments were, in fact, employed for sensing these changes.

The development of the transistor type of transmitter was also traced with particular reference to reduction in size. The possibility of producing such a unit capable of being implanted in the human eye without damage appears to represent the achievement of a point well along the asymptote to the infinitesimal.

### Oceanography

The rapidly growing recognition of the need to set up oceanographic telemetering networks on a worldwide basis is a natural result of the corresponding increase in the importance of oceanography. In particular, the U.S. contributions to the session on "Geophysical and Biomedical Systems" showed that an advanced stage of planning has been reached on an international scale. Technically the systems have much in common with those used for public utility supervisory schemes. A widely distributed group of buoys telemeter the required data e.g. temperature, pressure, salinity, etc. back to a shore station which interrogates them at suitable intervals. Because of the ranges involved and associated system design considerations, it is planned to use frequency bands in the 4-23 Mc/s section of the h.f. band for oceanographic telemetering. The h.f. band is, at present, probably the most congested of any, and the demands for space in it continue to grow. Consequently the oceanographer will be competing for bandwidth with a large number of users, many of them representing public services. Nevertheless his claims appear to be such that at least a part of his requirements may well be met in the near future.

A far from tenuous link exists between oceanography and earth satellites such as the Canadian "Alouette" topside ionosphere sounder. Its main purpose is to measure, as implied by its functional name, the electron density distribution from above the ionosphere. The paper given on this satellite elicited major interest, especially with regard to the ground-based telecontrol system used with it. Reliability had proved to be extremely high. Launched from the Pacific Missile Range in California on September 29th, 1962, less than 0.1% failure had been experienced on telecontrol commands over this period. The telecontrol system is based on a 7-tone command unit, the tones, lying in the audio range, are applied sequentially as amplitude modulation of the v.h.f. carrier. The decision to adopt telecontrol had been found to have been amply justified, not least for the way in which power could be switched off during the gaps between station passes to keep within the power capacity limitations of the solar cells. The overall policy which had been adopted was influenced strongly by the need to make the command, telemetering, and tracking systems of the satellite compatible with the chain of N.A.S.A. Minitrack stations; and had as a guiding principle the concept of "keeping the complexity on the ground".

R.E.Y.



# SALON INTERNATIONAL RADIO-TÉLÉVISION

PARIS 1963

## "Deuxième Chaîne" Prospects Attract Record Crowds

AFTER missing a year the Paris radio exhibition reopened with renewed vigour from 5th to 15th September this year as an international show—in fact as well as in name. Rumours that this would be in effect a Franco-German exhibition turned out to be a malicious exaggeration. We hope it did not originate in the U.K. because Ferguson were the only firm who made the effort to show what Great Britain can produce. We congratulate them on doing something to make direct contact with the French buying public and on the excellent decor of their large stand. Well mixed with the 197 stands of French manufacturers were 49 firms from Germany, Holland, Denmark, Spain, Italy, Switzerland, Austria, Japan, the U.S.A. and the U.K.

We visited the Salon on the last Saturday of the period and in spite of warm sunshine found the ticket offices besieged. The organizers do not disguise their surprise at the success of this year's show as measured by the number of visitors which, helped by a fairly generous issue of invitations, reached a total of 400,000 when the show closed—nearly double the number at the previous exhibition in 1961.

The French broadcasting authority R.T.F. gave massive support to the

exhibition with special television programmes originating both in the hall and in the adjoining Palais des Sports with its aluminium domed roof and seating capacity of 6,000. Demonstrations were also given of the work of R.T.F. in assisting the development of broadcasting in the African countries, and of the work of their technical research departments. In common with most of the European radio and electronics shows this year there were exhibits dedicated to past history as well as to the future. The Centre National d'Etudes des Télécommunications had arranged a sequence showing the evolution of electricity and magnetism, and there were tableaux contrasting amateur transmitters, portable receivers, etc., of yesterday and today. The future was epitomized by a beautifully made model of the steerable horn antenna used for satellite reception at Pleumeur Bodou.

But most of the interest shown by the public was in the forthcoming second programme in Band IV on 625 lines, and throughout the period of the exhibition programmes were transmitted both on v.h.f. (819 lines) and u.h.f. (625 lines) to demonstrate the capabilities of the receivers shown on the stands. The ambient lighting in the main

hall was reduced so that picture quality could be better appreciated.

Although schedules from the Paris transmitter on channel 22 will continue daily for the purpose of receiver adjustment they will be mainly stills and test cards, but experimental programmes for the public will commence on 4th January 1964 and will continue each Saturday evening and each Sunday afternoon and evening until April 1964 when a full service will be established in the environs of Paris. At the same time experimental transmissions will start in Lyons-Fourvieres and before the summer of 1964 will be followed by transmissions from Lille, Marseille and Clermont-Ferrand.

All leading French television receiver manufacturers have either adapted their receivers for the addition of a u.h.f. tuner and a switched line timebase or are already selling sets fully equipped for the second programme. In this they are technically and chronologically on a par with British manufacturers. As in Belgium and Holland, multi-standard sets are also available and the firm of Singer SNR were showing a model (TM 18) which was claimed to receive *all* European systems, though on closer examination we noticed that 405 lines was not listed! Many sets make use of the twin-panel

plastic-coated type of display tube, usually described as *auto-filtrant*, but by Grammot as *ecran endochromatique anti-reflet*. Continental Edison showed a receiver with 70cm (27½in) tube and there was one example of projection television by Pyrus Télémonde to show that this system still has its adherents. A few portable television receivers made their appearance, one of the most interesting being the French-designed Célard "Radiotélécapte" which uses transistors, has an 8in display tube, is adjustable to five different European standards and will also receive medium- and long-wave radio stations. It measures 14½ × 13 × 8¼in and weighs 21 lb.

Célard were also showing an all-transistor table model television receiver taking only 24 watts from batteries or 50 watts from mains which uses a 23in, 110° tube and provides piano-key selection of the two 819-line and three 625-line European standards. The 32 transistors and 22 diodes are mounted in printed circuits which are hinged for access to both sides.

Colour television was not in evidence in the main exhibition, but we heard that private demonstrations were given of long-distance relaying (Paris-Marseille-Paris) of colour tests, designed to show the quality and stability of the SECAM system under these conditions.

Accessories to television were numerous and included a Fresnel-type magnifier (Beamscope) marketed by Pizon Bros. giving 30% increase in picture size, and a wide variety of television tables. Some of these, e.g. Voltam, are extremely functional

since their somewhat thick tops contain voltage regulators which seem to be necessary in France, due to the supply voltage variations in some districts. Other firms showing *reglateurs de tension* were Ducretet-Thomson, Dynatra, Opalec and Ribet-Desjardins. An effective ultrasonic remote control system which successfully overrode the high exhibition background noise was demonstrated by the Belgian firm of Cobar. So that visitors could see the working of the mechanism at close quarters, this set was demonstrated with the back off!

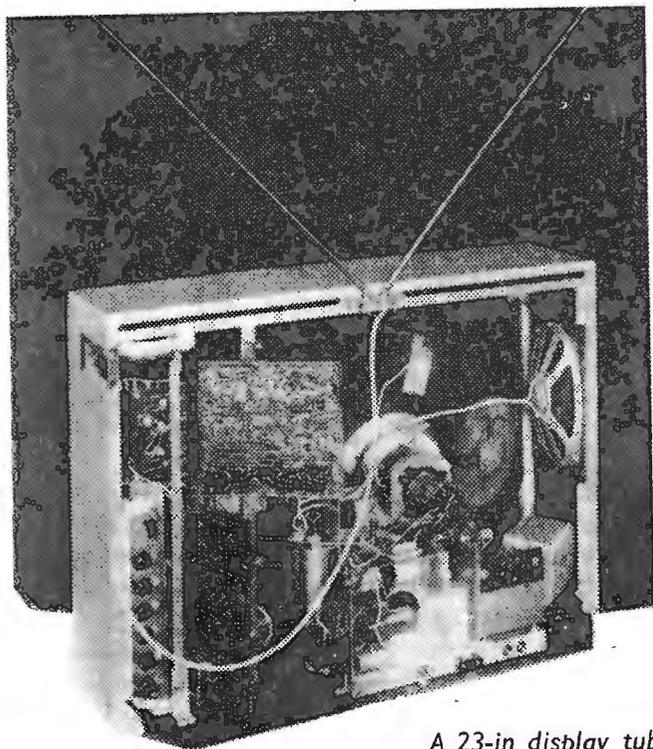
There was little new to report in the field of radio reception. Hardly anything was heard of stereophonic broadcasting, in spite of the lead given by R.T.F. in starting experimental broadcasts four years ago on a single radio channel. The authorities have evidently decided that their efforts to provide a good monophonic f.m. service are not yet sufficiently appreciated, and publicity was quite strongly directed towards *modulation de fréquence* as such. The majority of portables are of the hand-carrying rather than the vest-pocket type and in this respect the trend in France is similar to that noted in other European countries.

A trend peculiar to France is the *valise électrophone stéréo* of which upwards of 30 different makes were to be seen. This is a record player with twin loudspeakers which fit together to look rather like a piece of expensive airline luggage and which, at the drop of a catch (and connection to the nearest mains socket), gives extremely good sound quality. Inquiries of several firms as to who

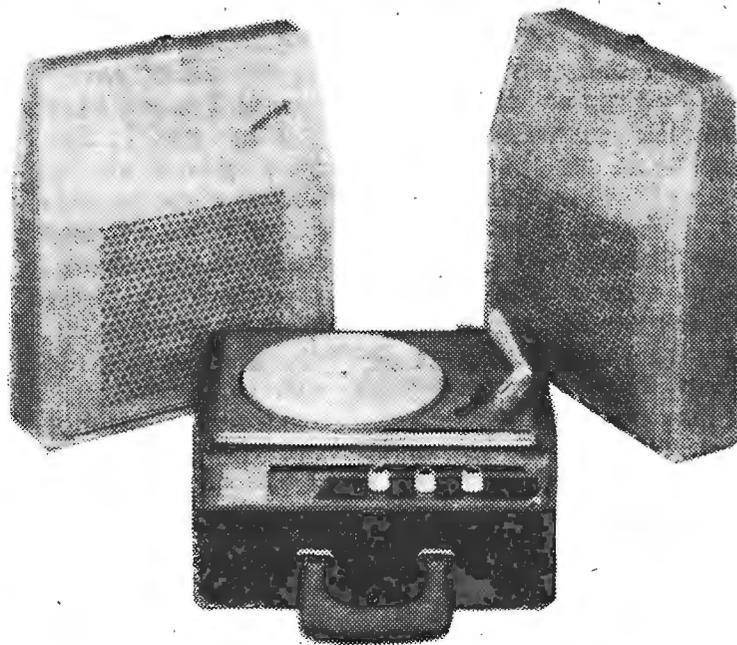
bought these outfits, which are so good to look at while in transit, and why they were carried around, did not produce any satisfactory answer. "*Nous ne savons pas, mais ils sont très populaire.*"

There is a strong *haute fidélité* movement in France, but the Radio and Television Salon is not really their show (this, the International Festival of Sound, will be held in the Palais D'Orsay next year from 12th to 17th March). However, one or two examples of high-power and high-quality sound amplifiers were noted. The Harmon Kardon (American) 50W+ amplifier, for instance, shown by Dyna Empire Inc., was demonstrating what these ratings mean in terms of millibars in the auditory meatus. Grundig (German) were also collecting appreciative crowds by the sonority of their larger "music chests". Among the native French products Teppaz, whom one has hitherto associated with inexpensive portable record players, were giving more emphasis to the public address side of their activities and showed a wide range of valve power amplifiers with graphical direct indication of tone control characteristic settings, and also a range of transistor amplifiers for either 6V (7 watt output) or 12V (15 watts) supplies.

The Paris Radio Show is, more than most, a retail sales show where visitors are encouraged to sit down and settle final details of a purchase there and then. From the amount of business we saw being conducted in this way we can appreciate the organizers' and exhibitors' satisfaction with this year's event.



A 23-in display tube is used in the Célard "Télécapte 59" transistor multi-standard television receiver.



Schneider "Zambra", an example of the "stereo valise" portable record players now popular in France.

# Why Coaxial Cables?

By "CATHODE RAY"

EVER since I wrote a two-part treatise on r.f. cables 13 years ago and it was reissued in the book "Second Thoughts on Radio Theory," I have complacently assumed that the subject was covered. Those who were at home with hyperbolic functions had plenty of books from which to choose, and those who weren't could, I hoped, get what they wanted from my simpler though less elegant treatment. So I was surprised and slightly disconcerted the other day to get a letter from someone who declared that he had read the said treatment in "Second Thoughts" and it hadn't helped him.

He went on to ask quite a lot of questions, and although I felt a few points were in fact covered by what he had read he did succeed in convincing me that there was a gap in available teaching on the subject.

It is no good (it seems) to clarify, beyond even the capacity of the dimmest to misunderstand, the

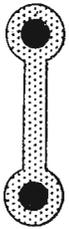


Fig. 1. Section of type of parallel-wire cable sometimes used for linking television set with aerial.

mysteries of reflection coefficient, standing wave ratio, characteristic impedance, quarter-wave transformers, etc., if you omit to mention what it is all in aid of.

This is how, 13 years ago, I began:

"Now that television is going ahead in a big way, more and more people are having to become acquainted with the fact that for connecting the aerial to the set one cannot just use any old bit of wire." If I'd had my ear closer to the ground I might have heard the insistent rejoinder "Why not?" But I just went on: "One has to use a special sort of 'feeder' cable, and it must have the right impedance." Again, I missed the cries of "Why?" and plunged straight into the technicalities of impedance.

Now, after a delay that only a cable to the stars and back would provide, but without its attenuation, comes the simple query: Why is a coaxial cable needed? Why not the ordinary electric sort?

It may not have escaped notice that my questioner was concerned about *coaxial* cables, whereas my treatise was entitled "R.F. Cables." Although the two things have a large overlap, they far from completely coincide. Not all r.f. cables are coaxial and not all coaxial cables are for r.f. (which stands for radio frequency). But it was clear that the inquirer meant r.f. coaxial cables. I pointed out to him that parallel-wire cables or transmission lines are preferred for some r.f. purposes.

Talking about purposes, although I mentioned television—because it is by far the most familiar

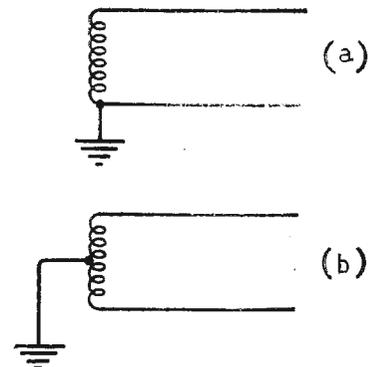
—there are others. Wherever r.f. power or signals have to be transmitted over a significant distance with as little loss as possible, that is where r.f. cables or lines are used. In radio communications and radar equipment, for example.

What, in this context, is a significant distance? It would be quite wrong to give the answer in yards, or even metres—unless the frequency or wavelength was known. The general answer would be: Something more than a very small fraction of a wavelength. How about 5 yards—or, what is nearly the same, 5 metres—for example? If this was anything over, say, one twentieth of a wavelength it would be significant. 20 times 5 being 100, that works out to include all wavelengths less than 100 metres. If you think in frequencies, you will divide 300 million by this and say: Oh, yes! 3 Mc/s. As a matter of fact it isn't quite so simple as that, because 300 million is (in round figures) the number of metres travelled by light and radio waves per second *in empty space*. Along a cable, which is what we are talking about, they travel slower. How much slower depends on the kind of cable, and that we don't know; but 200 million metres per second is near enough for most r.f. cables. Recalculating the lowest frequency for which 5 metres of cable is certainly a significant distance, we get 2 Mc/s. For some purposes even one-twentieth of a wavelength would be too large a fraction, and 2 Mc/s therefore not the lowest frequency for which 5 metres of cable would matter.

I can imagine my questioner asking, "Why?"

The waves take time, however short, to move from A to B, so there is a phase difference between the two points, and it is this phase difference that is the significant thing. For most purposes even one twentieth of a cycle ( $18^\circ$ ) is appreciable.

Fig. 2. (a) Unbalanced and (b) balanced termination for parallel-wire line.



And so we find that a few inches don't matter very much at the frequencies used for television—at least, on the present bands I and III—but they matter a lot with centimetre waves. At the other extreme, a mile of cable would introduce only about one fourteenth of one degree of phase difference at power frequency (50 c/s.).

Going back to where we got involved in this question of distance, we should note that the first require-

ment of the cable is that it should transport r.f. power with negligible loss. There are three different ways in which it can lose power. The most obvious, perhaps, is in the cable itself; due to the resistance of the conductors to current flowing through them and the behaviour of the insulating materials to capacitive currents. There can also be loss by radiation—and, to the extent that there is, liability to interference entering such cable used to link a receiver with its aerial. Lastly there is the more involved subject of impedance mismatching. This doesn't so much actually waste power as limit the amount transmitted, to something less than the maximum possible.

It is in these respects that the cables used at power frequencies—or even telephone frequencies—are likely to be found wanting. Not that the resistance of the conductors is likely to be excessive, though one does have to bear in mind that at very high frequencies the surface rather than the whole substance carries most of the current. (There is no time just now to explain why; if you don't know, look up "Skin Effect" in any good book on radio.) But dielectric losses are of major importance.

That is easy enough to understand, because every inch of the cable is a capacitor into which current is driven by any voltage between the two conductors. The amount of such current, for a given voltage, is directly proportional to the frequency. So at 50 Mc/s it is a million times as much as at 50 c/s. If the space between the conductors were a vacuum there would be no waste of power (though of course the capacitance current has a profound effect on the behaviour of the cable), and the same is very nearly true for air. But one can't keep the conductors apart by a vacuum, or even by air; something more substantial is needed, and whatever is used wastes a proportion (called the power factor) of the power flowing to and fro through the cable's capacitance.

At 50 c/s so little power does flow this way that there is no need to worry much about its power factor; if the material is chosen to resist voltage breakdown successfully, its power factor should be low enough. Not only is power factor enormously more important at r.f., in proportion to the frequency, but the power factor of some materials itself increases with frequency. That is why such care has to be taken to choose cable insulating materials for r.f., and especially for v.h.f. and microwaves. The development of polythene during the war deserves the description "breakthrough" more than many things so described, because it combines extremely low v.h.f. power factor with flexibility over a wide range of temperature.

Even the best solid material wastes some power—and costs some money—so there is a double incentive to use as little of it as possible. In most types of r.f. cable it is limited to disk or cup shaped spacers at intervals along it, or it takes the form of a continuous spiral cord—there are many ingenious designs. Obviously there must be sufficient solid material so placed as to prevent the conductors from touching or (in power feeders) getting close enough for a flash-over, but the requirement is more rigorous than that because it is necessary to maintain the capacitance per inch at the same figure throughout or there will be mismatching trouble.

Power feeders such as those used to take the output from a television transmitter up the tower

to the aerial need not be flexible (in fact, should not be) and are on such a scale that they can be built up of rigid rods and cylinders, with very little solid insulation. When many kilowatts of power are to be carried, one doesn't want to waste even a few per cent of it.

Next, there is the reason for the coaxial form. Why not use ordinary twisted flex? Well, in the first place flex is usually insulated by p.v.c., which has much too high a power factor. Presumably that could be got over by substituting polythene. Next, the conductors are so close together that the capacitance per inch is large, tending to cause a large loss, and also resulting in an inconveniently low impedance for matching the things the wire is connected to. Probably, too, the capacitance would not be very constant, and certainly it would be increased wherever the wire was placed close to metal structures.

Some of these disadvantages are reduced by spacing the wires apart as shown in Fig. 1, and parallel-wire

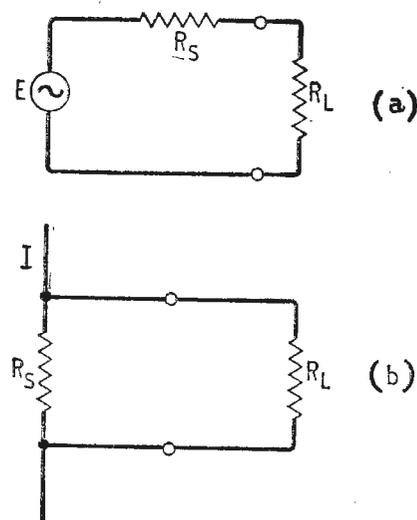


Fig. 3. (a) Constant-voltage generator and load system and their simplest equivalent forms.

feeder of this kind is used for television receivers, etc., where cheapness is important. But the need to keep it away from other conductors is even greater, and the absence of twist results in greater radiation and possibility of interference. On a larger scale, parallel wires or rods separated mainly by air and supported by insulators rather like overhead telephone wires are sometimes used at radio frequencies, but rarely at very high ones.

That brings us to the questions of radiation and interference. They are both the same question really, so far as the characteristics of the line are concerned; a line that radiates a lot is open to accept a lot of interference, just as the receiving ability of an aerial can be found by measuring its radiating ability, and *vice versa*. Although far more people use r.f. lines for receiving than for transmitting, the two-fold question can perhaps be discussed more easily in terms of radiation.

Radiation is proportional to the rate at which the electric and magnetic fields are changing; that is to say, the frequency. But frequency is decided on other grounds than minimizing radiation, so is not a possible variable for that purpose. Even a very fast-changing field will not radiate much, however, if it is very close (in terms of wavelength) to its source. It has to spread out. That is why aerials are shaped as they are. Exactly the opposite is in mind when transmission lines or cables are being designed. Fields are inevitable—and indeed essential to the functioning of the line—so the only solution is to make them cancel one another out as completely as

possible at all points more than a small fraction of a wavelength from the conductors.

At such low frequencies as 50 c/s it is not unusual to connect things together with a parallel-wire line, one wire of which is earthed, as in Fig. 2(a). It happens when we use one of the untwisted types of flex for our domestic appliances. If all the current goes via the wires and none via earth, then the wires carry equal and opposite currents; and because they are very close together the mutual cancellation of their magnetic fields is effective everywhere beyond a *very* small fraction of one wavelength (at 50 c/s, 3,750 miles!). But because one wire is earthed and the other is "live", there is an unbalanced electric field between the latter and earth, and consequently a capacitive current that way. So the balance of currents is upset, the mutual cancellation of magnetic fields is imperfect, and there is a spread-out electric field between the live wire and earth as well as the concentrated one between it and the earthed wire. However, the earthed wire provides some screening, and in any case the capacitive current at 50 c/s is negligible, and even if it weren't the radiation at that frequency is negligible.

At v.h.f., however, the wavelength is at least a million times shorter, and the frequency (and therefore the current via a given capacitance) a million times greater. Moreover the wires have to be spaced farther apart if the impedance of the line is not to be inconveniently low—and, in r.f. power lines, if there is to be no flash-over. So there is liable to be a very appreciable inequality in the currents in the wires, and therefore a resultant magnetic field. And the wider spacing would reduce cancellation even if the currents were equal.

Consequently at such frequencies the practice is to earth the centre point, as in Fig. 2(b), so that the wires are at equal and opposite potentials. Then, provided they are both at practically equal distances from any earth, the current balance is maintained and the magnetic fields cancel at distances that are large compared with the spacing between the wires.

To meet other requirements this spacing is likely to be appreciable compared with a wavelength, and

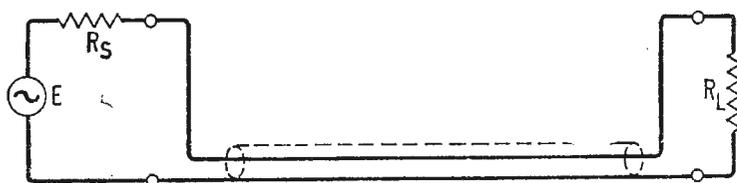


Fig. 4. Modification of Fig. 3 (a) when generator and load are in different places, necessitating a coaxial cable to join them.

so therefore is radiation from this type of line. It is particularly unsuitable if used close to earth—and that, of course, includes all earthed conductive objects.

So where it is important to keep radiation or interference down, the coaxial type is preferred. It has the extra advantage that no centre-tapping is needed; the outer conductor is earthed. So only the inner conductor is at r.f. potential, and as it is entirely surrounded by the outer conductor the electric field is confined to the space between the conductors, and in spite of the unbalanced connection there is no current unbalance. Consequently there is maximum mutual cancellation of magnetic fields, aided by the fact that the outer conductor

is all round the other instead of at one side of it.

Lastly, impedance. Here the governing principle is that when a constant e.m.f. or current is provided by a source, it delivers the maximum power to a load when the impedance of the load is the conjugate of the impedance of the source, and the total power is then shared equally between source and load. That may sound rather alarming, but it is quite simple really. Fig. 3 shows the simplest case, in which the impedances are resistances. (a) is the voltage form, in which  $E$  is the constant e.m.f., in series with a fixed source resistance  $R_s$  and the load resistance  $R_L$ . The theorem says you get the maximum power in  $R_L$  when  $R_L = R_s$ . (b) is the constant-current form, which is equivalent; the circuit of any actual power generator, such as a radio transmitter, can be boiled down into either of these two forms. You would naturally choose the one that was easier to calculate. In general, however, there is some reactance as well as resistance in the source, and the bit about the conjugate means you would have to tune that out by means of an equal amount of the opposite kind of reactance across or in series with the load. (Remember, at any one frequency there is a parallel reactance equivalent to any series reactance; and in this case you choose the one that is easiest or cheapest to provide. Calculations are easiest if both are in series in (a) and in parallel in (b).)

The proof of the theorem is by simple calculus and is given in the textbooks on circuit theory.

The situation we are considering is where the load is some distance from the source, so that an r.f. cable has to be used between them, as in Fig. 4. This cable makes no difference to the power delivered to  $R_L$  if (i) its characteristic resistance  $R_0$  is equal to  $R_L$  and  $R_s$ , and (ii) it is loss-free. Condition (ii) is not entirely possible, but we have already seen how the loss can be minimized, and the makers of the cable usually state it in dB per 100 feet. Condition (i) is ideal because it not only fulfils the impedance-matching theorem but also ensures that the loss in the cable is kept to the unavoidable minimum. However, the cable, or part of it, can be used not only to convey the power across a distance but also to act as a transformer, effecting a match between *unequal* source and load impedances. By suitable choice of  $R_0$ , one can make the resistance of load plus cable equal to  $R_s$ , and source plus cable equal to  $R_L$ , so achieving perfect matching at both ends. As explained in the treatise on the subject, the greater the transformation ratio the greater the amount of power surging to and fro (indicated by the standing-wave ratio, SWR) besides the steady flow of power from source to load. As a proportion of all the power through the cable is lost, the total loss is thus greater than it need be; so the transformer effect is used only when the distance to be covered is not more than a wave-length or two, or else a quarter-wavelength of special line is used as a transformer to match the resistances at either or both ends to the main cable.

Paradoxically as it may seem, the impedance of the cable would be a pure resistance if the cable were perfectly loss-free. In practical low-loss cables it is almost entirely resistive. The value of  $R_0$  depends on the inductance and capacitance per unit length, which in turn depend on the sizes and spacing of the conductors and the material between them;

(Continued on page 573)

formulae are given in the books for coaxial and parallel-wire lines. The range of  $R_o$  that can be provided is limited by the dimensions that are practical to about  $200\ \Omega$  to  $650\ \Omega$  for parallel-wire and  $40\ \Omega$  to  $140\ \Omega$  for coaxial; and to keep loss to a minimum they should not be very far from  $600\ \Omega$  and  $75\ \Omega$  respectively. That is another reason why, if a widely different value is needed for impedance-matching purposes, its length should be limited to the minimum needed for that purpose—quarter of a wavelength. Yet another reason is that the length of an unmatched (or transforming) line is critical in relation to wavelength, whereas the precise length of a matched line doesn't matter and it can be used for quite a wide range of frequency. Quarter-wave transformers are sometimes used at the aerial end, but other matching devices are more usual at the other end.

Although I am trying not to go over well-trodden ground, it may be helpful to be reminded that the correct  $R_o$  for a  $\lambda/4$  section to match  $R_1$  to  $R_2$  is  $\sqrt{R_1 R_2}$ . It may also be helpful to repeat that a mismatch between source and load restricts the power reaching the load; the extent to which it does so is shown in Fig. 5. But if  $R_L$  is greater than  $R_S$  the efficiency (proportion of total power reaching the load) is greater than the 50% obtainable with a perfect match, so if power efficiency is more important than maximum power this kind of mismatching is deliberately used.  $R_L$  lower than  $R_S$  not only reduces the amount of power in the load; it reduces the efficiency too, so has nothing to recommend it.

A mismatch at the load end of the line, or anywhere along the line, results in standing waves set up by power reflected towards the source; this increases the power lost in the line, and may also cause "ghosts" in television pictures, false "blips" on

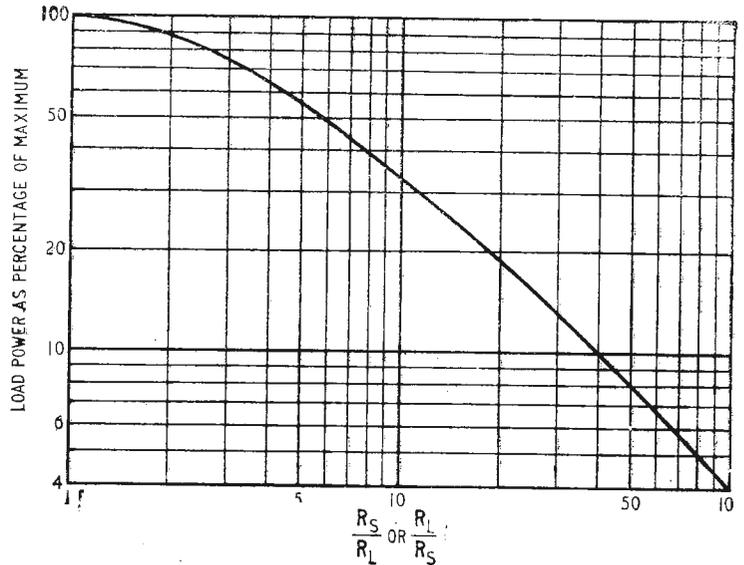
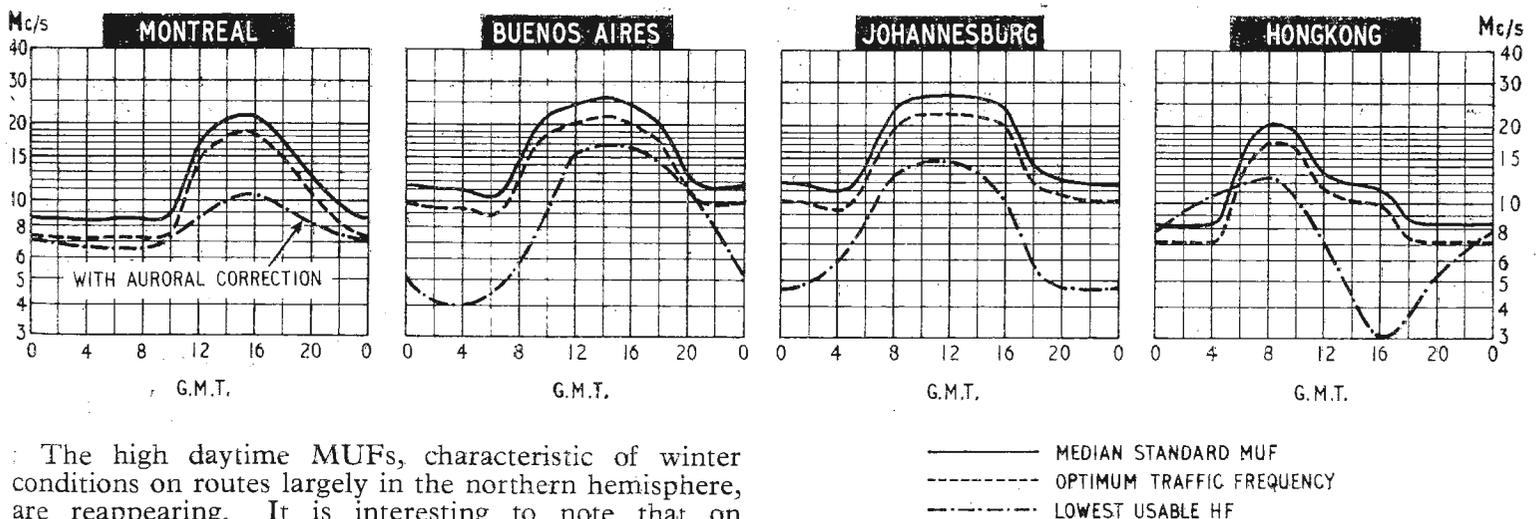


Fig. 5. Graph showing restriction of power due to mismatching. This is a different matter from loss of power.

radar screens, etc. Mismatching occurs wherever there is a change of  $R_o$ , and because  $R_o$  depends on spacings and dimensions one should take care to avoid sudden changes in these. For instance, where a coaxial line is joined to another or to some equipment, a coaxial plug and socket designed to have the same impedance should be used. Nowadays one can get special (hermaphrodite) coaxial terminals that connect with their own kind, abolishing the need for distinctive plugs and sockets.

I believe I have now covered all the questions put by my correspondent. If any other readers who have joined in are complaining about the lack of explanation of standing waves, etc., may I suggest they read "Foundations of Wireless," 7th edition, Chapter 14?

## H. F. PREDICTIONS — NOVEMBER



The high daytime MUFs, characteristic of winter conditions on routes largely in the northern hemisphere, are reappearing. It is interesting to note that on southerly circuits to Africa and South America the highest frequencies in the h.f. band will be of use again, even though the sunspot cycle is close to its minimum.

The prediction curves show the median standard MUF, optimum traffic frequency and the lowest usable high frequency (LUF) for reception in this country. Unlike the MUF, the LUF is closely dependent upon such factors as transmitter power, aerials, local noise level and the type of modulation; it should generally be regarded with more diffidence than the MUF. The

LUF curves shown are those drawn by Cable and Wireless, Ltd., for commercial telegraphy and they serve to give some idea of the period of the day for which communication can be expected.

During the period 13th-23rd September radio conditions were at times violently disturbed by solar flares associated with a large sunspot. Several Dellinger-type fade-outs were followed by a severe ionospheric storm between 20th and 23rd September.

# CONFERENCES AND EXHIBITIONS

Latest information on events during next year both in the U.K. and abroad is given below.  
Further details are obtainable from the addresses in parentheses.

## LONDON

- Jan. 14-17 R.H.S. Halls  
**Physical Society Exhibition**  
(Inst. of Physics & Phys. Soc., 47 Belgrave Sq., S.W.1.)
- Feb. 24-28 Savoy Place  
**Transmission Aspects of Communications Networks**  
(I.E.E., Savoy Place, W.C.2.)
- Mar. 18-25 Earls Court  
**Electrical Engineers Exhibition**  
(Association of Supervising Electrical Engineers, Museum Street, W.C.1.)
- Apr. 2-5 Hotel Russell  
**Audio Festival & Fair**  
(C. Rex-Hassan, 42 Manchester Street, W.1.)
- Apr. 8-10 Savoy Place  
**Dielectrics and Insulating Materials**  
(I.E.E., Savoy Place, W.C.2.)
- May 5-15 Earls Court  
**Mechanical Handling Exhibition**  
(*Mechanical Handling*, Dorset House, Stamford St., S.E.1.)
- May 25-30 Olympia  
**Instruments, Electronics & Automation Exhibition**  
(Industrial Exhibitions, 9 Argyll Street, W.1.)
- Aug. 26-Sept. 5 Earls Court  
**National Radio Show**  
(Radio Industry Exhibitions, 59 Russell Square, W.C.1.)

## BIRMINGHAM

- July 6-9 The University  
**Signal Processing in Radar & Sonar Directional Systems**  
(Brit.I.R.E., 9 Bedford Square, London, W.C.1.)

## BRIGHTON

- Sept. 14-18 College of Technology  
**Computer Conference**  
(British Computer Society, Finsbury Court, Finsbury Pavement, London, E.C.2.)
- Sept. 29-Oct. 1 Hotel Metropole  
**Battery Symposium**  
(D. H. Collins, Admiralty Eng'g Lab., W. Drayton, Middx.)

## BRISTOL

- Jan. 1-4 The University  
**Solid State Physics**  
(Inst. of Physics & Phys. Soc., 47 Belgrave Square, London, S.W.1.)

## CAMBRIDGE

- Mar. 17-19 Cavendish Laboratory  
**Cold Cathode Tubes and their Applications**  
(Brit.I.R.E., 9 Bedford Square, London, W.C.1.)

## CRANFIELD

- Apr. 13-16 College of Aeronautics  
**Flight Test Instrumentation Symposium**  
(M. A. Perry, College of Aeronautics, Cranfield.)

## EASTBOURNE

- Apr. 26-29 Queens Hotel  
**R.T.R.A. Conference**  
(Radio & Television Retailers' Assoc., 19 Conway Street, London, W.1.)

## EDINBURGH

- Mar. 31-Apr. 3 Heriot-Watt College  
**Joint Computer Conference**  
(British Computer Society, Brit.I.R.E. & I.E.E.)  
(Computer Conference Secretariat, I.E.E., Savoy Place, London, W.C.2.)

## FARNBOROUGH

- Sept. 7-13 R.A.E.  
**Air Show**  
(S.B.A.C., 29 King Street, London, S.W.1.)

## NOTTINGHAM

- Sept. 7-11 The University  
**Magnetism**  
(Inst. of Physics & Phys. Soc., 47 Belgrave Square, London, S.W.1.)

## SOUTHAMPTON

- Aug. 26-Sept. 2  
**British Association Annual Meeting**  
(British Assoc. for the Advancement of Science, 3 Sanctuary Buildings, Gt. Smith Street, London, S.W.1.)

## TEDDINGTON

- Sept. 23-25 N.P.L.  
**Fundamental Problems of Low-Pressure Measurements**  
(Inst. of Physics & Phys. Soc., 47 Belgrave Square, London, S.W.1.)

## OVERSEAS

- Jan. 7-9 Washington  
**Reliability and Quality Control**  
(R. Brewer, G.E.C. Hirst Research Centre, Wembley, Middx.)
- Jan. 30-31 Chicago  
**Computer Applications Symposium**  
(I.I.T. Research Institute, Chicago, 16)
- Feb. 2-11 Rome  
**Scientific & Technical Documentation & Information**  
(Comitato Nazionale per la Productivita, Viale Regina Margherita 83D, Rome)
- Feb. 5-7 Los Angeles  
**Military Electronics Convention**  
(I.E.E.E., Box A, Lenox Hill Station, New York 21)
- Feb. 7-12 Paris  
**Electronic Components Exhibition**  
(F.N.I.E., 23 rue de Lübeck, Paris 16e)
- Feb. 19-21 Philadelphia  
**Solid-State Circuits Conference**  
(H. Parks, Martin Co., Mail 683, Baltimore 3, Md.)
- Feb. 26-28 Washington  
**Scintillation and Semiconductor Counter Symposium**  
(I.E.E.E., Box A, Lenox Hill Station, New York 21)
- Mar. 12-17 Paris  
**Festival of Sound**  
(Syndicat des Industries Electroniques de Reproduction et d'Enregistrement, 14 rue de Staël, Paris 15e)
- April 6-8 Washington  
**Nonlinear Magnetics**  
(R. C. Barker, Dept. of Eng. & Applied Science, Yale University, New Haven, Conn.)
- April 19-25 Phoenix  
**Aerospace Electro-Technology**  
(A. A. Sorenson, Martin Co., Baltimore 3, Md.)
- April 21-23 Washington  
**Computer Conference**  
(J. Roseman, 2313 Coleridge Dr., Silver Spring, Md.)
- May 5-7 Washington  
**Electronic Components Conference**  
(Dr. J. Bohrer, International Resistance Co., 401 N. Broad Street, Philadelphia 8, Pa.)
- May 11-13 Dayton  
**Aerospace Electronics Conference**  
(I.E.E.E., 1414 E. Third St., Dayton, Ohio)
- May 19-21 New York  
**Microwave Theory & Techniques**  
(Leonard Swern, Sperry Gyroscope Co., Great Neck, Long Island, N.Y.)
- May 25-28 Los Angeles  
**Telemetry Conference**  
(I.E.E.E., Box A, Lenox Hill Station, New York 21)
- June 2-6 Budapest  
**Conference on Acoustics**  
(Hungarian Society for Optics, Acoustics and Filmtechnics, Szabadság tér 17, Budapest, V.)
- June 8-10 New York  
**Symposium on Quasi-Optics**  
(J. Fox, Polytechnic Institute of Brooklyn, 55 Johnson Street, Brooklyn 1)

June 18-20 <b>Precision Electromagnetic Measurements</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Boulder	Oct. 12-16 <b>Instrument-Automation Conference</b> (W. H. Kushnick, 212 Sixth Avenue, Pittsburgh 22, Pa.)	New York
June 26-28 <b>Automatic Control Conference</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Stanford	Oct. 19-21 <b>National Electronics Conference</b> (N.E.C., 228 N. La Salle St., Chicago, Ill.)	Chicago
Sept. 7-11 <b>Microwaves, Circuit Theory &amp; Information Theory</b> (Dr. K. Morita, Oki Elec. Indus. Co., 4 Chome Nishi-Shibaura, Minato-Ku, Tokyo)	Tokyo	Oct. 21-23 <b>Aerospace &amp; Navigation Electronics</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Baltimore
Sept. 14-16 <b>Military Electronics</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Washington	Oct. 29-30 <b>Electron Devices</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Washington
Sept. 22-24 <b>Antennas &amp; Propagation</b> (H. Jasik, Jasik Labs., 100 Shames Dr., Westbury, N.Y.)	Long Island	Nov. 12-15 <b>Solar Symposium</b> (The University of Sydney, Australia)	Sydney
Oct. 4-9 <b>Space Electronics</b> (C. H. Doersam, Jr., Instruments for Industry, Hicksville, L.I., N.Y.)	Las Vegas	Nov. 16-18 <b>Engineering in Medicine and Biology</b> (Dr. P. Frommer, Genl. Hospital, Cincinnati 29, Ohio)	Cleveland
Oct. 7-12 <b>Communication Congress</b> (Civico Institute Colombiano, Palazzo Tursi, Genoa)	Genoa	Nov. 16-19 <b>Magnetism &amp; Magnetic Materials</b> (I.E.E.E., Box A, Lenox Hill Station, New York 21)	Minneapolis
		Dec. 2-4 <b>Technical Progress in Communication Wires &amp; Cables</b> (H. H. Kingsley, R. & D. Lab., Fort Monmouth, N.J.)	Asbury Pk., N.J.

## AUTOMATIC 100 POLAROID LAND CAMERA

UNLIKE most automatic cameras in which the current from a photocell operates the "leaves" of an iris diaphragm, the new Polaroid 100 has a fixed aperture and the exposure time is varied by a transistor circuit. The exposure time is determined by the average scene lighting and the manufacturers claim that the camera can produce perfectly exposed pictures under any lighting conditions, including flash, and that the system is more robust and accurate than the direct iris control method which involves delicate meter mechanisms of almost "microamp sensitivity."

As it can be seen from the diagram, two transistors are used in the

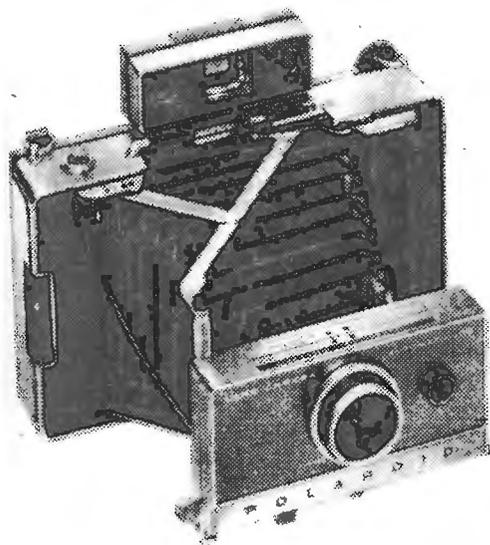
shutter mechanism, one acting as a hold-on device and the other as a switch. Tripping the shutter button causes two things to happen; first, it trips the "operating" blade and, secondly, it closes the battery switch which allows the hold-on transistor VT2 to conduct and pass current to the electromagnet. The magnet pulls the "closing" blade to one side and allows light to reach the negative material, and at the same time the capacitors in the base circuit of the switching transistor VT1 are allowed to charge. The rate at which they charge is dependent upon the resistance of the photocell, which, of course, varies with the intensity of light on its surface. As the capacitors charge, the base potential of the switching transistor rises and once the transistor conducts it shorts the base potential of the hold-on transistor. This disconnects the battery and the "closing" blade returns to its original position to block the path of light to the negative material to

complete the exposure cycle. The capacitors are shorted when the shutter is re-cocked and to enable the shutter to handle films of various speeds, different combinations of capacitance are selected in addition to changing the aperture.

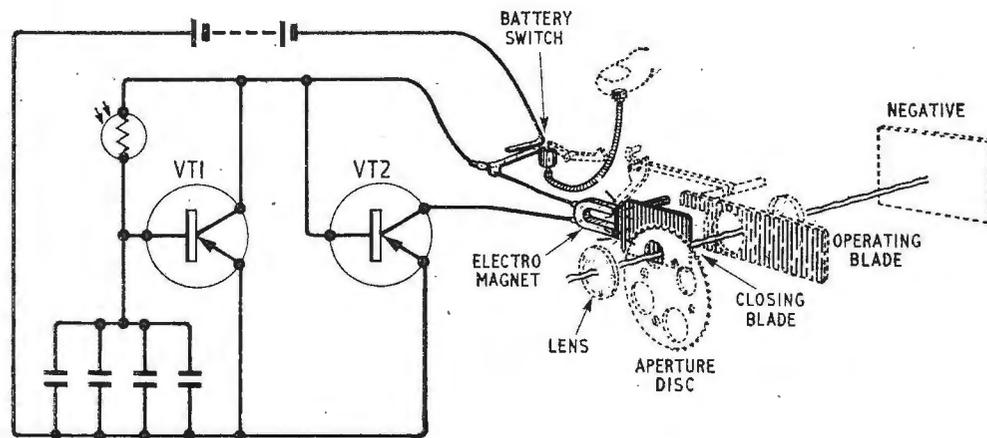
There are times when an overall meter reading of the whole scene will not give the desired results, as it may be necessary to emphasize darker or lighter parts of the scene. This is achieved in this camera by internally placing filters of differing densities over the photocell.

For those who are photographically minded, the picture format remains at  $3\frac{1}{2} \times 4\frac{1}{4}$  in. Monochrome and colour film packs are available for the camera and, unlike its forerunner, the actual processing is done outside the camera. The time to process monochrome pictures remains at ten seconds and colour pictures take 50 seconds.

2WW 301 for further details.



Above: The new Polaroid 100 camera and (right) simplified schematic diagram of the camera shutter mechanism shown in the open position with the magnet holding the "closing blade".



# NOVEMBER MEETINGS

*Tickets are required for some meetings: readers are advised, therefore, to communicate with the secretary of the society concerned.*

## LONDON

6th. I.E.E. & Brit.I.R.E.—Colloquium on "Logic circuits for digital computers" at 2.30 at Savoy Place, W.C.2.

6th. Brit.I.R.E.—"Bandwidth compression systems for speech transmission" by J. S. Williams at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

8th. Junior Institution of Engineers.—"Research in space science" by J. Heywood at 7.0 at Pepys House, 14 Rochester Row, Westminster, S.W.1.

13th. I.E.E.—Colloquium on "Parametric amplifiers" at 10.0 at Savoy Place, W.C.2.

13th. Brit.I.R.E.—"Human factors in industrial design" by W. D. Cain and R. W. Stevens at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

13th. Society of Instrument Technology.—"The N.P.L. mekometer—distance measurement by means of a light beam modulated at microwave frequency" by R. H. Bradsell at 7.0 at Manson House, 26 Portland Place, W.1.

14th. Radar & Electronics Assoc.—"The radar story" with contributions from Sir Robert Watson-Watt, Sir John Cockcroft, Dr. F. E. Jones, Gp. Capt. E. Fennessy and Gp. Capt. Philip Dorte at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

15th.—I.E.E.—Discussion on "Synthesis of transfer functions" opened by R. J. A. Paul and P. L. Taylor at 5.30 at Savoy Place, W.C.2.

15th. Institute of Navigation.—"Long-range radio aids to navigation" by J. R. Mills at 5.30 at the Royal Institution of Naval Architects, 10 Upper Belgrave Street, S.W.1.

15th. Television Society.—"The k-rating of television equipment and networks" by B. W. Osborne, A. M. Peverett and D. A. R. Wallace at 7.0 at the I.T.A., 70 Brompton Road, S.W.3.

18th. I.E.E.—"The colour performance of the Secam colour television system" by G. B. Townsend at 5.30 at Savoy Place, W.C.2.

18th. I.E.E. Graduates.—"Electronic telephone exchanges" by M. T. Hills at 6.30 at Savoy Place, W.C.2.

20th. I.E.E.—"Computers in control of processing—the coming revolution in industry" by Dr. D. N. Truscott at 5.30 at Savoy Place, W.C.2.

20th. Brit.I.R.E.—Short contributions on "Systematic selection procedures for technical courses" at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel St., W.C.1.

22nd. Institution of Electronics.—"Printed circuit techniques" by P. Millet at 7.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

25th.—I.E.E.—Colloquium on "Recent advances in d.c. amplifiers" at 2.30 at Savoy Place, W.C.2.

27th. I.E.E.—Discussion on "The application of electronic building bricks" opened by I. V. Idelson and Prof. J. E. B. Gray at 5.30 at Savoy Place, W.C.2.

27th. Brit.I.R.E.—Annual General Meeting at 6.0 followed by the presidential address of J. L. Thompson at the London School of Hygiene and Tropical Medicine, Keppel St., W.C.1.

27th. British Kinematograph Soc.—"Electronic cam. system—vidicon cameras as electronic view-finders on 35mm cameras" by D. Robertson at 7.30 at the Central Office of Information, Hercules Road, S.E.1.

28th. I.E.E.—"The results of tests at Goonhilly with the experimental earth satellites Telstar and Relay" by F. J. D. Taylor, W. J. Bray and R. W. White at 5.30 at Savoy Place, W.C.2.

28th. I.E.E.—Discussion on "Consideration of the practical applications of lasers" opened by Dr. Denis Taylor and Dr. R. P. Howson at 5.30 at Savoy Place, W.C.2.

29th. Television Society.—"Television receiver design trends" discussion opened by P. L. Mothersole at 7.0 in the I.T.A. Conference Suite, 70 Brompton Road, S.W.3.

## ARBORFIELD

21st. I.E.E.—"The impact of modern ionospheric research on communications" by G. Millington at 5.0 at the Garrison Hall, Arborfield Camp.

## BASINGSTOKE

28th. Brit.I.R.E.—"Principles and practice of data logging" by R. F. Martin at 7.30 at the Technical College.

## BIRMINGHAM

21st. Brit.I.R.E.—"Principles and uses of silicon controlled rectifiers" by R. J. Bland at 6.15 at the Electrical Engineering Dept., The University.

## BRISTOL

12th. Brit.I.R.E.—"Non-destructive testing" by Dr. A. Nemet at 6.30 at the College of Science and Technology.

14th. Society of Instrument Technology.—"The application of digital computers to on-line control in the process industries" by G. H. Laycock at 7.30 in the University Physics Dept., The Royal Fort.

## CARDIFF

6th. Brit.I.R.E.—"Teaching machines, their circuitry and techniques" by D. Rowntree at 6.30 at the College of Advanced Technology.

## CAMBRIDGE

14th. I.E.E.—"The satellite environment and the implication which it has for electronic design" by Dr. A. P. Willmore at 8.0 at the Engineering Laboratories, Trumpington Street.

28th. I.E.E.—"Electronics—the expanding frontier" by Dr. R. C. G. Williams at 8.0 at the Engineering Laboratories, Trumpington Street.

## CHESTER

25th. I.E.E.—"Development of the Atlas computer" by Dr. D. B. G. Edwards at 6.30 at the Town Hall.

## EDINBURGH

6th. I.E.E. & Brit.I.R.E.—"Lasers" by Dr. A. C. Moore at 7.0 at the Department of Natural Philosophy, The University.

12th. I.E.E.—"Opto-electronics" by G. G. Scarrott at 7.0 at the Carlton Hotel, North Bridge.

26th. I.E.E.—"Stereophonic broadcasting systems" by Dr. G. J. Phillips at 7.0 at the Carlton Hotel, North Bridge.

## GLASGOW

7th. I.E.E. & Brit.I.R.E.—"Lasers" by Dr. A. C. Moore at 7.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, C.2.

11th. I.E.E.—"Opto-electronics" by G. G. Scarrott at 6.0 at the Royal College of Science and Technology.

## GRANGEMOUTH

14th.—Society of Instrument Technology.—"Solid-state instruments for process control" by L. C. Towle at 7.0 at the Leapark Hotel, Bo'ness Road.

## HENLOW

18th. I.E.E. & Royal Aeronautical Soc.—"The Sun, the earth and radio" by J. A. Ratcliffe at 7.0 at the R.A.F. Technical College.

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## LEEDS

27th. I.E.E.—“Microminiaturization” by Dr. J. W. Granville at 6.30 at the University Electrical Engineering Dept.

## LEICESTER

12th. Television Society.—“Servicing tape recorders” by A. W. Rowe at 7.30 in the Main Hall, Vaughan College, St. Nicolas Street.

13th. Brit.I.R.E.—“Digital techniques” by A. C. Elliott at 6.45 at The University.

## LIVERPOOL

20th. Brit.I.R.E.—“Electronics in archaeology” by D. Reaney at 7.30 at the Walker Art Gallery.

## LOUGHBOROUGH

26th. I.E.E.—“Optical masers” by I. L. Davies at 6.30 at the Union Building, College of Technology.

## MANCHESTER

6th. I.E.E.—“Solid circuits” by R. I. Walker at 6.15 at the Reynolds Hall, College of Science and Technology.

7th. Brit.I.R.E.—“Spark erosion techniques” by Dr. D. W. Rudorff and G. V. Smith at 7.0 at the Reynolds Hall, College of Science and Technology.

19th. I.E.E.—“Data processing” by R. H. Tizard at 6.15 at the Reynolds Hall, College of Science and Technology.

## NEWCASTLE-UPON-TYNE

4th. I.E.E.—“The general problems of f.m. multi-channel communications” by R. G. Medhurst at 6.30 at the Rutherford College of Technology, Northumberland Road.

13th. Brit.I.R.E.—“Laboratory microphones” by W. J. Parker at 6.30 at the Institute of Mining and Mechanical Engineers, Westgate Road.

18th. I.E.E.—“Satellite astronomy” by Prof. R. L. F. Boyd at 6.30 at the Rutherford College of Technology, Northumberland Road.

## NORWICH

4th. I.E.E.—“Semiconductor static switching” by D. D. Jones at 7.30 at the Assembly House.

## PLYMOUTH

13th. Brit.I.R.E. & I.E.E.—“The field effect transistor and its applications” by C. S. den Brinker and D. Ellison at 6.30 at the College of Technology.

## PORTSMOUTH

21st. I.E.E.—“Semiconductor devices—progress and recent applications” by J. J. Limb and J. F. Spilling at 6.30 at the College of Technology.

## SOUTHAMPTON

12th. I.E.E.—“Electronic telephone exchanges” by Dr. J. E. Flood at 6.30 at The University.

13th. Brit.I.R.E.—“The development and application of ultrasonic cleaning” by A. E. Crawford at 6.30 at the Lanchester Theatre, The University.

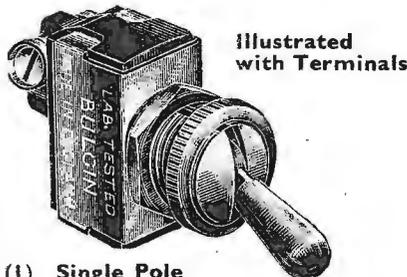
## STONE

18th. I.E.E.—“Optical masers” by I. L. Davies at 7.0 at Duncan Hall.

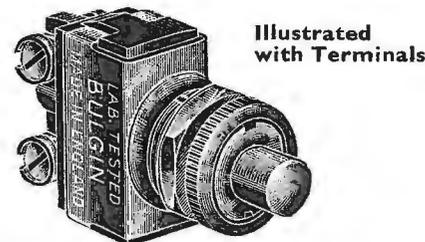
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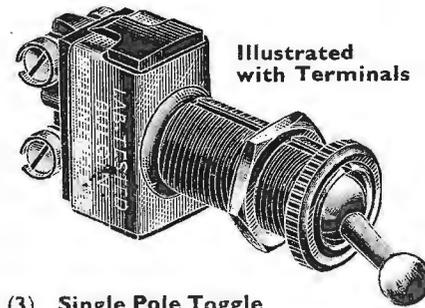
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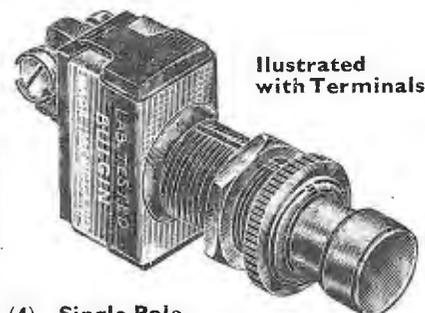
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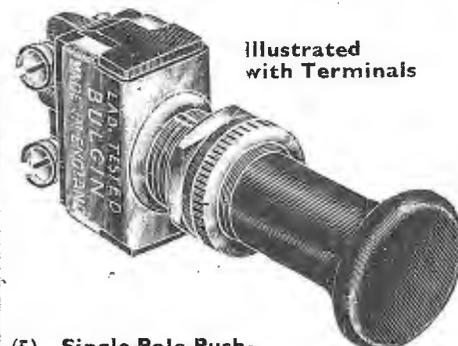
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## *Masts are a "Must"*

SOME of the aerials which are being produced in readiness for the u.h.f. television service scheduled to start next April are formidable-looking affairs, and will undoubtedly place quite a strain on our chimney stacks especially in a high wind. The leverage exerted by these lengthy rows of bird perches will be quite considerable even without the pigeons or seagulls which will inevitably rest upon them.

Because of this I would have expected architects of new houses to have included in their plans specially strengthened chimney stacks designed to withstand the inevitable crowbar effect, but, from observations I have made in various districts, they have not.

If any of you know of any houses being built in which the architect has been "with it" sufficiently to make special provision for u.h.f. aerials, I shall be very grateful if you will let me know. Maybe I can then induce the Editor to pay my fare and hotel expenses there, more especially if "there" happens to be in an attractive part of the country.

To my mind the thing needed for the support of one of these elongated u.h.f. aerials is a tubular steel mast with its root planted firmly in the house foundations, and rising up through the roof well above chimney height. This would not only give strength to withstand the leverage of the long boom or booms likely to be needed in some fringe areas, but would also give us that extra height which will be so much needed for adequate reception of these quasi-optical wavelengths.

Another advantage would be that the hollow steel mast would provide an ideal conduit for the downlead. Also, since the mast will pass through all floors, probably by the side of the chimney breast, an aerial outlet socket could be provided for use in bedrooms.

## *Dog Eats Dog*

IT is no part of my business to discuss or criticize television or sound programmes except when some speaker ventures into the field of wireless technology, and says something which it would be almost criminal for me to let pass without comment. An instance of this occurred a few weeks ago in the B.B.C.'s regular weekly TV programme "It's my opinion".

In this programme, as most viewers will know, a number of prominent people are gathered on a platform in front of an audience of local people, the venue being changed every week. On this particular occasion—at Worcester—the question cropped up of the noisome nuisance of transistor sets on beaches and elsewhere.

To my surprise one of the platform celebrities said a friend of his had developed a pocket transistor set with which he caused a cacophonous caterwauling to come from all nearby transistor sets inducing their owners to switch them off. The speaker added that this special "dog-eats-dog" transistor device was not yet available to others.

The obvious inference was that it would soon be on the market, and it was equally obvious the device was a small modulated oscillator. It did not seem to occur to the speaker that his friend was breaking the law by deliberately causing interference and also by installing and operating an unlicensed transmitter. Furthermore, by inferring that these devices would soon be on the market, his friend was preparing to commit yet another legal offence namely, inciting others to commit the same offence as he was doing at present. Personally, I think a court would also hold the B.B.C. guilty as an accessory by permitting this broadcast. In essence it would be the same as if the B.B.C. allowed a housebreaker to give a talk on how to pick locks and then hint that special lock-picking tools like his would be available to all.

## *Juan Fernandez 1963*

NO doubt many of you will have noticed a recent item of news telling how a company director in a London-bound express train desiring to send an urgent telegram, was advised by the guard to write it out and enclose it in a hollowed-out potato obtained from the kitchen of the restaurant car. This potato was then thrown out as the train was passing a signal box.

I had a somewhat similar experience long years ago as I recounted in these columns in October 1947. My mind did not, however, turn to potatoes but to the traditional method used by sailors when cast away on desert islands, namely a bottle. I proposed to put my message and my money into a bottle obtained from the restaurant car and to hurl it out when the train was

speeding through a wayside station. I was, however, deterred by the guard who quoted a regulation prohibiting the hurling of bottles from train windows.

This recent potato incident has served to remind me how astonishing it is that in these days when we can speak across half the world by radio, the passenger in a British non-stop train is as isolated as was Robinson Crusoe.

It is surely high time that not only a telegraph station but also telephone kiosks should be installed in our trains. It might be difficult to establish a direct radio link but surely it would be possible to devise an induction system between the train and the various conductors which run adjacent to the line. If necessary a special conductor could be strung along the neighbouring telegraph poles. Such an arrangement would probably do much to prevent future train robberies. As things are, the passengers and crew of a train on the move—at least in this country—are really as isolated as was Alexander Selkirk, the prototype of Robinson Crusoe, in his unenviable position on the island of Juan Fernandez as long ago as 1704.

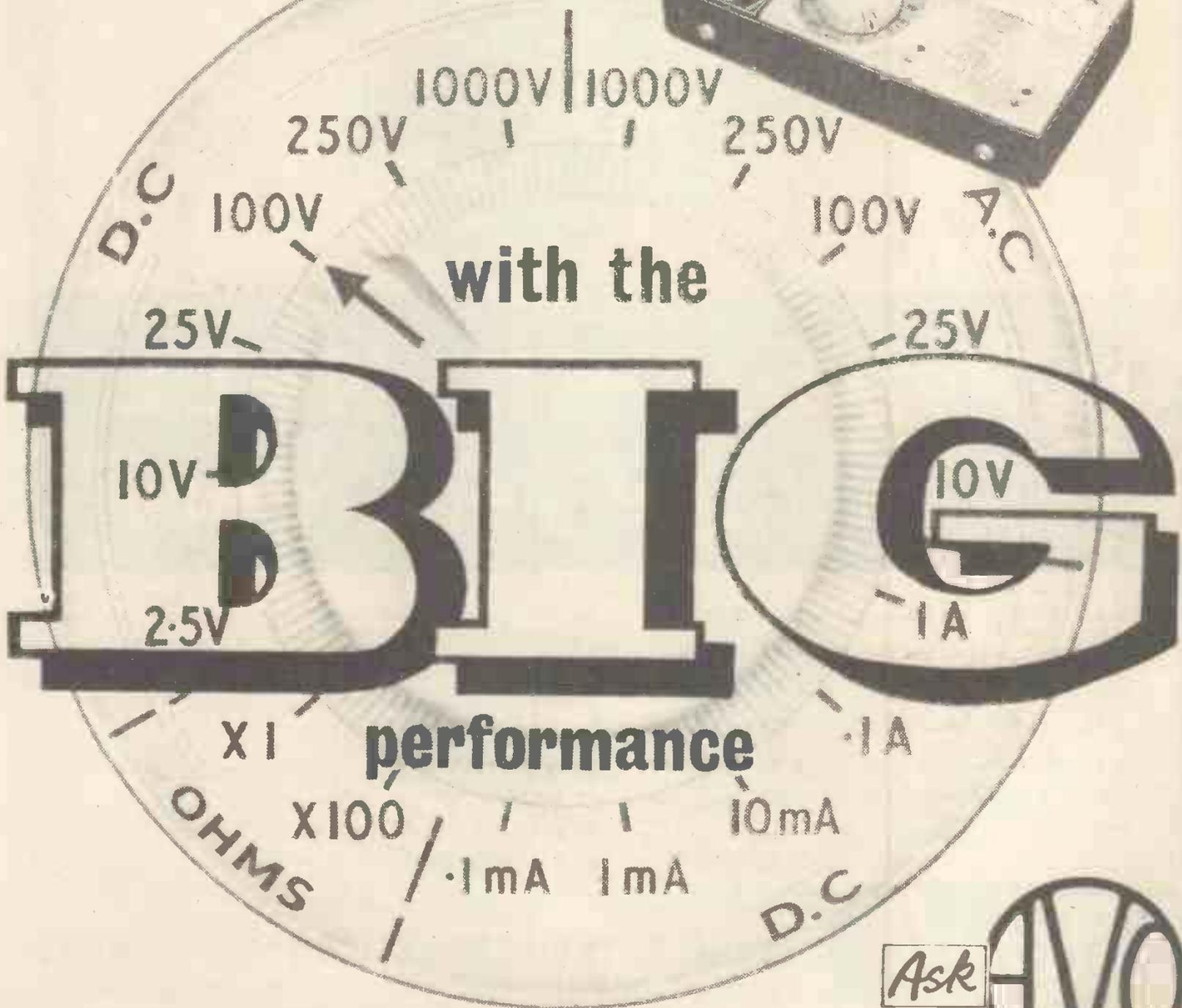
## *Typographical Tranquillity*

THOSE of you who went to the Open Day at the G.P.O. Research Station at Dollis Hill during September will probably have noticed, as I did, a machine that can speak the typed words that are fed into it. I did not, however, see any machine that did the opposite, namely, type the words that are spoken into it.

I am very sorry about this, as it is a machine which would be very useful to me, as I am not very expert with either pen or typewriter. It may be argued of course, that the answer to my requirements is a tape recorder, but this still requires the services of a tea-and-face-powder-consuming young lady to act as intermediary. Nowadays we have very good electric typewriters, and it only needs the introduction of an electronic phono-typist to convert the average office into a haven of all-male tranquillity.

Another electronic machine being shown at the G.P.O. Research Station was one, of which the eventual purpose is to read handwriting. No doubt the Editor is already weighing the cost of such a machine against the time spent in deciphering my handwriting.

The little instrument



with the

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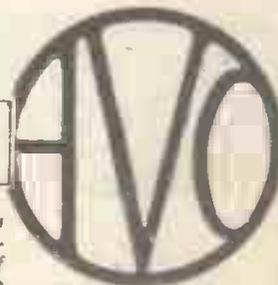
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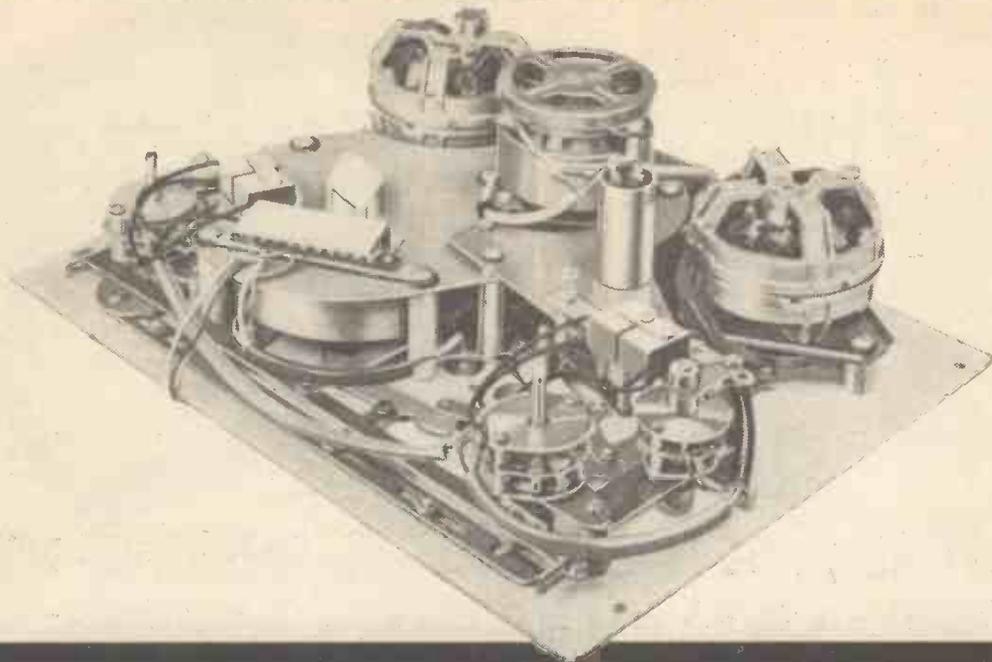
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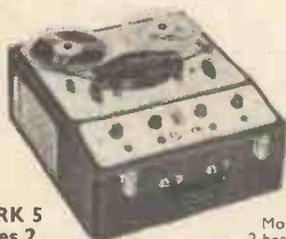
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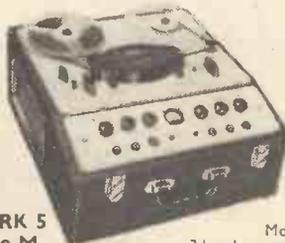
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This Combined Tape Record-Replay Amplifier is available in both monophonic and stereophonic models. Model TA-IM can be modified to the stereo version with modification kit TA-IC.

**TA-IM £19.2.6 TA-IS £24.10.0 TA-IC £6.15.0**

All Heathkit models are available ASSEMBLED and TESTED  
Prices on request.

**TELEPHONE AMPLIFIER KIT Model TTA-1 For Home, Office or Shop**

Don't be tied to your telephone. By placing handset on Amplifier cradle you can talk or listen with both hands free. All transistor circuit, inductive pick-up coil, built-in speaker and volume control. 9 v. battery operated. Ivory toned cabinet. Size 6 x 5 $\frac{1}{2}$  x 9 $\frac{1}{2}$ in. deep.

**£7.9.6**

**'GLOUCESTER'**  
HI-FI CABINET KIT

Will accommodate: Tape Deck and/or Record Player, F.M Tuner and Stereo Amplifier. For those with limited floor space speaker systems can be housed at each end. For this purpose a loudspeaker kit comprising two 4in plus 8in. speaker systems, balance unit, speaker grille, cutting template, padswal and mounting details are also available. Neutral hardwoods have been carefully selected so that the finished product can be stained and polished to individual choice. There is storage space for records, etc., also for power amplifiers. Dimensions: length 46 $\frac{1}{2}$ in., height 30in., depth 21in.

**Mk. I for Tape Deck or Record Player... £17 3 6**

**Mk. II for both T/D and R/P ..... £18 10 0**

**TAPE DECKS** Are available as "packaged deals" with other equipment. Details on request.

• Deferred Terms available on all orders above £10 •

**New! PUBLIC ADDRESS AMPLIFIER KIT Model PA-1**

This is a multi-purpose, high output, compact unit suitable for vocal and instrumental groups, guitars, electronic organs etc. 4 inputs for guitars, mics, record players. Has many features found only in expensive equipment i.e. 50 watt R.M.S. (100 watts pk.) output, two heavy duty speakers. 'Magic Eye' vol. indicator, variable tremolo, elegant cabinet.

**£54.15.0**

**New! MONO CONTROL UNIT KIT Model UMC-1**

Ideal for use with MA-12 or similar amplifier. Output 0.25 v. Send for full details

**£8.12.6**

**HI-FI STEREO AMPLIFIER KIT Model S-99**

Gives 18 w. output (9 per channel with 0.2 per cent. distortion at 9 w. per channel). It has ganged controls, STEREO/MONAUURAL gram., radio and tape recorder inputs and push-button selection as well as many other first-class features well above its price range. In grey metal cabinet with a golden surround and perspex panel. Also ultra-linear push-pull output. Printed circuit construction.

**£27.19.6**

**HI-FI SPEAKER SYSTEM KIT Model SSU-1**

Ducted-port bass reflex cabinet, "in the white". Frequency response is 40-16,000 c/s. Power rating 25 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies. With legs 11/12in.

**£10.17.6**

**"COTSWOLD" SPEAKER SYSTEM KIT**

This acoustically designed enclosure measures 26 x 23 x 14 $\frac{1}{2}$ in., and houses a special 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete, with speakers, cross-over unit, level control, Tygan grille cloth, etc. Left "in the white" for finish to personal taste, all parts are pre-cut and drilled for ease of assembly

**£23.4.0**

**"COTSWOLD M.F.S." SPEAKER SYSTEM KIT**

This model, based on the standard Cotswold, measures only 36in. high, 16 $\frac{1}{2}$ in. wide by 14in. deep. Particularly recommended to those who require the best results in small rooms.

**£23.4.0**

**DAYSTROM LTD.**

DEPT. W.W.11, GLOUCESTER, ENGLAND

MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

A member of the Daystrom Group

2W-008 FOR FURTHER DETAILS.

**Technically**



**excellent**

**5in. OSCILLOSCOPE KIT  
Model O-12U**



Laboratory quality at utility oscilloscope price and ease of assembly make this kit of outstanding value. Vertical frequency response 3 c/s to 5 Mc/s., +1.5 dB. -5 dB., sensitivity 10 mV. per cm. at 1 kc. Horizontal frequency 1 c/s. to over 400 kc/s. ( $\pm 1$ dB. up to 200 kc/s.) The Heath patented sweep circuit functions from 10 c/s. to 500 kc/s.,

in five ranges giving five times the usual sweep of other 'scopes. In addition it has exceedingly short re-trace and rise times and electronically stabilised power supply. Included is a 48-page Instructional Manual. **£35.10.0**

**ELECTRONIC SWITCH KIT Model  
(Oscilloscope Trace Doubler) S-3U**



This extremely useful, low priced device will extend the use of your single-beam oscilloscope for duties otherwise only in the province of the double-beam tube. In short, at a nominal cost, the Heathkit model S-3U will give you the advantages of a double (or other multiple) beam 'scope, while retaining all the advantages of your present single-beam instrument.

Hicerto an electronic switch of this nature, permitting the simultaneous observation of two signals on the screen of a single-beam C.R.T. oscilloscope, has cost nearly as much as the 'scope itself. **£11.15.6**

**RESISTANCE-CAPACITANCE  
BRIDGE KIT Model C-3U**



Measures capacitance 10pF to 1,000 $\mu$ F, resistance 100 $\Omega$  to 5 meg-ohms and power factor, 5 450 V. test voltages. Safety switch provided. **£9.5.0**

**MULTIMETER KIT  
Model MM-1U**

Provides wide voltage current, resistance and dB ranges to cover hundreds of applications. Sensitivity 20,000 ohms/volt D.C. and 5,000 ohms/volt A.C. Ranges: 0-1.5 v. to 1,500 v. A.C. and D.C.; 150 $\mu$ A to 15A D.C.; 0.2 $\Omega$  to 20M $\Omega$ . 4 $\frac{1}{2}$ in. 50 $\mu$ A. meter. **£12.10.0**

**AUDIO SIGNAL GENERATOR KIT  
Model AG-9U**



10 c/s to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's. **£21.9.6**

**AUDIO VALVE MILLIVOLTMETER  
KIT Model AV-3U**

Very sensitive. High stability. 1 mV. to 300 V. A.C. 10 c/s. to 400 kc/s. **£14.17.6**

**AUDIO WATTMETER KIT  
Model AW-1U**



This popular meter is used in many recording studios and broadcasting stations as a monitor as well as for servicing purposes. Dissipation rating up to 25 w. continuous. 50 w. intermittent. **£15.15.0**

**New! 'OXFORD' Dual-wave  
LUXURY  
TRANSISTOR  
PORTABLE  
RADIO KIT  
Model UXR-2**



Ideal for use as a domestic, car or personal receiver. Please send for full details. **£14.18.0**

**HI-FI F.M. TUNER KIT**

Tuning range 88-108 Mc/s. Flywheel tuning. Attractive Plastic Front Panel in two-tone grey with golden trim surround and motif. Thermometer type visual tuning indicator. Pre-aligned I.F. transformers. Three I.F. stages. Wide-band low distortion Ratio Detector. R.F. Unit, wired, tested and pre-aligned. Printed circuit for I.F. Amplifiers and Ratio Detector. Built-in power supply. Output sockets for stereophonic adaptor (for stereo transmission when available).



**TUNER UNIT Model FMT-4U with 10.7 Mc/s. I.F. output £2.15.0 (inc. P.T.)**  
**I.F. AMPLIFIER and Power Supply Model FMA-4U complete with case and valves. £12.6.0. Sold separately.**  
Total **£15.1.0**

**A.M./F.M. TUNER KIT**

Tuning range 88-108 Mc/s. (FM) 16-50, 200-550, 900-2,000 m. Flywheel tuning. Attractive Perspex front panel in two-tone grey with golden trim. Thermometer type tuning indicator, pre-aligned I.F. transformers. Switched wide and narrow AM bandwidths.

**TUNING HEART Model AFM-T1 £4.13.6 (inc. P.T.). I.F. AMPLIFIER and Power Unit Model AFM-A1. Complete with metal cabinet and valves £20.13.0.**  
Sold separately. Total **£25.6.6**

**TRANSISTOR PORTABLE  
RADIO KIT Model UXR-1**

Presented in elegant real hide case with tasteful gold relief. Can be assembled in 4 to 6 hours and you have a set in the top flight of transistor portables. Pre-aligned I.F. transformers, printed 7in. x 4in. high-flux speaker. **£12.11.0**



circuit and a

**4-wave TRANSISTORISED  
PORTABLE RADIO KIT  
Model RSW-1**

Using 7 latest type transistors and three diodes this highly sensitive set is specially designed for Short and Medium wavebands (200-550, 90-200, 20-40 and 11-16 m.). In solid leather case fitted with retractable whip aerial. **£19.17.6**



**£19.17.6**

**VALVE VOLTMETER KIT  
Model V-7A**

The world's most popular valve voltmeter, with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively d.c. volts to 1,500 and A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 Megohms with internal battery. D.C. input impedance is 11 megohms and dB measurement has a centre-zero scale. Complete with test prod. leads and standardising battery. **£13.18.6**



**HIGH VOLTAGE PROBE KIT  
Model HV-33E**

Extends measurement up to 30,000 v. D.C. with negligible circuit loading. A special High Stability 1,090 megohm resistor gives a multiplication factor of 100X when used with a valve voltmeter of 11 megohms input impedance such as the V-7A **£2.19.6**

**R.F. PROBE KIT Model 309-CU**

This complete probe kit will extend the frequency range of the V-7A Valve Voltmeter to 100 Mc/s. and will enable useful voltage indication to be obtained up to 300 Mc/s. **£1.13.6**

**POWER SUPPLY UNIT KIT  
Model MGP-1**

Compact, general purpose unit suitable for F.M. Tuners, Tape Recording Amplifiers and general laboratory use. Input 100/120 v., 200/250 v., 40-60 c/s. Output 6.3 v. 2.5 A. A.C.; 200, 250, 270 v. 120 mA. max. D.C. **£5.2.6**



**DECADE CAPACITOR KIT  
Model DC-1**

Capacity values 100 $\mu$ F to 0.111 $\mu$ F in 100 $\mu$ F steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£6.15.6**

**DECADE RESISTANCE BOX KIT Model DR-1U. Range 1-99,999 $\Omega$  in 1 $\Omega$  steps. Ceramic switches throughout. Current rating from 500 mA. to 5 mA. according to decades in circuit. Polished wooden cabinet supplied complete ..... £9 19 6**

**R.F. SIGNAL GENERATOR KIT  
Model RF-1U**

Provides extended frequency coverage on six bands from 100 kc/s. 100 Mc/s. on fundamentals and up to 200 Mc/s. on calibrated harmonics. **£12.15.6**



**2 $\frac{1}{2}$ in. SERVICE OSCILLOSCOPE  
KIT Model OS-1**

Light, compact, portable for service engineers. Printed circuit board for easy construction. Wt. 10 $\frac{1}{2}$  lb. Size 5in. x 8in. x 1 $\frac{1}{2}$ in. long. **£19.19.0**



**CAPACITANCE METER KIT  
Model CM-1U**

This Direct-Reading Capacitance Meter is a very low priced, time-saving instrument which is so useful that it should be part of the general equipment of every electronic laboratory and production line. Easily built in a few hours. 0-100 $\mu$ F, 0-1,000 $\mu$ F, 0-0.01 $\mu$ F, 0-0.1 $\mu$ F. The meter has 4 $\frac{1}{2}$ in. scale and can be used by an unskilled operator after a few minutes' instruction. **£15.15.0**



• Deferred Terms available on all orders above £10 •

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DEPT. W.W.11 GLOUCESTER, ENGLAND

A MEMBER OF THE DAYSTROM GROUP, MANUFACTURERS OF

thoroughly



dependable

**AMATEUR TRANSMITTER KIT**  
Model DX-40U



Covers all amateur bands from 80 to 10 metres, crystal controlled. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for V.F.O. Filters minimise T.V. interference.

£33.19.0

**SINGLE SIDEBAND ADAPTER KIT**  
Model SB-10U



May be used with most A.M. transmitters with certain provisions. Allows full use of existing equipment for SSB facilities. Band coverage: 80, 40, 20, 15, 10 m. Unwanted sideband suppression: Better than 30 dB. Carrier suppression: Better than 40 dB. Power requirements: 300 v. D.C. 85 mA.

(average), 30 mA. (standby), 140 mA. (transmit). 6.3 v. A.C., 3.5 A. Meter: 2 1/2 in. Scale edge reading, 200 μA movement, indicates carrier null and relative power output. Cabinet 1 1/2 in. high x 8 in. wide x 14 1/2 in. deep.

£39.5.0

**AUDIO SINE-SQUARE WAVE GENERATOR KIT.** Model AO-1U

An inexpensive generator which covers 20 c/s to 150 kc/s in four ranges with choice of sine or square waves. The latter up to 50 kc/s. Output voltage 10 v. max. and distortion less than 1%. An ideal instrument or audio testing. Size 9 1/2 in. x 6 1/2 in. x 5 in.

£13.15.0

**GRID-DIP METER KIT** Model GD-1U



Functions as oscillator or absorption wave meter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s to 250 Mc/s.

£10.19.6

Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves, 17/6.

**TRANSISTOR INTERCOM. KITS**  
Models XI-1U and XIR-1U

Ideal for home or business use. Up to five remote stations can be operated with each Master. The Master unit can call any one, any combination, or all five Remote stations and any Remote station can call the Master. A private call to any Remote station cannot be interrupted or overheard by any other while a conversation is in progress. Any Remote station can talk to any one or all others provided the Master is manned. These kits have been designed for easy construction and high performance.

The mahogany veneered wooden cabinets are supplied completely assembled and finished. The Master unit has a 4-transistor amplifier and is operated by an internal 9 v. battery as are the Remote units. Batteries are not included with the Kits.

Model XI-1U (Master) £10.19.6

Model XIR-1U (Remote) £4.7.6

★ Educational Presents for Youngsters ★

**ELECTRONIC WORKSHOP KIT** Mod. EW-1

Makes over 20 experiments £7.13.6

**TRANSISTOR RADIO KIT** Mod. UJR-1

An ideal introduction to radio £2.7.6

Additional Amplifier Stage UJR-IS 16/6 extra.

**AMATEUR BANDS RECEIVER KIT** Model RA-1



This receiver is designed as an ideal economically priced fixed station, portable or mobile receiver covering the amateur bands from 160-10 m., each band separately calibrated on a large illuminated slide-rule dial. Approx. 5 in. bandspread on each band. Features: Signal strength (tuning) 'S' meter, front panel dial calibration control, provision for a 100 kc/s calibrator, tuned R.F. amplifier stage, half-lattice filter, adjustable noise limiter. Excellent electrical and mechanical stability. Frequency coverage: 160, 80, 40, 20, 15, 10 metre bands. I.F. 1620 kc/s. Sensitivity: 2 μV for 10 dB S/N, image rej. 40 dB. Power requirements: 110-240 V. A.C. 40-60 c/s. (Provision for external P.S. for mobile use). Size 13 1/2 in. wide x 6 1/2 in. high x 10 1/2 in. deep.

Write for specification leaflet. £39.6.6

**"MOHICAN" GENERAL COVERAGE RECEIVER KIT**

Model GC-1U



This fully transistorised receiver includes 4 piezo-electric transmitters. Ideal for fixed or portable use. The R.F. "front end" is supplied as a pre-aligned, pre-assembled unit. Features include: 10 transistor circuit, printed circuit board, telescopic whip aerial, tuning meter, large slide-rule dial. Frequency coverage: 580 kc/s to 30 Mc/s in 5 switched bands. Electrical band spread on the Amateur bands 80-10 m. Size 6 1/2 in. x 12 in. x 10 in. Powered by two 6 v. dry batteries (not supplied). Please write for full specification. £39.17.6

**STABILISED POWER PACK**

Models MSP-1M and MSP-1W



Specially recommended for industrial and laboratory use, meeting the need for a reliable and versatile stabilised power pack capable of a very high performance. Input 200-250 v., 40-60 c/s. A.C., fully fused. Outputs: H.T. 200-410 v. D.C. at 20-225 mA. in 3 switched ranges. Unstabilised A.C. 6.3 v. at 4.5 A. centre tapped. Two 3 in. "easy-to-read" meters for reading voltage and current simultaneously. Separate L.T. and H.T. supply transformers. All output circuits are isolated. Size 13 in. x 8 1/2 in. x 9 1/2 in.

MSP-1M (with meters) £36.12.6

MSP-1W (without meters) £29.17.6

**BALUN COIL UNIT KIT**

Model B-1U. Will match unbalanced co-axial lines to balanced lines of either 75 or 300 Ω impedance. Frequency range 10-80 m., input up to 200 watts. £4.15.6

All prices include free delivery in U.K.

• Deferred Terms • available on all orders above £10.

**NEW! GENERAL COVERAGE COMMUNICATIONS RECEIVER KIT** Model RG-1

Of similar size and appearance to the model RA-1. Frequency coverage from 600 kc/s. to 1.5 Mc/s and 1.7 Mc/s to 32 Mc/s in 6 switched bands. Its many features include Half-lattice crystal filter. Available shortly! Send for full details £39.16.0

**AMATEUR TRANSMITTER KIT** Model DX-100U

The World's most popular Amateur TX Kit



- Completely self-contained compact Amateur Transmitter, 150 w. D.C. input.
- Built-in highly stable VFO and all Power Supplies.
- TVI: Careful design has reduced TVI to a minimum by use of effectively screened frequency-generating stages and pi-tuned circuits at the input and output of the PA stage and by 11 chokes and pi network filters to all outlets from the cabinet. No fewer than 35 disc-ceramic by-pass capacitors help to achieve the exceptional stability and high-performance for which this Transmitter is noted.
- The KT88 high-level anode and screen modulator stage gives over 100 watts of audio from less than 1.5 mV. input.
- Adjustable drive and clamp control ensure that valves are only driven sufficiently to maintain the required output.
- Keying on CW is via the VFO and buffer amplifier cathodes; the other RF valves are biased beyond cut-off. When zero-beating the TX with incoming signals, the exciter stages only may be run without the final amplifier being switched on.
- Provision has been made for remote control operation.
- VFO slow-motion drive is very smooth and backlash free. • VFO or Crystal control.
- Covers all Amateur bands up to 30 Mc/s 'phone or CW.

£74.19.0

**VARIABLE FREQUENCY OSCILLATOR KIT.** Model VF-1U

Specially designed to meet the demand for the maximum possible flexibility from an amateur Transmitter which would otherwise be subject to certain limitations imposed by crystal control. Calibrated for all Amateur bands 160-10 meters, fundamentals on 160 and 40 m. Ideal for Heathkit DX-40U and similar transmitters. £11.17.6



**Q MULTIPLIER KIT.** Model QPM-1

A reasonably priced Q Amplifier for the amateur and short-wave enthusiast. This self-powered unit (200-250 v. 50/60 c/s.) may be used with communications receivers to provide both additional selectivity and signal rejection. Model QPM-1 for 470 kc/s IF. Model QPM-16 for 1.6 Mc/s IF. £7.12.6



Either model £7.12.6

Please send me FREE CATALOGUE (Yes/No).....

Full details of Model(s).....

NAME..... (Block Capitals)

ADDRESS.....

WW11

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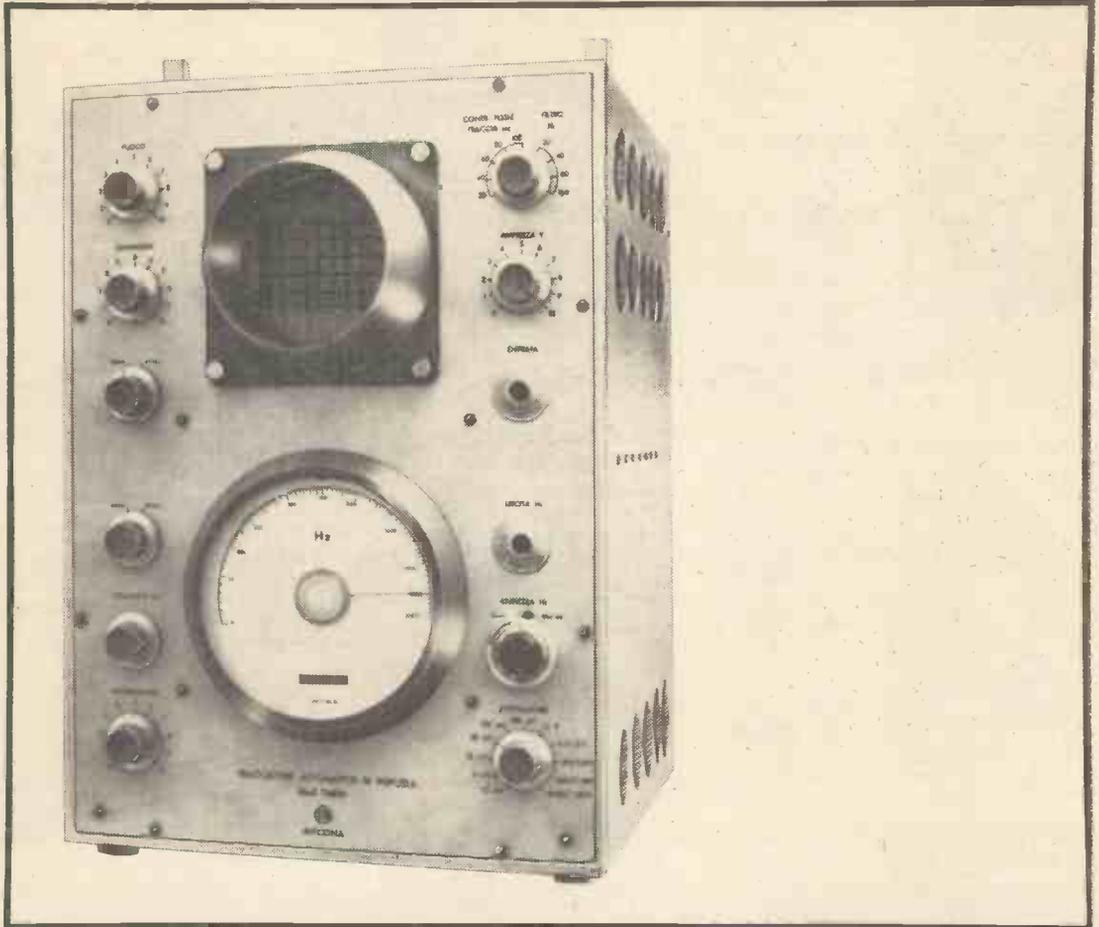
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THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

C.R.B. AUTOMATIC FREQUENCY RESPONSE TRACER  
**A UNIQUE AID TO DEVELOPMENT  
 AND PRODUCTION TESTING**



**CLAUDE LYONS LIMITED**

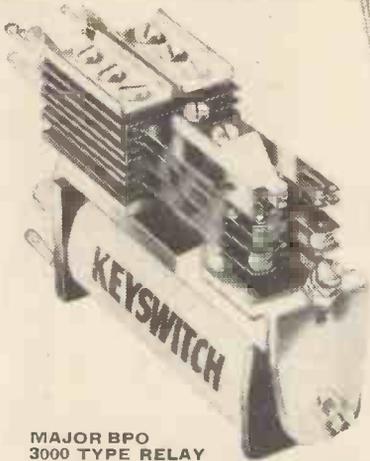


*C.R.B. Type TAR/61 Automatic Frequency Response Tracer*

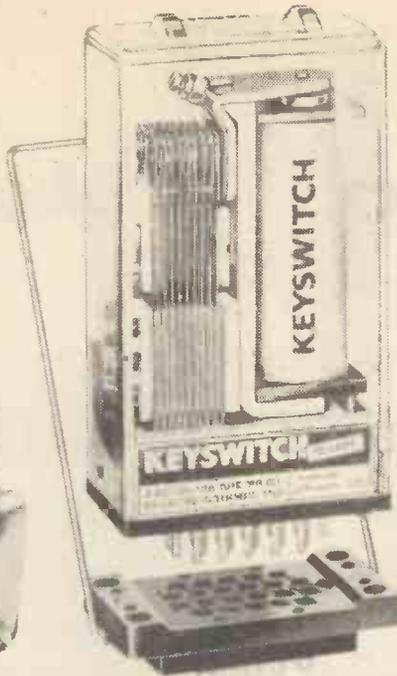
The TAR/61 is an audio frequency spectrum analyser which directly displays on a CRT screen an amplitude/frequency response curve. It is self-contained, including a low-distortion automatically swept power oscillator providing the input to the device under examination. Unequaled simplicity in use and directness of presentation make it essential to all engaged in production or test of amplifiers, filters, recorders, loudspeakers, microphones, pickups and transducers. *As the exclusive U.K. representatives, Claude Lyons Ltd will be glad to supply full technical information on this invaluable instrument.*

- Range — 20 c/s to 20 kc/s
- Oscillator output 1.5mV to 150V
- Distortion below 1.5% at 1 watt
- Sweeps 5, 10, 15 per minute, or manual
- Display on 5" long-persistence CRT
- Graticule directly calibrated in db. and mV versus c/s
- Logarithmic amplifier with 50 db. dynamic range
- Provision for compression amplifier to compensate for transducer non-linearity
- Price £430 net (duty free)

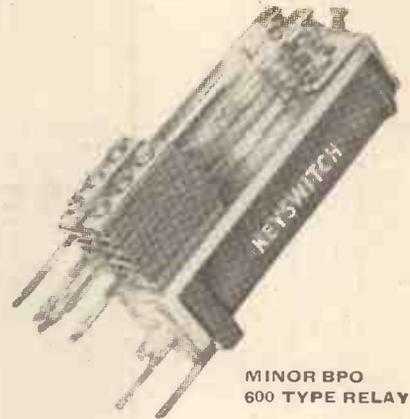
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MAJOR BPO  
3000 TYPE RELAY



PLUG-IN (P-33)  
3000 TYPE RELAY



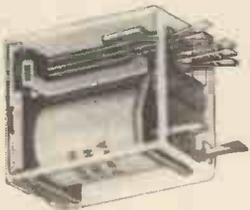
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600 TYPE RELAY

ENSURE PERFECT TIMING WITH

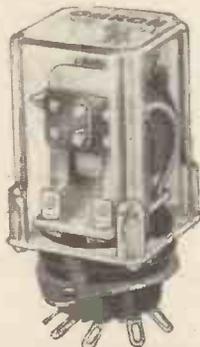
# KEYSWITCH & OMRON RELAYS

Keyswitch, renowned manufacturers of Post Office Relays, are now able to supply Omron relays of the same quality and delivery-by-return. These Units are fulfilling the most exacting requirements in electronics today.

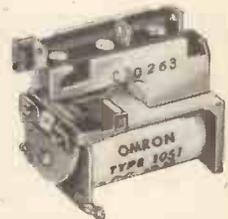
**OMRON** The name behind a world-famous range of electronic components. Their technical achievement enjoys such approval as UNDERWRITERS LABORATORY INC. of U.S.A. (approval No. E32677) and fulfils the MIL specifications of the U.S. Army. Below are three of the most popular OMRON Relays. Priced from 5/- to 20/-. Delivery Ex-stock.



**TYPE MH2**  
Sub-miniature Relay  
multi-contact D.C. only.  
Weight 15 grams.



**TYPE MK2P**  
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plug-in octal base  
up to 230 volts AC/DC



**TYPE 1051**  
Sub-miniature Relay  
snap-action 5 amp.  
contact, 6V, 12V and  
24V D.C. only.

## KEYSWITCH RELAYS

# SWITCH TO



# Nagard Oscilloscopes



## OS321 DOUBLE-BEAM OSCILLOSCOPE WITH INTERCHANGEABLE PRE-AMPLIFIERS

**Sweep Rate** 20ns/cm to 1.2s/cm.

**Sweep Expansion** x5 on both channels.

**Trigger** Internal 2 mm. or external down to 100mVp.p.

**Single Delay** on both channels 170ns.

**C.R.T.** 5-inch flat-faced double-gun with minimum 2cm overlap and adequate intensity for single-stroke recording at fastest time base speeds.

**Accuracy** Time and voltage direct from graticule  $\pm 3\%$ .

**Built-in Amplitude Calibrator.**

**PRICE NETT IN U.K. £425.**

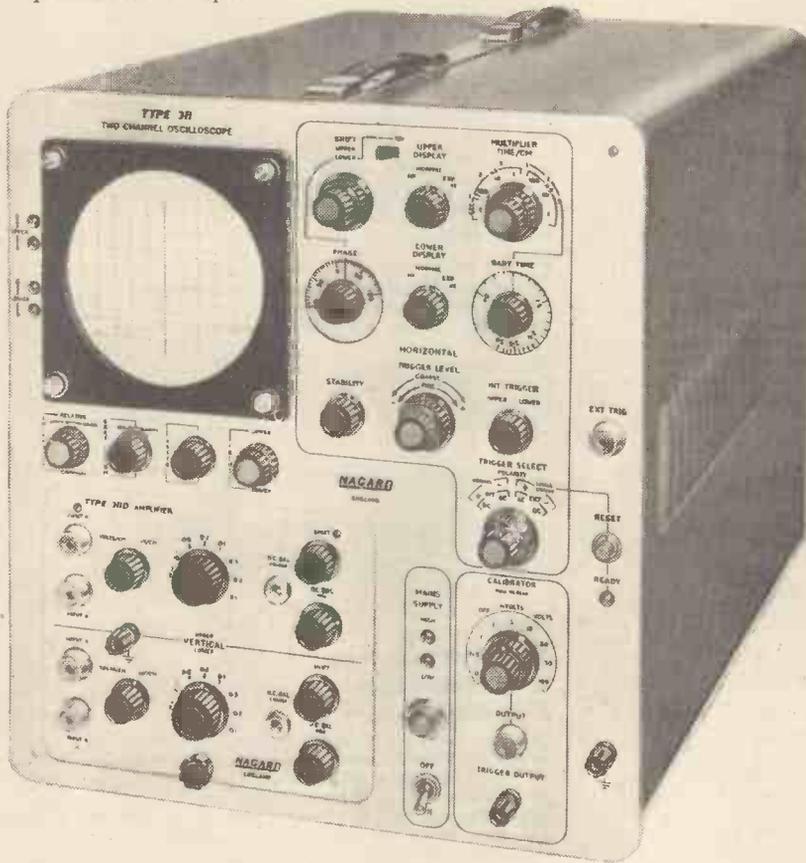
**P321A 2-Channel Pre-Amplifier** Sensitivity 10mV/cm to 12.5V/cm; Bandwidth D.C. to 20Mc/s; Rise time 18ns; Input impedance constant at 1M $\Omega$  shunted by 35pF.

**PRICE NETT IN U.K. £70.**

**P321D 2-Channel Pre-Amplifier** Sensitivity 1mV/cm to 125V/cm; Bandwidth D.C. to 5Mc/s; Rise time 70ns; Input impedance constant at 1M $\Omega$  shunted by 35pF (each side). Balanced inputs with in-phase rejection ratio better than 500:1 at 5Mc/s for 5Vp.p. input and maximum sensitivity.

**PRICE NETT IN U.K. £70.**

Nagard Oscilloscopes cover varied requirements for wide bandwidth and high sensitivity by using integral switched pre-amplifiers or interchangeable plug-in pre-amplifier units. Three models are available, the OS301 being a high-speed, wide-band, single-beam Oscilloscope, while the OS311 and OS321 utilise double-gun cathode ray tubes and interchangeable pre-amplifiers. We suggest you write or telephone for complete specifications. Technical representatives are always available to arrange demonstrations and to discuss your particular requirements on request.



## OS301 HIGH-SPEED WIDE-BAND SINGLE-BEAM OSCILLOSCOPE

Sweep Rate 0.1  $\mu$ s/cm to 1.2s/cm  
Sweep Expansion x10 giving maximum sweep rate of 10ns/cm.  
Trigger Internal 2mm. or external down to 0.1Vp.p.

C.R.T. 5-inch flat-faced.

Integral Pre-Amplifier Switched in  
Sensitivity 10mV/cm; Bandwidth 2.5c/s to 20Mc/s; Rise time 18ns.

Integral Pre-Amplifier Switched out  
Sensitivity 100mV/cm to 20V/cm;  
Bandwidth D.C. to 40Mc/s; Rise time 9ns; Signal delay 180ns.

PRICE NETT IN U.K. £425.

## OS311 DOUBLE-BEAM OSCILLOSCOPE WITH INTERCHANGEABLE PRE-AMPLIFIERS

Sweep Rate 1 $\mu$ s/cm to 15s/cm.

Sweep Expansion x5 on either or both channels.

Phase Measurement  $\pm 180^\circ$  by calibrated horizontal shift.

Lissajous Displays by switching lower vertical channel to give horizontal deflection on upper channel.

Trigger Internal 2mm. or external down to 50mVp.p.

C.R.T. 5-inch flat-faced double-gun with full screen display overlap.

Accuracy Time and voltage direct from graticule  $\pm 3\%$ .

Built-in Amplitude Calibrator. PRICE NETT IN U.K. £340.

P311D 2-Channel Pre-Amplifier Sensitivity 100 $\mu$ V/cm; Bandwidth D.C. to 150Kc/s; Rise time 2.3 $\mu$ s; Input impedance 10M $\Omega$  shunted by 35pF (each side).

Balanced inputs with in-phase rejection ratio better than 1000:1 for 1Vp.p. input and maximum sensitivity. PRICE NETT IN U.K. £55.

P311V 2-Channel Pre-Amplifier As for P311D but with switched H.F. and L.F. attenuation. PRICE NETT IN U.K. £85.

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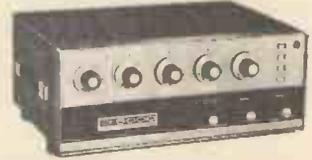
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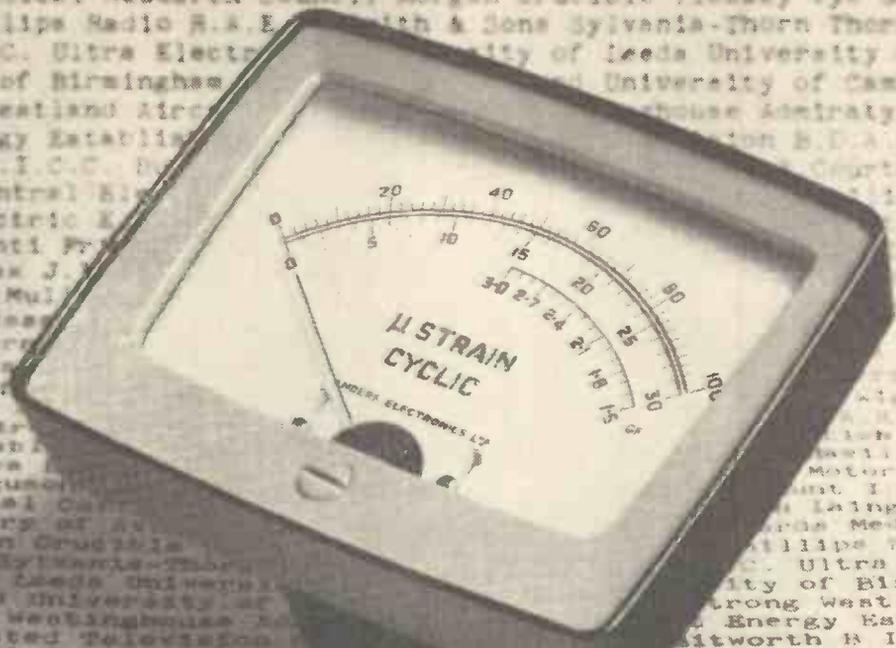


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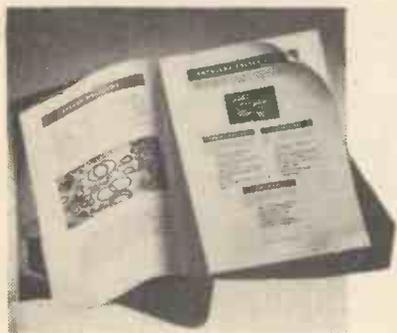
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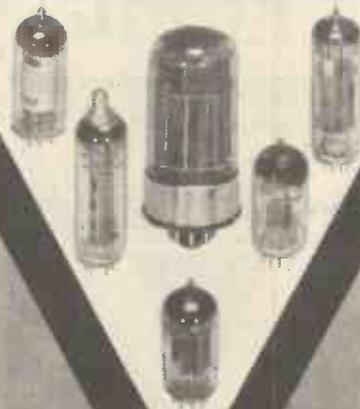
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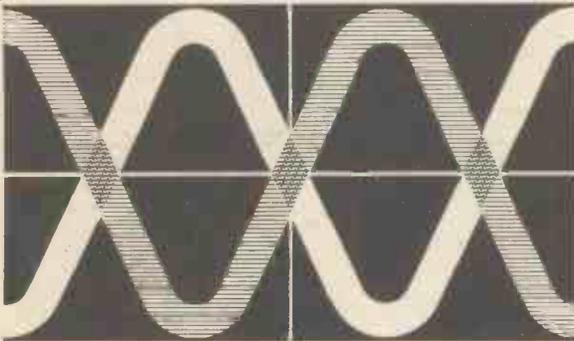
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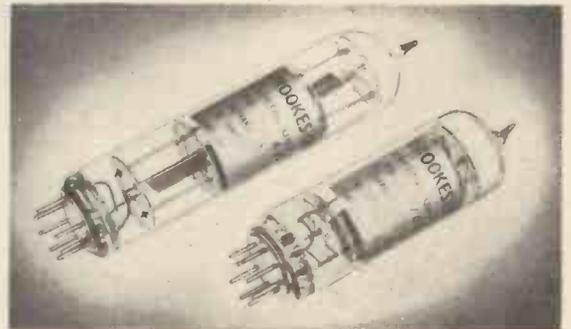
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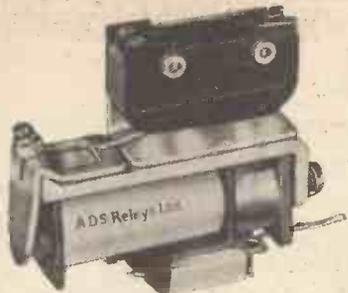
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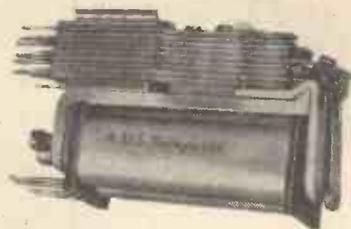
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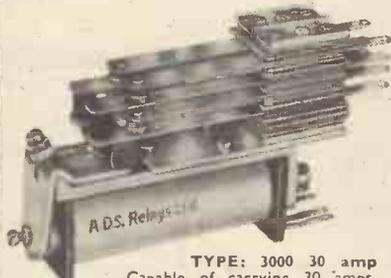


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Can be fitted with any type of micro switch; light and heavy duty contact sets as required. Coil: 2 to 80,000 ohms.

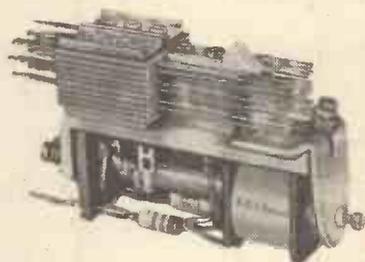


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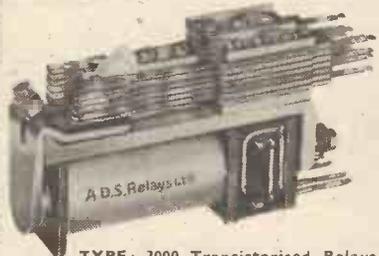


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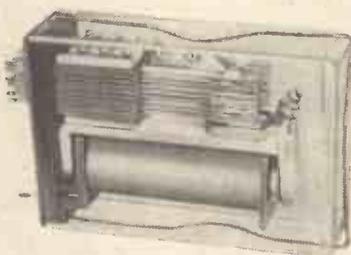


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This relay can be supplied with operate/delay up to 25 seconds from supply of 6 to 50 volts D.C. Release delay up to 25 seconds with trigger circuits to 1½ volts D.C. Energised from 6 to 50 volts D.C. Contacts maximum 6 change overs light duty. With adjustable resistor giving plus or minus 2 seconds of nominal figure on operate and release relays.

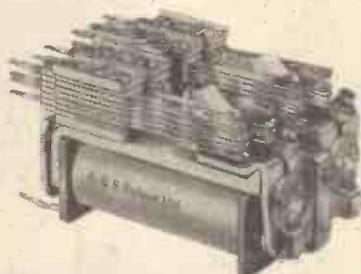
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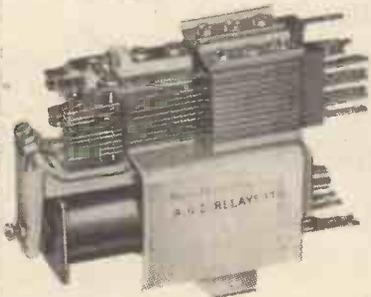
**TYPE: 3000 Transistorised Relays**  
T.1 Operates from 300 to 500 micro/amps. at 1½ volts D.C.  
T.2 Operates from 3 to 5 micro/amps. at 1½ volts D.C. Maximum contacts 2 change overs light duty or 2 change overs heavy duty.  
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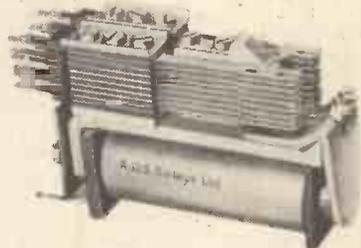
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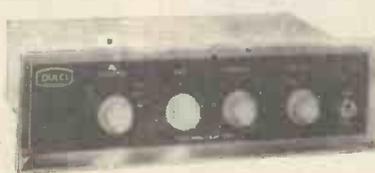
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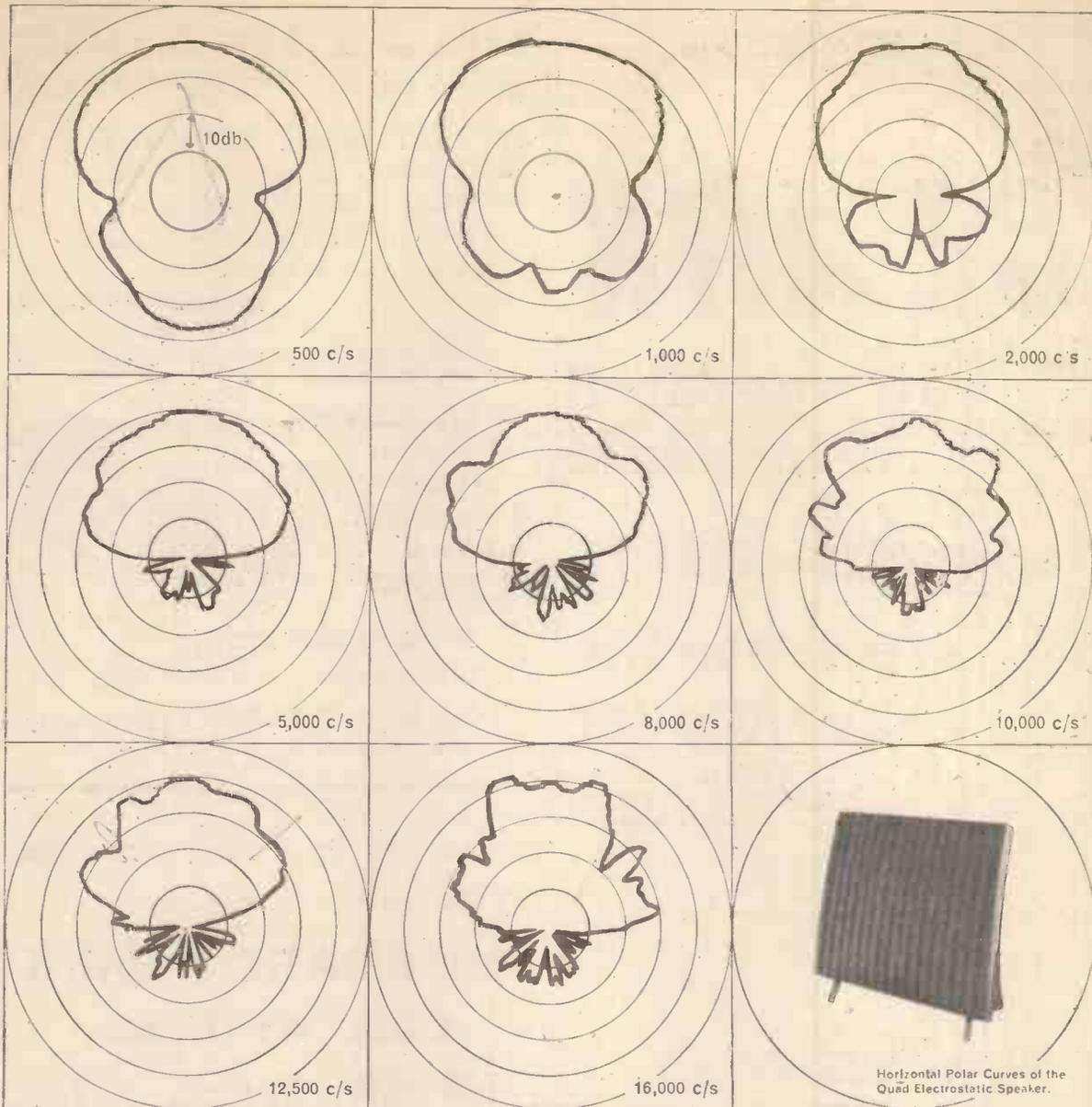
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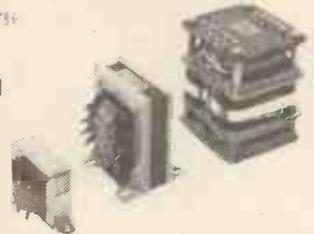
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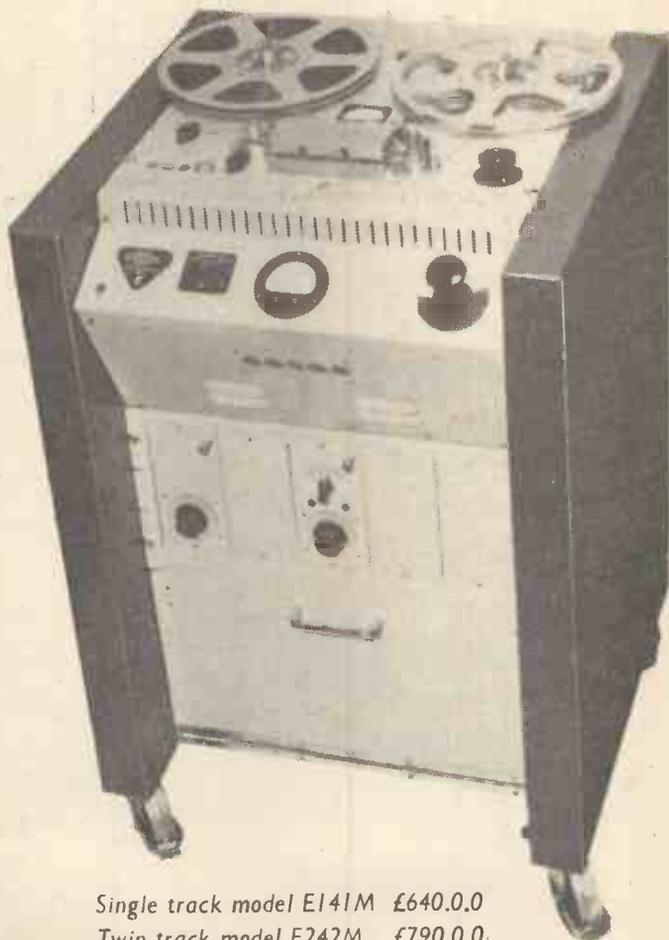
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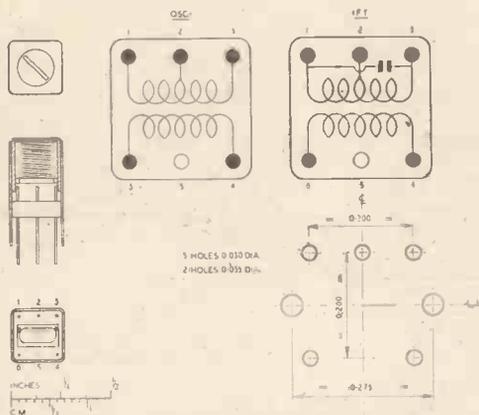
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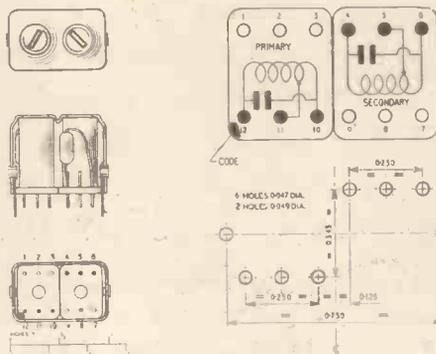
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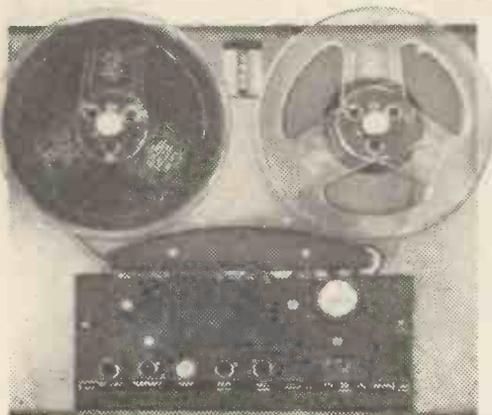
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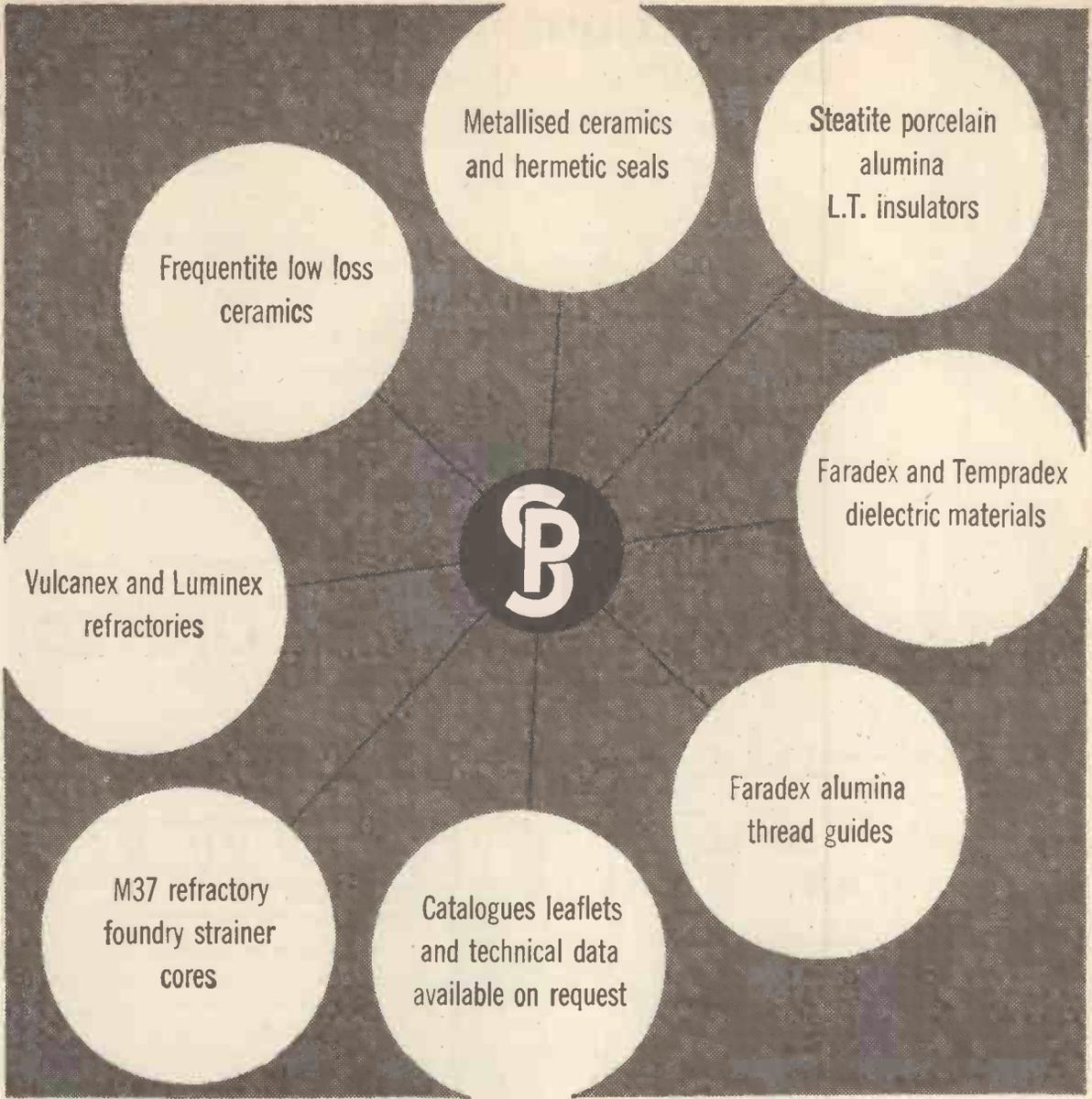
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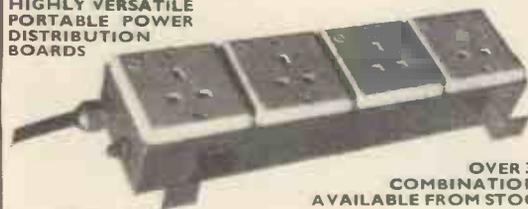
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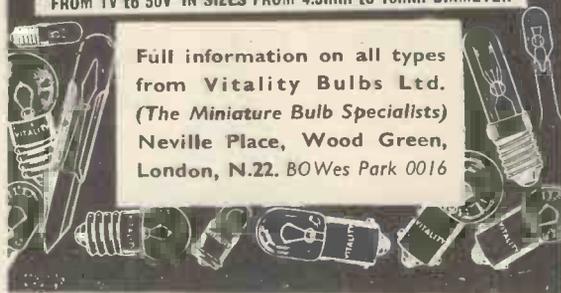
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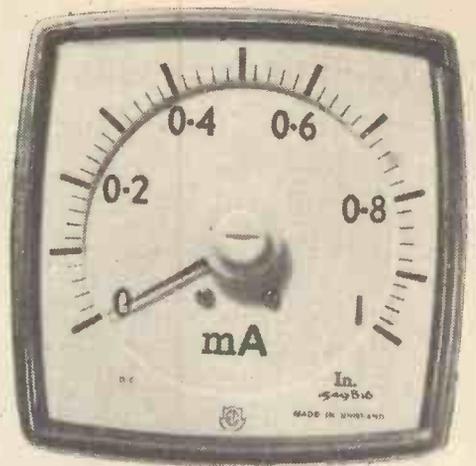
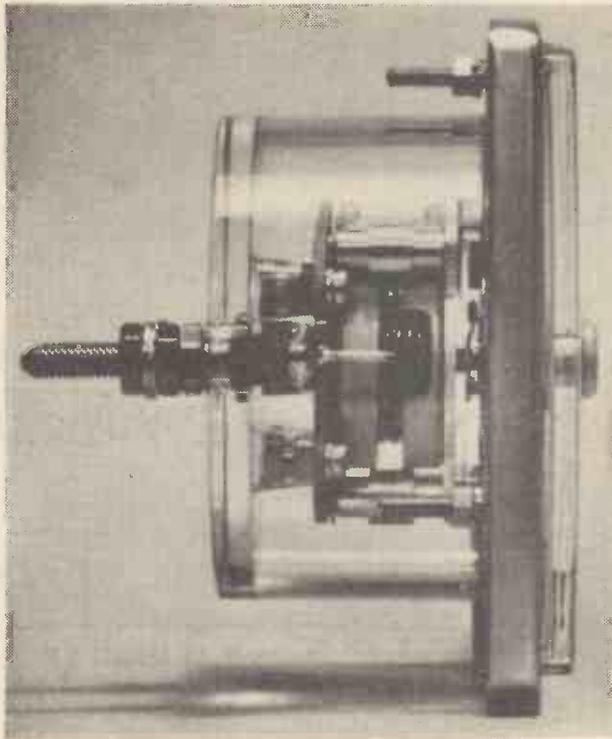
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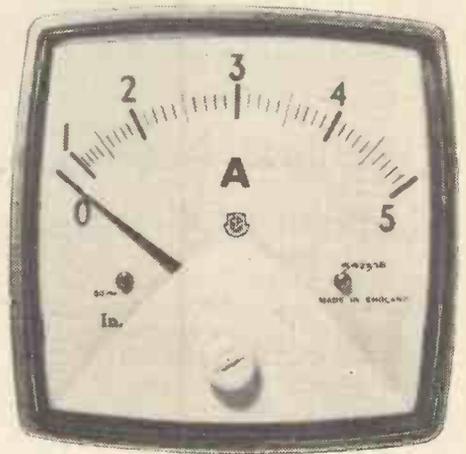
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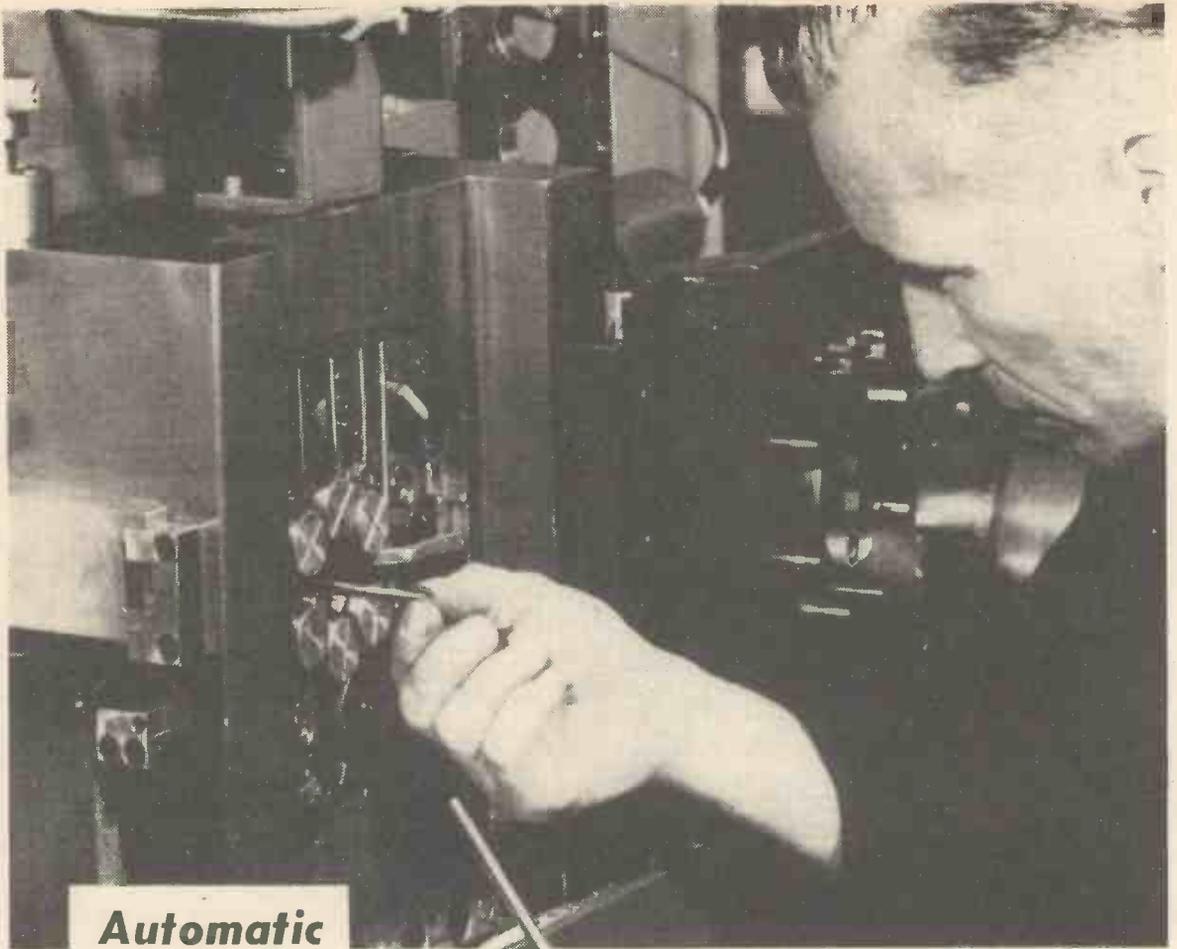
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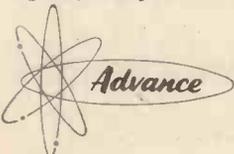


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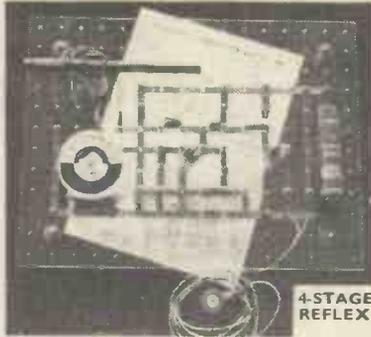
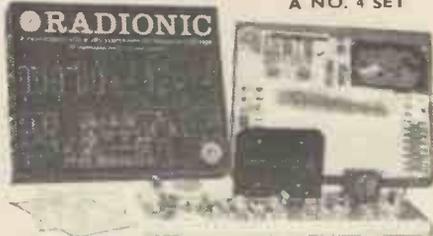
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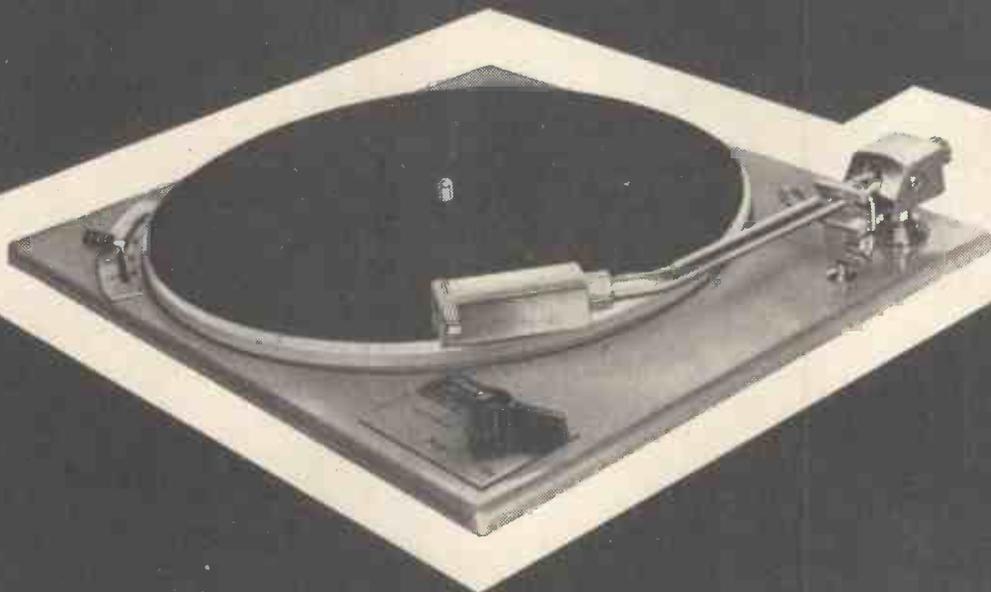
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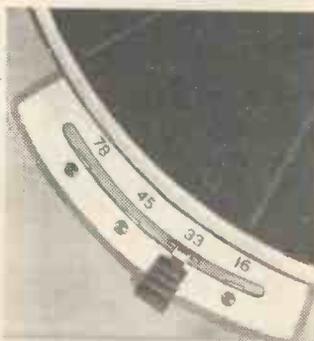
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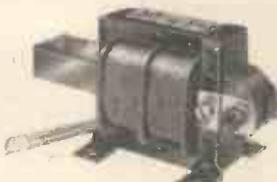
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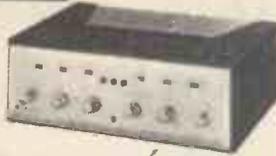
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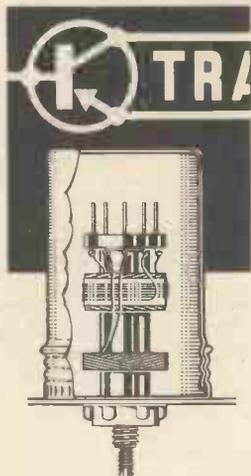


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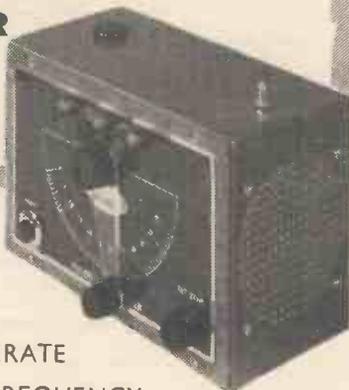
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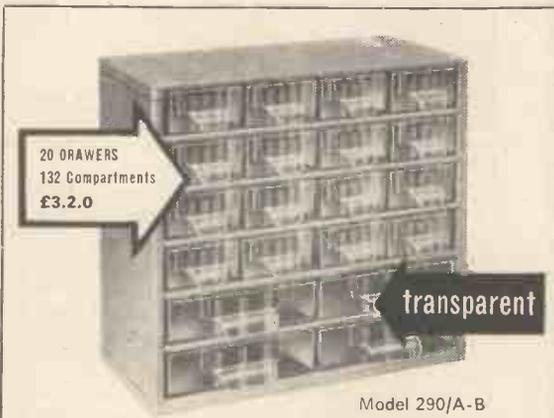
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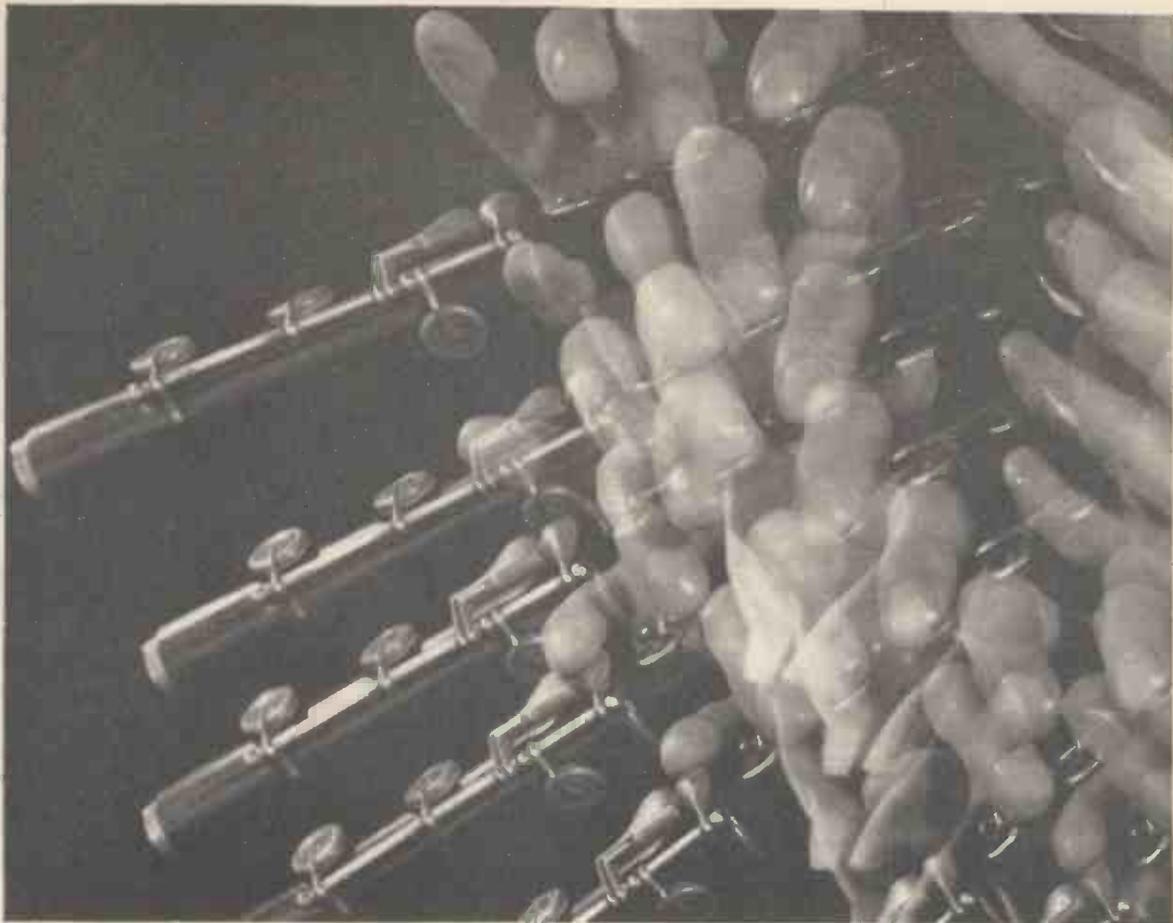
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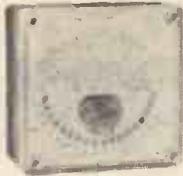
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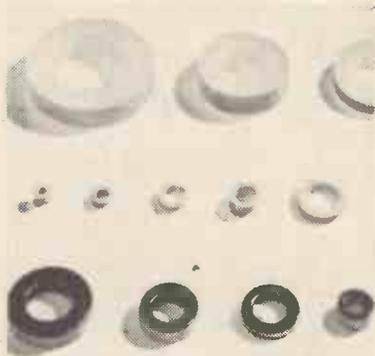
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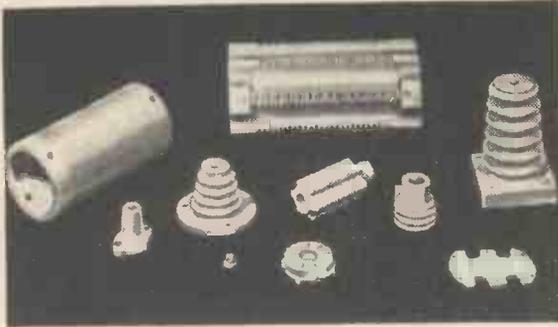


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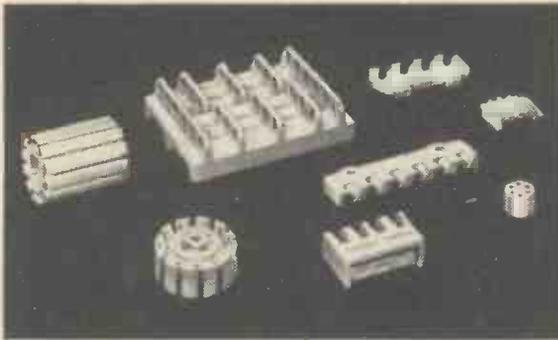
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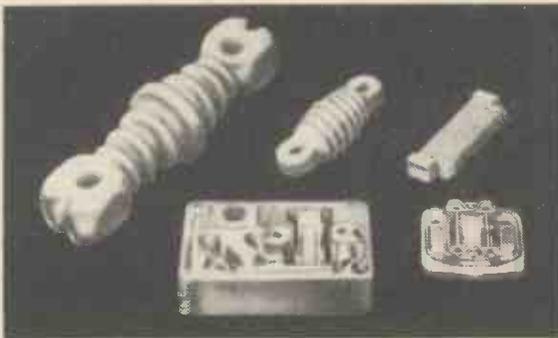
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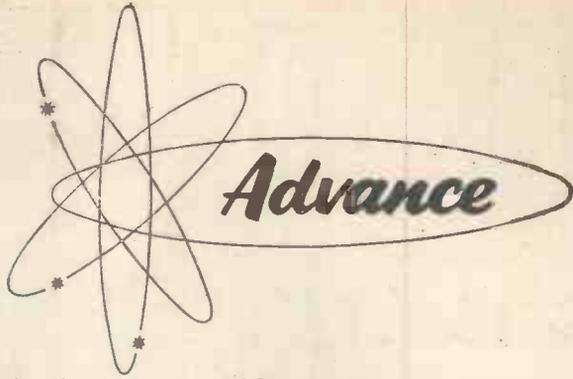
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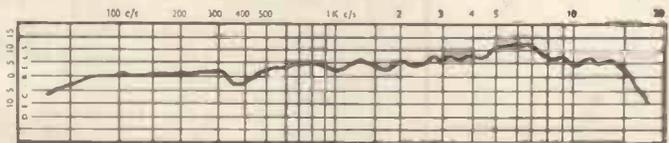
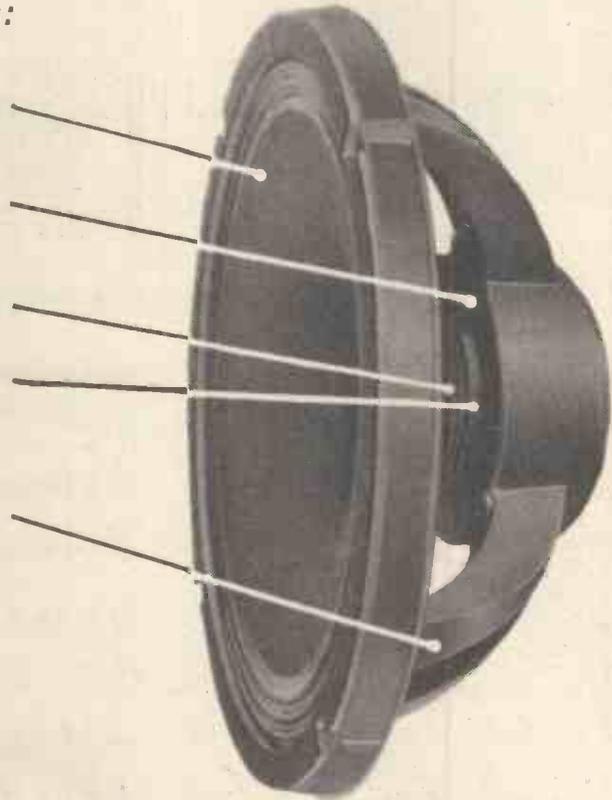
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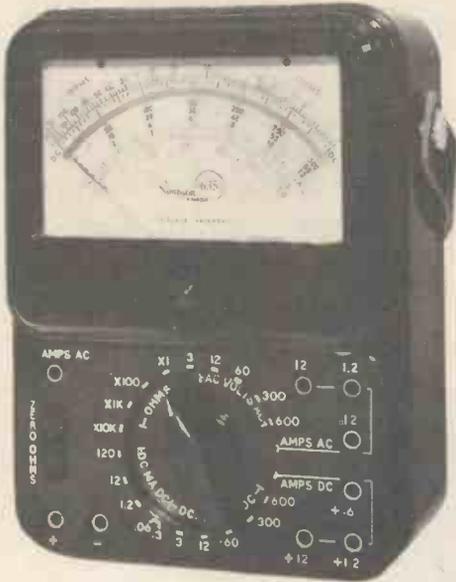
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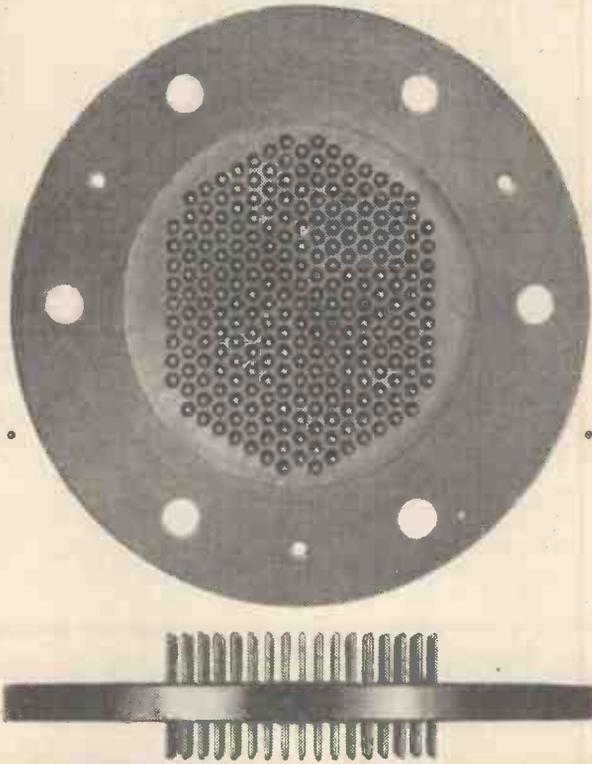
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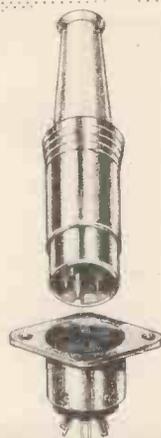
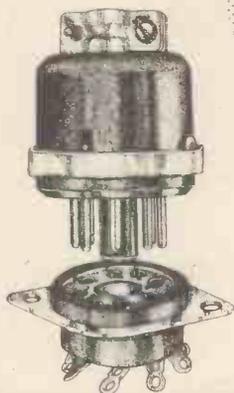
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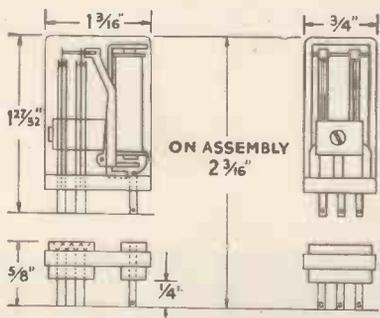
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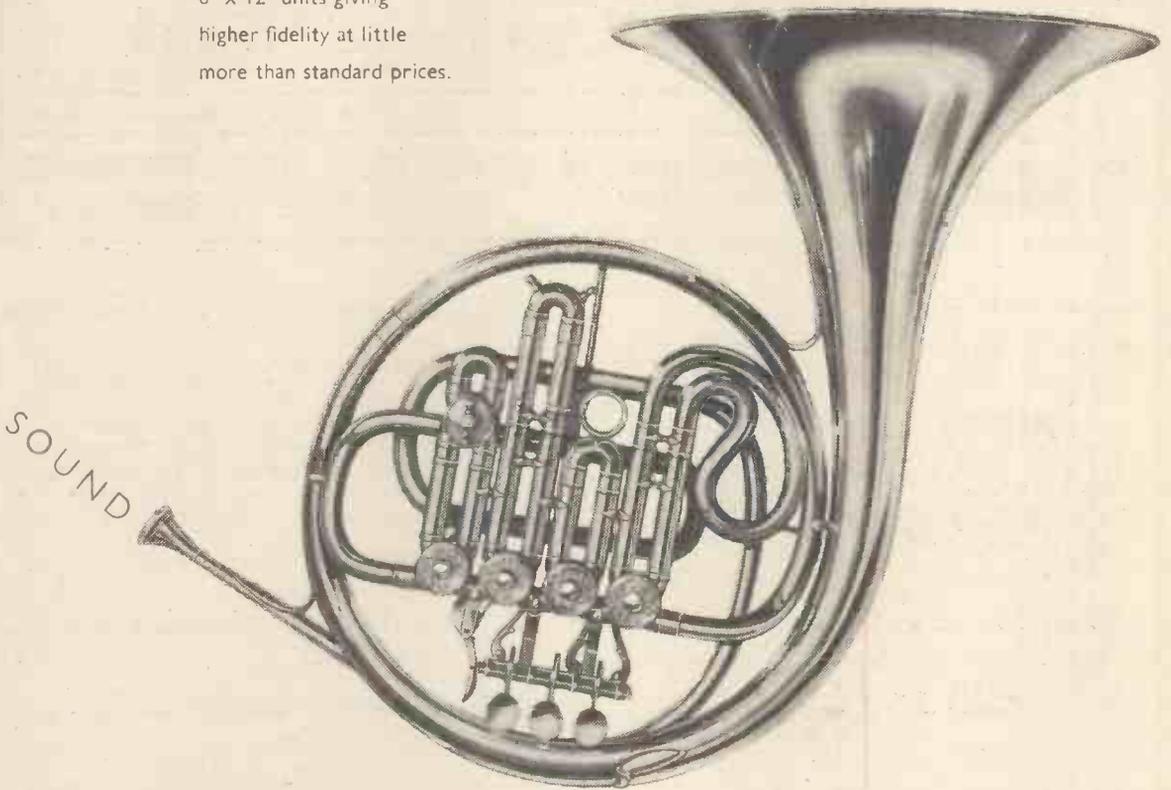
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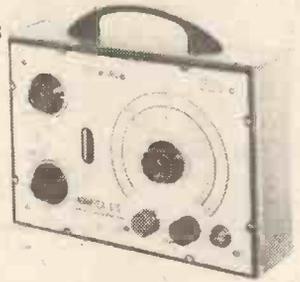
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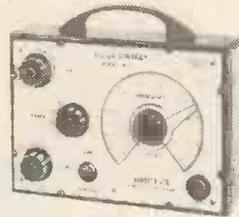
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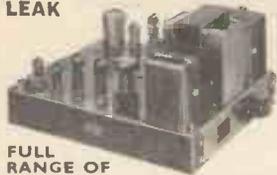
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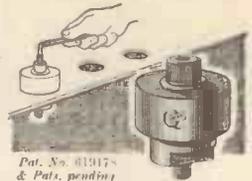
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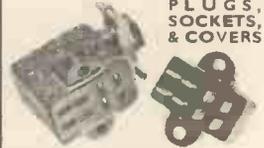


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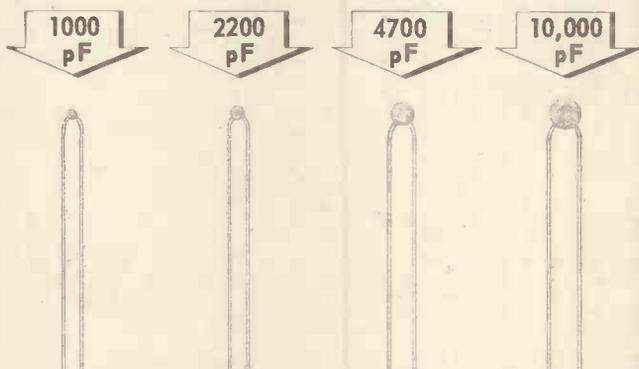
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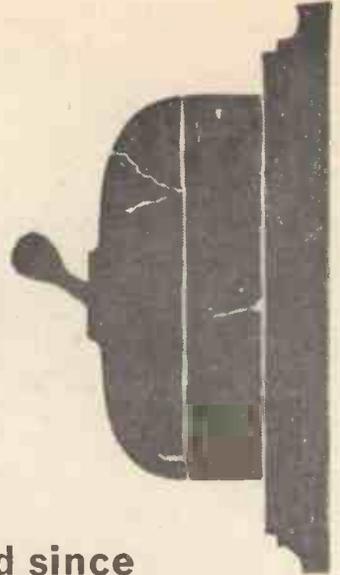
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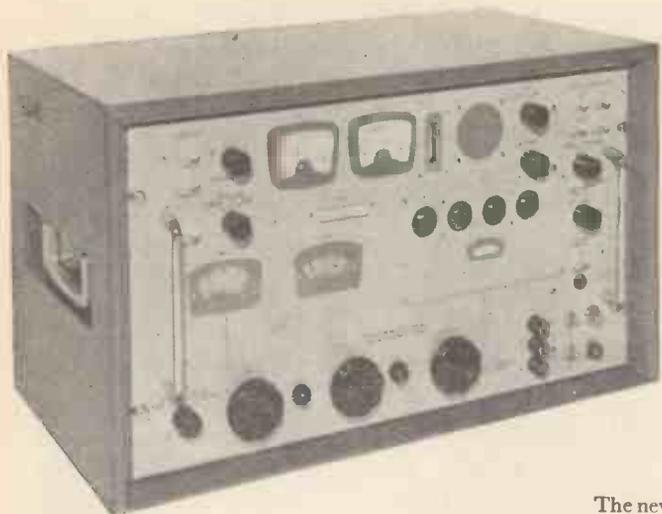


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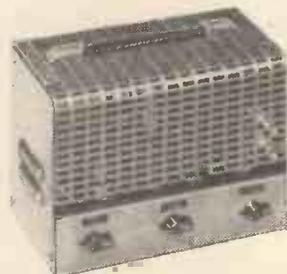
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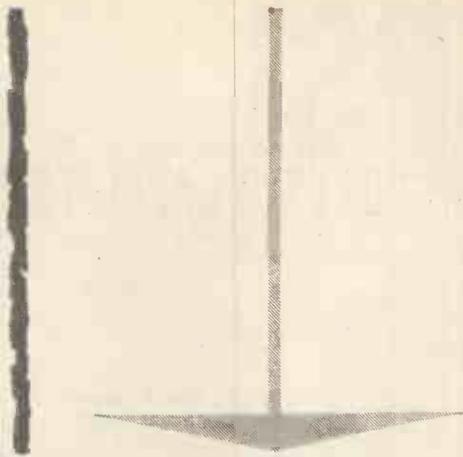
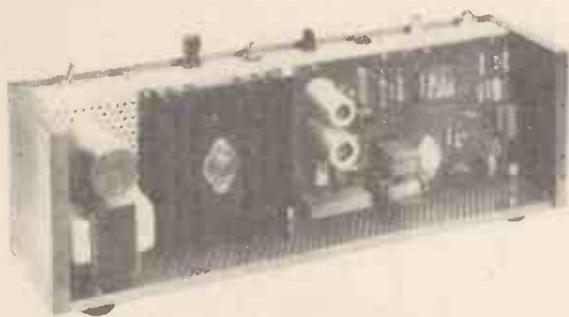
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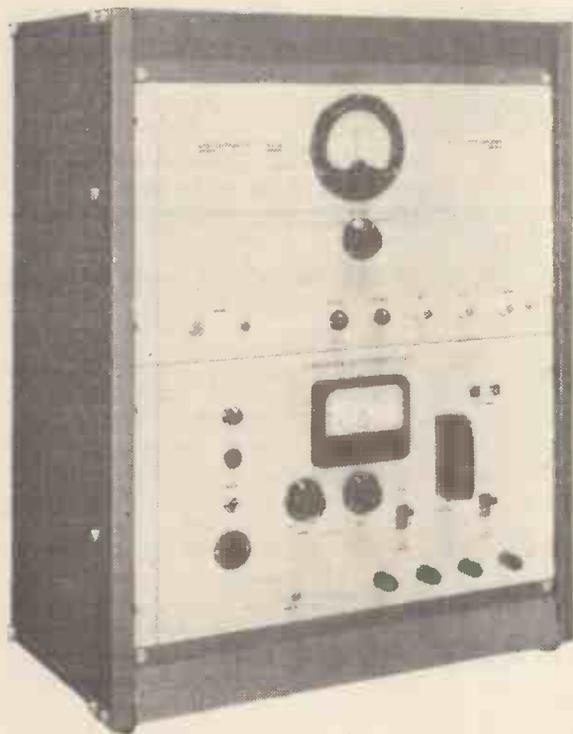


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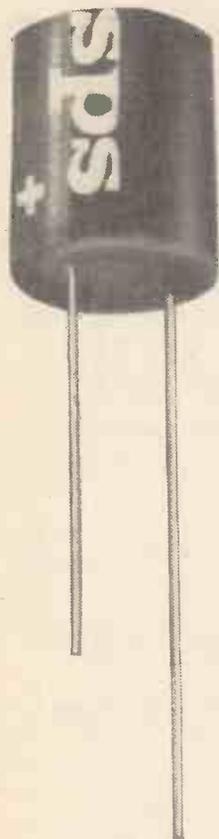
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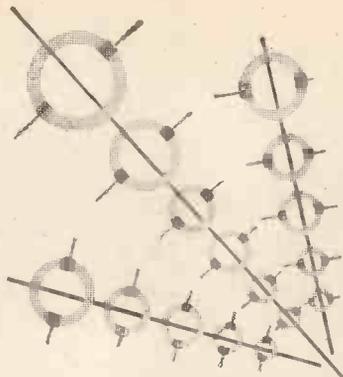
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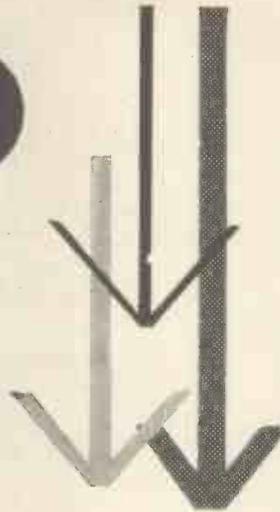
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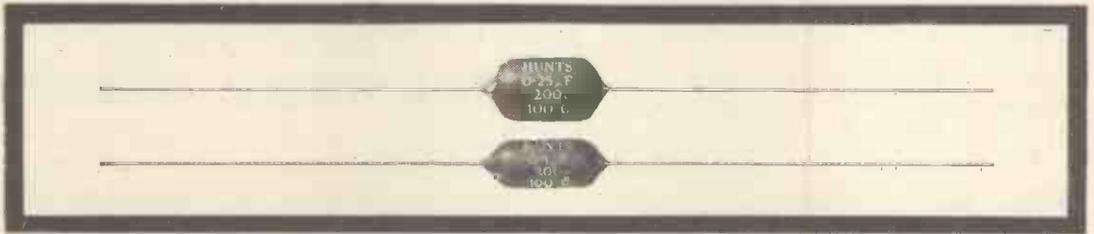
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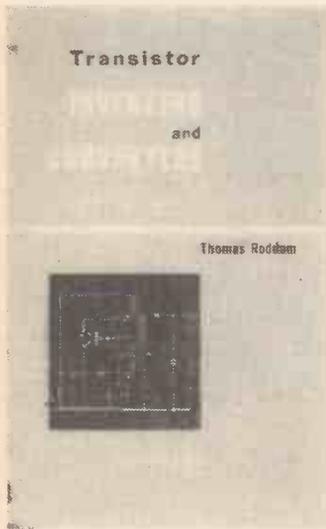
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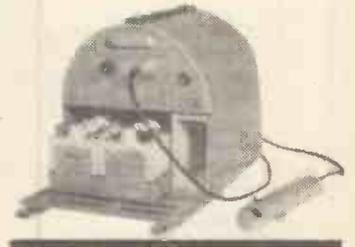
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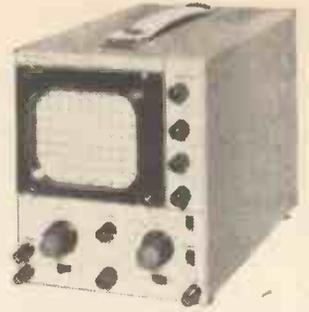
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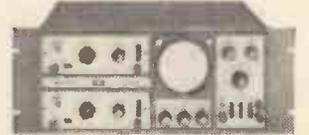
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**PRICE:** £72.

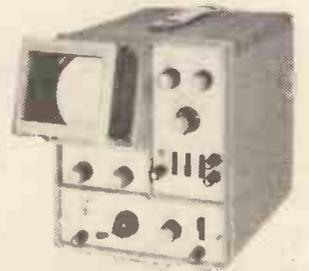
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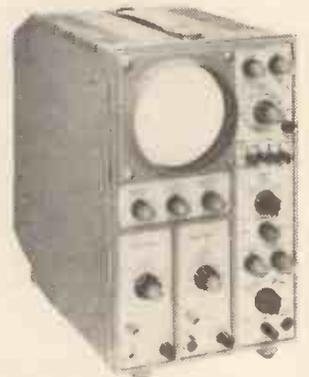
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# Wireless World

ELECTRONICS, RADIO, TELEVISION

NOVEMBER 1963

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*Managing Director:* W. E. Miller, M.A., M.Brit.I.R.E.

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# PY88-BOOSTER DIODE

*For Dual-Standard  
T.V. Receivers*

**LINE OUTPUT  
PENTODE  
PL500  
FOR DUAL-STANDARD  
RECEIVERS**

It is important in dual-standard television receivers to ensure that the performance of the line timebase does not deteriorate when the receiver is switched from one line standard to another.

Most of the functions of the line timebase are critical in application and such changes in performance would therefore be noticed by the viewer. Thus consistency in performance must be achieved despite the fact that the energy requirements for 625-line operation are roughly half as great again as those of 405-line operation.

In many new dual-standard receivers, the task of ensuring comparable performance has been simplified by utilising the new Mullard line output pentode, type PL500. This new valve has improved ratings compared

## WHAT'S NEW IN THE NEW SETS

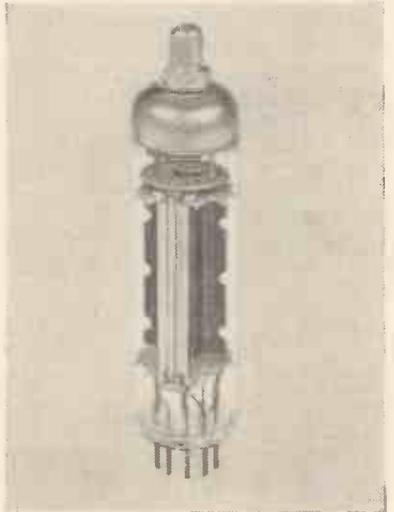
These articles describe the latest Mullard developments for entertainment equipment

with valves previously recommended for 405-line operation. In particular, an exceptionally high ratio of anode current to screen-grid current is achieved by an entirely new form of anode—the 'cavitrapp' anode. With this construction, secondary-emission electrons from the anode—which contribute greatly to the screen-grid current—are recaptured by the partitions of the cavitrapp anode. Because of the improved current ratio, the PL500 is capable of delivering greater deflection power, which helps to prevent any significant change in performance between the two line standards.

**T**HE PY88 is a Mullard television booster diode now to be encountered in the line timebase circuits of switchable receivers, especially in conjunction with the Mullard PL500 line output pentode.

Because of the excellent insulation between the heater and cathode, the PY88 has a high heater-to-cathode voltage rating of 6.6kV. The peak and average anode current ratings of the valve are also high—550 and 220mA respectively—but to achieve these it has been necessary to increase the heater voltage from the 19V required with the PY800 Mullard booster diode to 30V.

With its improved ratings, the PY88 is thus well equipped to meet the more stringent booster diode requirements of 625-line operation, and the valve is particularly suitable for stabilised timebase circuits using the PL500 high-output line pentode.



## COMPLEMENTARY MATCHED PNP AND NPN TRANSISTORS FOR TRANSISTOR PORTABLES

Designed for use in transformerless audio amplifiers, the new Mullard audio frequency package—the LFK3—is now to be encountered in many portable receivers. The output pair of the package consists of the complementary matched p.n.p. and n.p.n. transistors types OC81 and AC127. The p.n.p. driver transistor type OC81D completes the package.

The current amplification factor of the output transistors is greater than 50 at 200mA and 38 at 300mA. The base currents of every pair are matched to within 20% at a collector cur-

rent of 50mA, and each output transistor is cross-matched with the driver transistor to give reduced current gain spreads.

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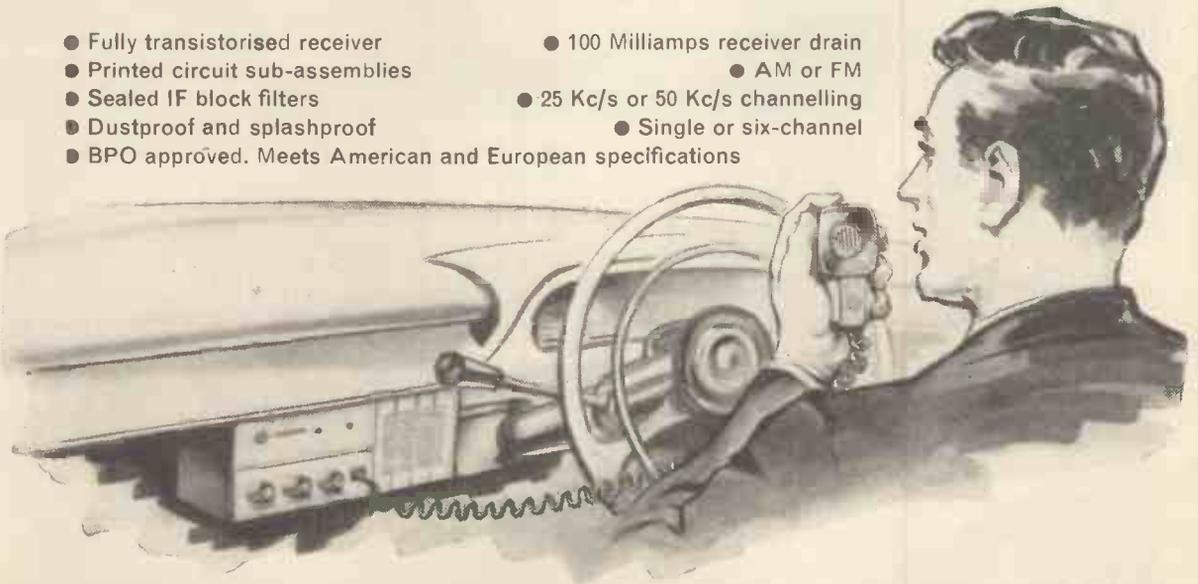


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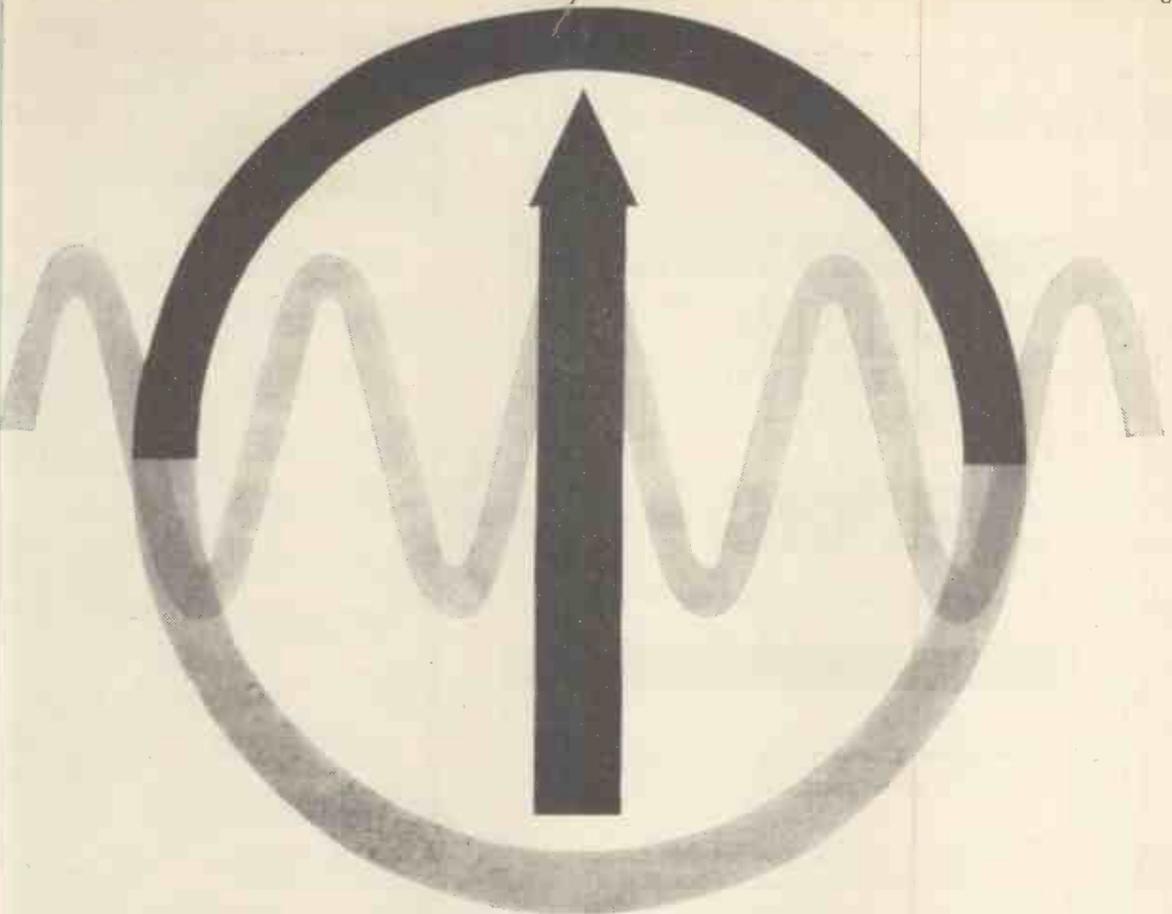
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- 3 Time measurement from 3 $\mu$ s to 28 hours.
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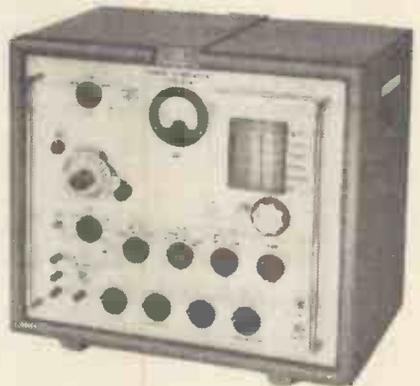
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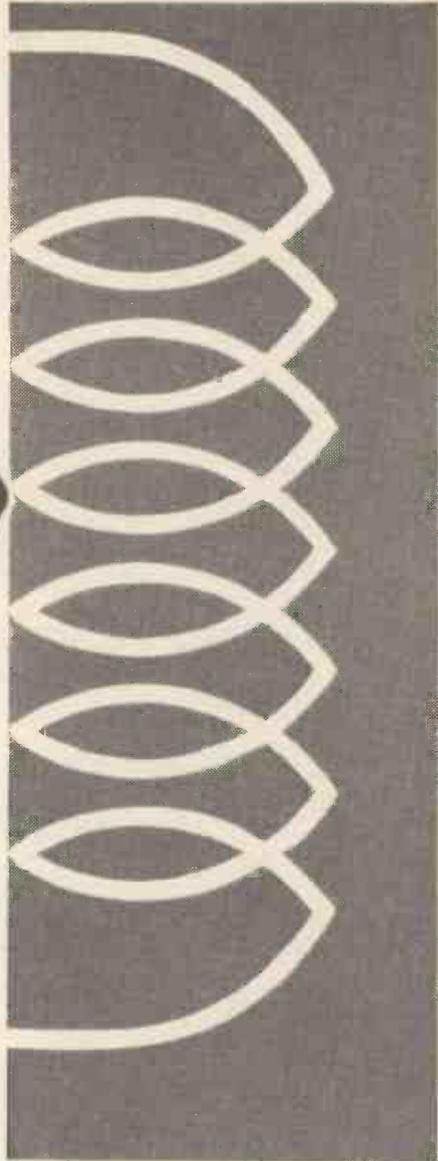


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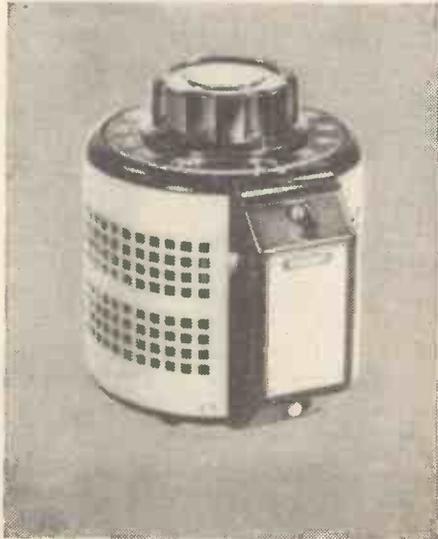
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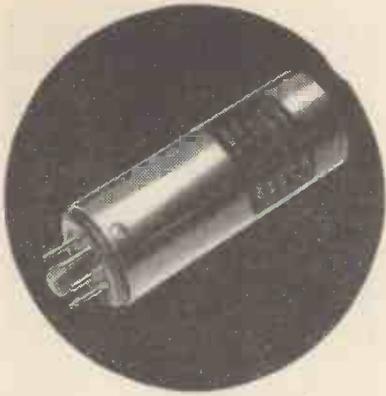


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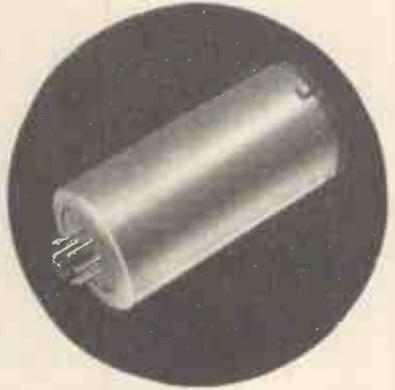
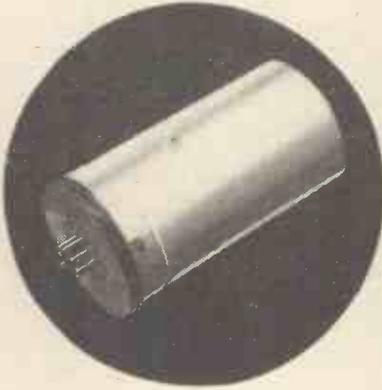
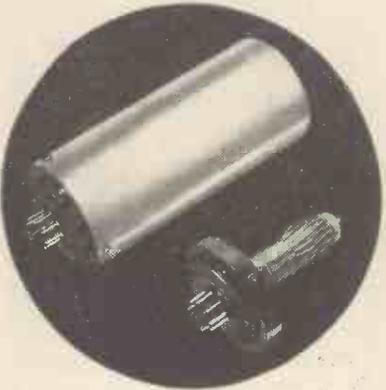
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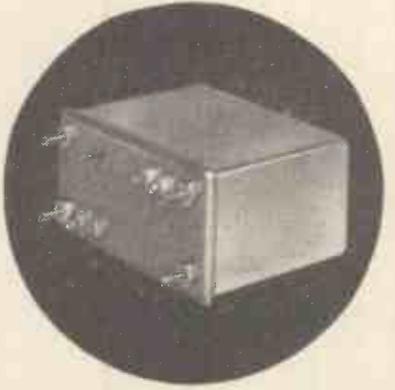
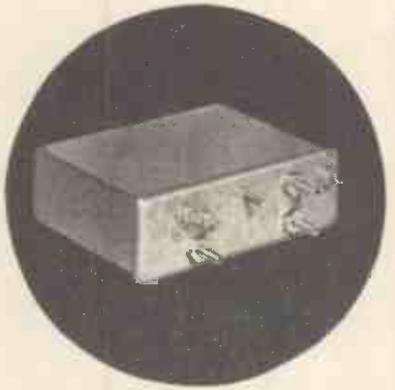
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**BELLING-LEE NOTES**

No. 46 of a series.

**Is an aerial balun really necessary at u.h.f. ?**

A balun is a device for coupling a balanced circuit to an unbalanced one (hence its name), or vice versa. By a "balanced circuit" is meant a circuit which is comprised of two halves of equal impedance, each of which also has a common impedance to earth and to other electrical circuits. A balanced circuit cannot be connected directly to an unbalanced one without becoming unbalanced.

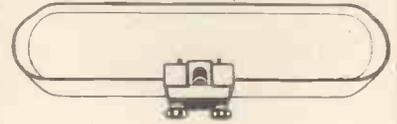
Now a conventional television aerial incorporating a centre fed dipole, and this includes Yagi arrays, is essentially a balanced arrangement. It can, of course, become unbalanced by bad design, or by induction if mounted too close to anything which disturbs the surrounding field asymmetrically; mounting it vertically inevitably disturbs the balance to some extent, however slight. If this occurs, the two halves of the aerial are no longer of equal impedance and the current distribution therefore becomes different in each half, and if a balanced transmission line (the feeder or down-lead) is connected directly to it, the unbalanced component of the aerial current appears in the line, unbalancing it.

considerably more skill and care in its installation if the balance is not to be upset, e.g. by stray capacitances; also, unbalanced receiver inputs are easier and cheaper to produce.

Fortunately, the amount of unbalance of a coaxial cable is small if the diameter of the cable is small compared with the wavelength of the signals to be handled, and this is normal practice in domestic receiving systems. An unbalanced current does flow in the outer conductor (screen), and this in turn means that the current distribution in the two halves of the aerial dipole is unbalanced, which affects the nulls and overall pattern of the aerial's polar diagram; in the case of a transmitting aerial, it also means a waste of power. The effect will be a minimum if the feeder cable is correctly matched to the aerial, i.e. if the characteristic impedance of the cable is of the same value as the centre impedance of the aerial.

The accompanying polar diagrams, recording the performance on channel 33 (567 Mc/s) of a typical 10-element (reflector, dipole, and 8 directors) u.h.f. aerial connected to a coaxial cable with and without a balun, show how slight the effect of a normal coaxial (unbalanced) line is when the aerial and cable are correctly matched for impedance. The small amount of spooliation has no practical significance under normal domestic reception conditions where local noise is predominantly thermal, and the

as a balun. The alternative is to alter the centre impedance of the folded dipole, which can be done by varying the cross-section of its limbs along their length, and if this is done correctly, a good impedance match to the cable can be achieved without a transformer. A balun then becomes unnecessary for a domestic aerial.

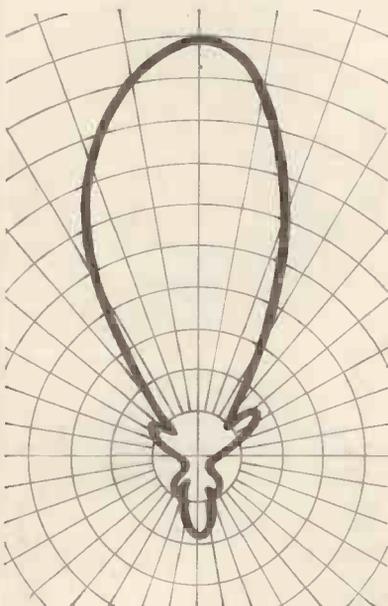


**COMPLETE RANGE OF U.H.F. AERIALS**

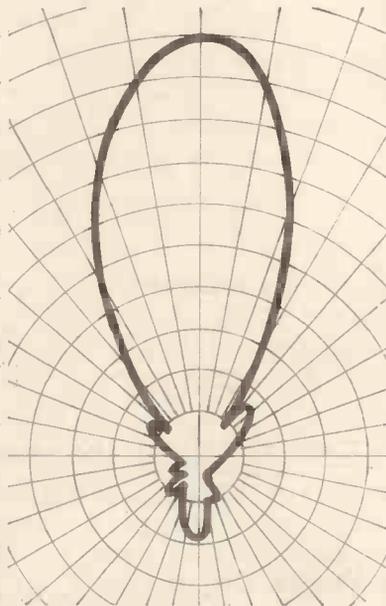
Belling-Lee make a range of u.h.f. aerials from a simple 3-element (reflector, dipole and one director) to an 18-element (16 directors) and a double 10-element broadside array. These aerials provide uniform gain over the four local channels; the graduated dipole is correctly matched to the cable, requiring no balun. They are extremely easy to install. For example, note the removable cable termination, which allows the feeder to be made up on the ground.

**VOLTAGE POLAR DIAGRAMS**

8 Director array — 567 Mc/s



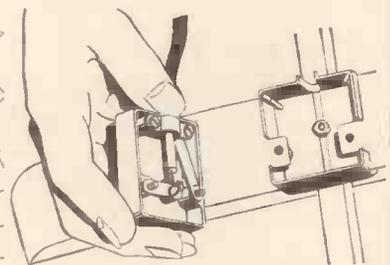
with balun



without balun

In practice, in order to achieve optimum reception, it is usual to mount television aerials clear of disturbing influences and so, for all practical purposes, balance is maintained. However, in this country, a coaxial feeder is usually employed for conducting the signal energy to the receiver, and this is not a balanced transmission line. The reasons for this practice are that a balanced line needs

back-to-front ratio and directivity are imperceptibly affected as far as the ordinary viewer is concerned. Of course, if there is an appreciable impedance mismatch (say, greater than 2:1) anywhere in the response band of the aerial, the effect will be magnified and it may then be necessary to fit an impedance matching transformer; in this event the transformer can be designed to function also



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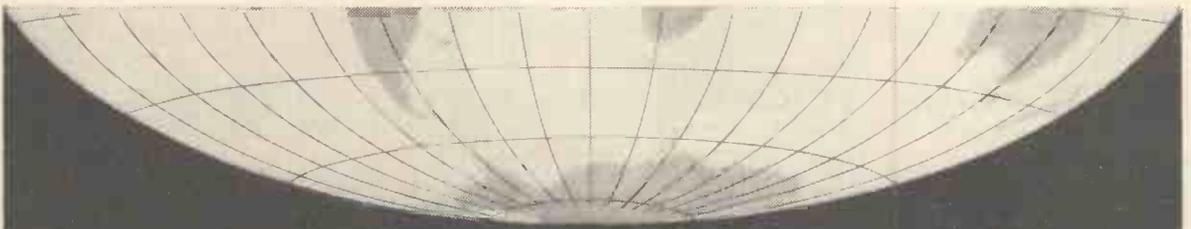
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Grid Resistor	$R_{g1}$		27	53	k $\Omega$
Peak R.F. Grid Voltage	$v_{g1}(pk)$		47	60	V
Peak A.F. Grid Voltage	$v_{g1}(pk) - v_{g1}(pk)$	40			V
D.C. Anode Current	$I_a$	40	60	50	mA
D.C. Screen Grid Current	$I_{g2}$	2.0	3.7	2.6	mA
D.C. Control Grid Current (Approx.)	$I_{g1}$		1.5	1.0	mA
Effective Load Resistance (Anode to Anode)	$R_{a-a}$	5.0			k $\Omega$
Driving Power (Approx.)	$P_{dr}$		1.0	0.4	W
Useful Power Output	$P_{out}$	20.5	6.5	3.0	W
Total Harmonic Distortion	$D_{tot}$	5.0			%

Please ask for Data sheets

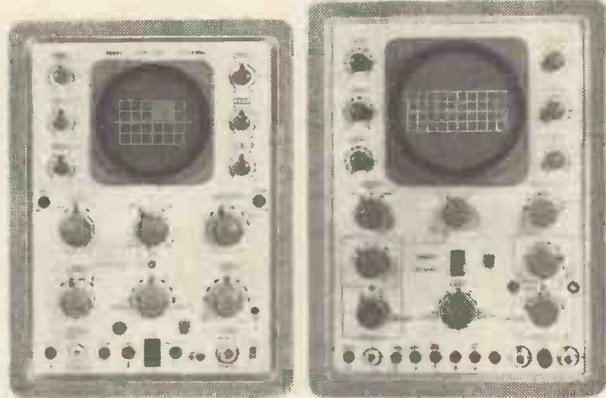
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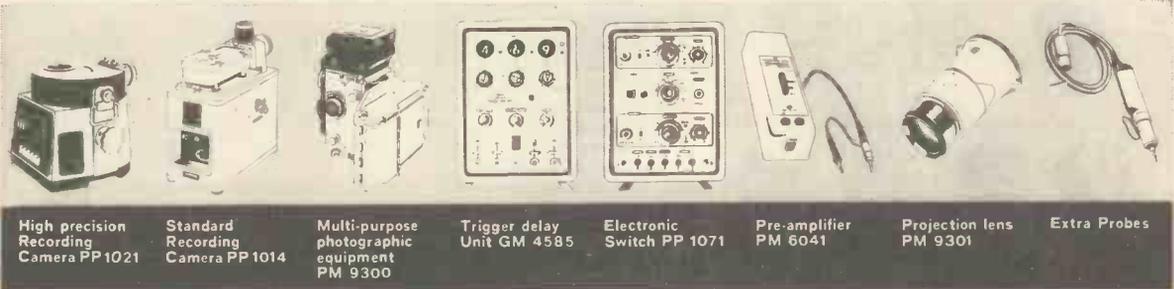
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Signal delay	300 ns	300 ns
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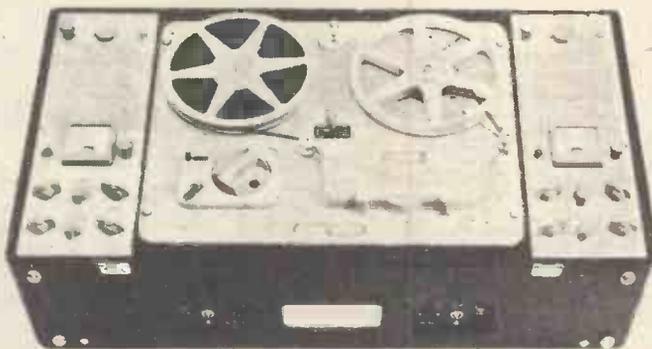
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**Low noise**  
**Low characteristic spread**

Mazda Frame-Grid Valves offer all the advantages associated with this outstanding manufacturing technique, plus some noticeable extras. Most incorporate a new Mazda cathode coating process which ensures smooth surface textures and gives a final dimensional accuracy of  $\pm 4/10$ ths of a thou. Some have tightly controlled variable - mu characteristics to give superior cross modulation performance. These high-performance valves are available for various uses, as detailed below, and are of sound mechanical design. *Please ask for appropriate data sheets.*

					
<b>30L17/PCC806</b>	<b>30C17/PCF87</b>	<b>6F29/EF183</b>	<b>6F30/EF184</b>	<b>6F28/EE80</b>	<b>30FL12/PCE82</b>
<b>Tuner Valves</b>	Low noise · High gain Low cross modulation	<b>I.F. Valves</b>	High gain Low cross modulation	<b>Video Output Valves</b>	High peak current available High sensitivity Low distortion



## Thorn-AEI Radio Valves & Tubes Ltd.

HEAD OFFICE:

155 CHARING CROSS ROAD

LONDON, W.C.2

Telephone: GERrard 9797

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2W W-119 FOR FURTHER DETAILS.

**World-wide**

**demand**

**for LEAK**

**HI-FI**

**lowest prices**  
**highest quality**



Left: The beautifully restyled Southdown Cabinet which incorporates many improvements. Price £28 7s. 0d. The Cabinet is shown with Point-One Stereo Pre-Amplifier (£21 0s. 0d.), Stereo 20 Power Amplifier (£30 9s. 0d.) and Trough-Line II F.M. Tuner (£29 7s. 6d.).

**FIRST-CLASS PERFORMANCE**

Each Leak instrument is individually built in the time-honoured British tradition and has the same high-quality performance as Leak equipment supplied to the B.B.C. and Broadcasting and Television Companies and Disk Recording Studios throughout the World, who use them for monitoring (quality checking).

**FIRST-CLASS APPEARANCE**

Leak equipment has been styled by industrial designers to enhance its appearance in the home. The styling of the new Leak "Sandwich" Loudspeaker has been approved by Britain's Council of Industrial Design and has recently gained the coveted Fashion Foundation of America Gold Medal.

**REASONABLE PRICE**

The World-wide demand keeps the Leak Organisation fully and efficiently employed, and, in turn, explains the very reasonable price of Leak studio-quality Hi-Fi equipment.



Right: The new Leak "Sandwich" loudspeaker System with the new "Sandwich" Cone gives, for the first time in history, a direct-radiator loudspeaker diaphragm which behaves in the theoretically ideal manner of a rigid piston and reproduces the signal applied to the speech coil without flexing and free of break-up distortions. £39 18 0

Please send me full details of LEAK EQUIPMENT

- MONO
- STEREO
- SANDWICH

(please tick your requirements)

Name.....

Address.....

.....

.....

WW10/63

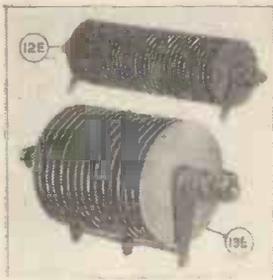
**H. J. LEAK & COMPANY LIMITED**

**BRUNEL ROAD, WESTWAY FACTORY ESTATE, LONDON W.3**

Telephone: SHEpherds Bush 1173

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**Rectifier Bargains**



Selenium-rectifier type 12, 500 v. 1 amp half-wave, easily rebuilt into full wave or multiple type, contains 30 35 mm. discs. Price 8/6 plus 1/6 post. Type 13, 36 volt 9 amp. easily rebuilt into six full wave charger rectifiers suitable for 6 or 12 volt batteries at 3 amps., contains 24 84 mm. discs. Real bargains at 19/6 plus 1/6 post. Type 14—240 v. 4 amp. 7/6.

Make up one of these latest type heaters, ideal for bath-room, kitchen, bedroom, etc. They are simple to make from our easy to follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for watt element and metal casing as illustrated 19/6 plus 2/6 post and insurance.



**Infra-Red Heater**

**Waterproof heater wire.** 16 yd. length. 70 watts. Self regulating temperature control, 10/-, post free.

**Morganite Potentiometers**

Single and 2-gang types available, standard size with good length spindle, all new and boxed. Single types, 1/- each, values available: 5K, 10K, 25K, 50K, 100K, 250K. 1 meg., 2 meg. Gang type 3/- each—values available 5K ± 5K, 100K ± 100K, 1 meg. ± 1 meg., 2 meg. ± 2 meg.



**T.V. CAMERA LENS**

16 mm. lens in mount 1/3.5 and triple anastigmat suitable for vidicon tube £3/10/-. Post & ins. 2/6.

**MAGNETRONS**  
American made 725 A 15/- each. British made CV93 12/6.

**KLYSTRONS**  
Type number CV224 17/6, type CV 12/6

**HEAVY DUTY THYRATRONS**  
CV13—5 v. 20 amp. heater 16 Kv. peak anode volts, 120 amp. peak anode current 25/- each.

CV1141, 4 v. 1.75 amp. heater, 350 v. 200 mA., 10/- each.

**TRANSMITTING VALVES (U.S.A.)**  
813 50/-; 860 10/-; 861 25/-

**HIGH VOLTAGE RECTIFIERS**

CV19 63kV peak 800mA	£4 17 6
CV1504 60 kV peak 1200mA	£5 17 6
CV74 40 kV peak 600mA	£2 17 6
CV1508 8 kV peak 1000mA	£1 17 6
CV1111 14 kV peak 350mA	7 8
CV1253 14kV 800mA	£1 8 0
CV1261 14kV 600mA	£1 2 0

**Xaxley Switches**

1 pole, 2 way 2/-	1 pole, 5 way 2/6
1 pole, 4 way 2/3	1 pole, 9 way 3/-
1 pole, 7 way 3/-	1 pole, 12 way 3/3
1 pole, 11 way 3/3	2 pole, 4 way 2/6
2 pole, 2 way 2/3	2 pole, 6 way 3/6
2 pole, 5 way 4/-	3 pole, 3 way 2/-
2 pole, 12 way 5/6	3 pole, 12 way 8/6
3 pole, 6 way 4/-	4 pole, 3 way 3/6
4 pole, 2 way 6/6	4 pole, 5 way 6/6
4 pole, 6 way 6/6	4 pole, 11 way 10/6
4 pole, 12 way 11/6	5 pole, 3 way 4/6
5 pole, 6 way 8/-	5 pole, 12 way 14/6
6 pole, 2 way 3/6	6 pole, 3 way 4/6
6 pole, 6 way 6/6	6 pole, 11 way 16/6
6 pole, 12 way 17/6	8 pole, 2 way 4/6
6 pole, 4 way 6/6	8 pole, 6 way 11/6
8 pole, 12 way 23/6	12 pole, 2 way 6/6
12 pole, 5 way 16/6	12 way fader 3/6

1 pole, 6 way incremental shorting 3/6.

**CABINET & PICK-UP**

Made for a famous company intending to make a Battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a CosmoCORD pick-up with crystal cartridge and sapphire stylus. Both items new and perfect.



**ONLY 19/6** Plus 4/6 post and insurance

**DO YOU EVER FORGET?**



This pocket Secretary could eliminate the trouble (often embarrassment) your forgetfulness causes you—she will stay in your jacket pocket and as fast as you can think she will capture and store—ideas—notes—formulae—appointments—anything you can say or sing, then at your command she will play them back to you.

Undoubtedly one of the smallest precision tape recorders made. Entirely controlled by push buttons, you can record and play back with the instrument in your pocket. It is a full function machine using standard 1/4" tape and easy to replace batteries. Speaking and playing back is from the same (crystal) microphone.

Specification: Dimensions: 6 1/2 x 2 1/2 x 1 1/2 in., weight: 14 oz.; recording time: 12 mins.; rewinding time: 4 mins.; recording system: D.C. Bias; erasing system: Magnetic erasing, wow and flutter: within 2% and frequency response: 500-1,200 c/s (within -6dB).

**PRICE £9.19.6** Complete ready to work.

**THIS MONTH'S SNIP**



**E.M.I. SINGLE PLAYER**

Complete with turnover crystal pick-up with Sapphire stylus—standard 4 speeds. Good quality product using shaded pole motor carefully tried for best performance, fitted 8 1/2 in. turntable and rubber mat—

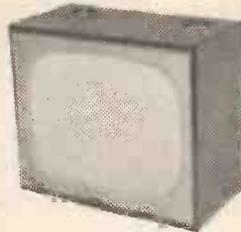
**Offered this month only at 59/6**  
Post and Insurance 6/6.

**TV CABINETS for callers only**

**FOR 17in. MODEL**

Really well-made and finished with polyester lacquer. Originally intended for Philco sets.

Price 5/-



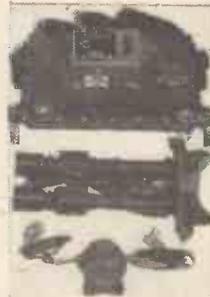
**SHELLS** available for 21in. models, beautifully polished and finished, but would need a moulded front and back to complete.

Price 7/6 for callers only

**TABBY EQUIPMENT**

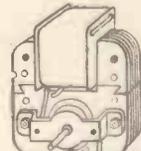
With details to make Closed Circuit TV Lens System

"See in the dark" equipment comprising 5,000 volt power pack which contains ignition coil, vibrator, etc. Control unit interconnecting cables and infra-red blueculars. Offered for one month only at the give-away price of £3/19/6, plus 10/- carriage. These are unused, just as received from the Ministry, believed in good working order but sold without guarantee.



**MOTOR BARGAIN**

Silent running mains motor by very famous maker. Ideal for gramophone, tape recorder, fan, etc., etc. 200-250 volts. A.C. shaded pull start. Size: approximately 2 1/2 x 2 1/2 x 1 1/2 in. 2,750 r.p.m. Spindle diameter 5/32 in. Spindle length 1 in. Brand new guarantee. Price 12/6, plus 1/- post.



**Speaker Bargain**

12in. High-fidelity loudspeaker. High flux-permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts Bral new, by famous maker. Price 27/6 plus 3/6 post and insurance.

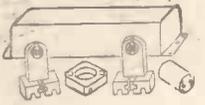


**Hi-Fi Speakers**

E.M.I. Ceramic magnet 12,000 lines, size 1 1/2 x 3 in. (roughly equivalent to 12in. round speaker). Bass frequency 40-80 c/s. Baffles up to 10 watts. Price 33/6, plus 5/- carriage and ins. State whether 13 ohm or 3 ohm.

**Fluorescent Light Bargain**

Kit of parts comprising choke, two lamp holders, starter and holder, 40 watt. 19/6 80 watt. 27/6. Plus 2/6 post and insurance.

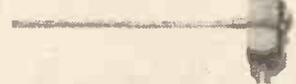


**Building a Scope?**



3in. oscilloscope tube. American made type No. 31E7, base 6.3 v. 6 amp. heater electrostatic deflection, brand new and guaranteed, with circuit diagram of scope, 15/- each plus 2/6 post and insurance.

**Adjustable Thermostat**



Suitable for industrial or domestic purposes such as controlling furnace oven, immersion heater etc. Can also be used as a flamestat or fire alarm. Made by 8mmv these are approximately 17in. long and adjustable over a range 0 to 550° F. The contacts are rated at 15 amps., 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at £3 or £4 each, these are offered at only 8/6 plus 2/6 postage and insurance.

**Ice-Stat**

This is a small thermostat which cuts on and off at around freezing point. Has many uses, one of which could be an ice warning device to be fitted under your motor car. Price 7/6. Post 1/-.

**Simmerstat Heater Regulator**

Suitable to control elements, heaters, soldering irons and boiling rings up to 2,500 watts. Complete adjustable, normal price 53/- each, special snip price 12/6, plus 1/6 postage and insurance.

**15 amp. Thermostat**

Adjustable over a fairly wide range of temperatures but set for 70° F. suitable for wall mounting to control room heaters. Exceptional bargain at 9/6, plus 1/- post and insurance.

**Refrigerator Thermostat**

Standard type with adjustment for all normal refrigerator temperatures, 7/6, 1/- post.

**Suppressor Condenser**

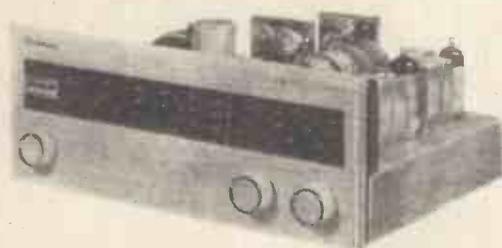
Stop your drill or other appliances interfering with your own or your neighbours' radio or television. Simple instructions given. 1/6 each. 12/- dozen.



**ELECTRONICS (CROYDON) LIMITED**

266 LONDON ROAD, BROAD GREEN, CROYDON  
OPPOSITE SAVOY CINEMA

A new range of amplifiers and tuners from *Armstrong*

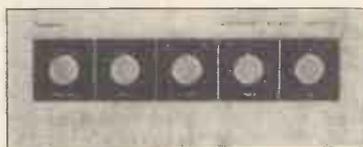


**224 FM TUNER**  
**223 AM-FM TUNER** (illustrated)

Self powered with full provision, including space on the chassis, for simply plugging in an Armstrong Stereo Multiplex Decoder when regular stereo transmissions begin. Featuring precision tuning meter, dual audio outputs with pre set gain control on each, and exceptional sensitivity. The styling of the 224 is similar to the 223 as illustrated. The 223 AM-FM Tuner is identical in performance to the 224 but with the addition of the medium waveband.

Price: 224—~~£22.10.0~~  
 Price: 223—~~£28.15.0~~

Continuing in the tradition of high quality with economy, Armstrong introduce a **NEW Integrated Stereo Amplifier** designed for the Decca Deram and other high quality ceramic pick-ups.



**222 INTEGRATED STEREO AMPLIFIER**

Providing 20 watts power output and facilities for radio tuners, tape recording and playback and for any ceramic or crystal pick-up. Suitable for use as the basis of an extremely good yet relatively inexpensive high fidelity system.

Price: ~~£27.10.0~~

**222 SPECIFICATION**

Power Output—10 watts per channel.  
 Frequency Response—30—20,000 c.p.s.  $\pm 1$  db.  
 Distortion—less than 0.5% at 8 watts.  
 Loudspeaker Output Impedance—4, 8 and 16 ohms  
 Sensitivity—80 mV.  
 Rumble Filter— -6 db at 35 c.p.s.  
 Controls—Selector, Volume, Balance, Treble, Bass.

**224 SPECIFICATION**

Coverage—87—108 M/cs.  
 Sensitivity—1.5  $\mu$ V for 20 db quieting.  
 Output—0.2 volts variable to match any amplifier or tape recorder  
 Stages—R.F. Stage, Two IF Amplifiers, Limiter Stage and Foster Seeley Discriminator.

**223 SPECIFICATION**

FM Band—as the 224 above.  
 AM Band Coverage—180—600 metres.  
 Sensitivity—5 $\mu$ V for 20 db quieting.  
 Automatic Variable selectivity—2 to 8 K/cs depending on signal strength.  
 Filter—Built in Hetrodyne rejection filter.

Optional cases of teak and vinyl-hide as the 225 illustrated below are available for all models.

220 STEREO POWER AMPLIFIER Price ~~£24.18.0~~

225 STEREO PRE-AMPLIFIER Price ~~£22.12.0~~



Full descriptive literature available from Dept. No. WAN.

Re-styled versions of the A20 amplifier and PCU 25 Pre-amplifier to match the new Armstrong Tuners. The specifications remain the same.



**ARMSTRONG AUDIO LTD.** Warlters Road, London, N.7. Telephone: **NORth 3213**

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**AERIAL MAST** 25ft., self supporting, large ceramic base, galvanised steel 4 sections 2 1/2 in. taped to 1 1/2 in. complete. £10, carr. 30/-  
**Portable Dipole** B44 50 mc/s. to 100 mc/s. 27/6 each, P. 5/-.

**VALVE VOLTMETER TF428.** 10 to 150 v. in five ranges at 2% F.S.D. with probe £15/10/0 each, post 12/6. CT 54 Valve V. 2.4 to 480 volts with multiplier 2400 v., resistance 0.1 to 10K, five ranges £30.

**DE-ICER, Controller Mk. 3.** Contains 10 relays D.P. change-over heavy duty contacts, 1 relay 4P. C/O. (235 ohms coil). Stud switch 30 way relay operated, one five way ditto, D.C. timing motor with Chronometric governor 20-30 volts 12 RPM., geared to two 30 way stud switches and two Ledex solenoids, 1 relay relay, etc., sealed in steel case, size 4 x 5 x 7 in. £3 each, 5/- post.

**BC640 MODULATOR UNITY.** 2 x 811's, mod. transformer and fil., trans. complete mod. unit fits 19 in. rack 50 watts. £5/10/0, carr. £1.

**SIGNAL GENERATORS.** TS-13AP freq. 9305-9445 mc/s. £25 each, carr. £1. 10 cm, BC1277 £20, carr. 25/- RCA 710A 370-560 mc/s. £30, carr. £1. TF 144G 85 Kc/s. to 25 mc/s £25, carr. 25/- Test set UPM 1 A & B comprising of Signal Gen., Wavemeter, Oscilloscope and Video amp., in one unit freq. 155/235 mc/s. and 460-570 mc/s., 115 and 230 V. A.C., new £35 each, carr. £2. Dynamotor test set TS 414A £30, carr. 30/-.

**RE-ENTRANT** speakers 15 ohm 20 watts, good condition. £4/12/6, carr. 15/-.

**TRANSFORMERS** (Isolation). 230 to 115 volts 300 va., £3 each, 5/- post. 230-115 volt auto 750 watts £4, carr. 10/- 110-230 275-0-275 at 125 ma, 6.3 at 4 amps 22/6 each, post 5/- 230v., 6.3v. x 3 at 3 amps 21/- each, post 4/- 230v., pri 1850-0-1850 at 500 ma., £5 each, carr. 15/6 230 v., pri., 6.3 x 3 at 3 amps 20/- each. post 4/-.

**RELAY BOXES** with 10 x 600 type relays £2 each, post 5/-.

**POWER & SMOOTHING UNITS.** 100-250v., A.C., input 24v., D.C., at 3 amps or 12v. twice at 3 amps, continuous rating, switched fused, etc. In metal case 19 x 7 x 7 in. Smoothing two large chokes and 0.1 ma meter scaled 0-50 volts. £7/10/0 (pr.), 15/- carr.

**GEARED MOTOR.** 24v. D.C., 1.4 r.p.m., reversible with two micro switches inside gear box, silent operation. £2 each, post 5/-.

**POWER SUPPLY** unit for SENDER No. 36 110-240 A.C. input contains Speech amplifier. Modulator and External power supplies, 3xFW4/500 rectifiers provide H.T. for R.F. unit Speech amplifier 6C5G, Modulator 2x 6C5G and 2 x 807 output. Size 24 x 16 x 14 inches. Housed in a fine oak case with circuit. Wt. 110lbs. As new £6/12/6, carr. 30/-.

**CONVERTERS.** Type 8 a., 24 v. D.C., 115 v. A.C. at 1.8 amps., 400 cycles. 3-phase. £5 each, carr. 7/6.

**CONDENSERS.** 1 mfd., 20kv., £6/12/6 each, post 12/6 each. 0.25 mfd., 32,500 volts Wkg. £5 each, post 12/6 each. 150 mfd., 290 volts A.C. £5 each, post 12/6. 50 mfd. 330 volts A.C., 40/-, post 4/- 10 mfd. 2 Kv 27/6, post 5/- 10 mfd., 1,000 v. 12/6, post 2/6. 8 mfd., 1,500 volts 17/6, post 2/- 8 mfd., 1,200 volts 12/6, post 3/- 8 mfd. 600 volts 8/6, post 2/6. 0.1 mfd. 3 kv. 4/-, post 1/6. 0.25 mfd. 2 kv. 4/-, post 1/6. Vacuum condenser 50 pf 32 Kv 30/-, post 1/6. 6pf. 20 kv. 22/6, post 1/6. All the above are new in cartons.

**RECEIVER C52** less outer case good condition Freq. 1.75-16 mc/s. on three bands complete with all valves. £6/19/6, post 12/6.

**AR88 PORTABLE KITS.** Fine well made box for the receiver and spares with original speaker. Vibrator unit 6 volt D.C., 14 valves lamps headset shockmounts cables, brand new, £7/12/6, carr. 25/-.

**POWER SUPPLY UNIT PN-12.B.** Ex BC 640. 230 volts A.C. input, fits 19 in. rack, 800 volts D.C. @ 350 ma., 395 volts 300 ma., 4 x 5U4G valves, 2 chokes 9 H., 300 ma., 2 x 10 mfd. oil filled caps, £6/10/0 each, carr. £1.

**VARIABLE POWER UNIT (VARIAC)** 0-230 volts 9 amps with meter 0-250v. with on/off switch, mounted in 19 in. rack, £15/10/0, carr. 12/6.

**LEAD ACID BATTERIES,** 6 v., 40 amps. in metal case. New 25/-, each post 6/- 6v. 75 amps. heavy duty £3, post 12/6.

**USA SOLENOIDS.** 24/28 volts D.C., 200 amps SPST., £2/10/0 each, post 4/-.

**CIRCUIT BREAKERS,** 3 pole 150 amps. 600 v. A.C., £3 each. Made by GEC, U.S.A., post 6/-.

**METERS** 0-390 v. A.C./D.C. 17/6, post 2/6.

**DESK TELEPHONES** 39/6 each, post 4/-.

List available 6d. S.A.E. for all enquiries.

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# WEST END RADIO LTD.

(EST. 1929)

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ALL GOODS POST FREE

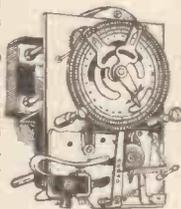


▲ SWITCH PANELS

Ex-R.A.F. containing 16 single pole toggle switches and other useful parts. 12/6 ea.

**TIME SWITCHES**  
**MURHEAD.**

Full mains operated. For 10 amps and adjustable 1 on 1 off in 24 hours. Reconditioned. 47/6 ea.



**ROLA-CELESTION 12in. SPEAKERS.**

3 or 15 ohms, 10,000 Gauss, 85/-.

**PAMPHONIC GRAM. MOTORS**  
 Battery driven with crystal pick-up for 45 r.p.m. in portable case, 55/-.

**CELESTION SPEAKERS.**

8in. x 2 1/2 in. 3 ohms, 12/6.

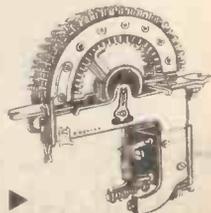
**WATER PUMPS**

Impeller Type. Aluminium body and Rotor. 1/2 in. spindle, 8/6. 4in. pulley wheel, 2/6.

**UNISELECTORS**  
 G.E.C. DELIVERY FROM STOCK. 3, 4, and 5 Bank. 25 way, full wipe. New in maker's cartons. 100 ohm coil, 50/-, 60/-, 70/-. Special prices over 1 dozen.

For Callers only:—  
**V.H.F. RECEIVERS**  
 Fixed frequency 80 m/c. with S. Meter and Speaker G.E.C. £7/10/-.

**MAIHS TRANSMITTER.**  
 For above £12/10/-.



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# Important announcement!

**STERN RADIO LTD., CLYNE RADIO LTD., PREMIER RADIO**  
Three well known names with a reputation for quality and service announce their amalgamation into

# STERN-CLYNE

LIMITED



Combined resources, technical knowledge and over 50 years' experience gives you an organisation offering a fully comprehensive specialist service in the rapidly expanding world of electronics.



## HOW THIS WONDERFUL NEWS BENEFITS YOU

- STERN-CLYNE means a wider range of exclusive equipment available from one source, including our speciality—MULLARD DESIGNS—for the home constructor or ready assembled.
- STERN-CLYNE buying power means competitive prices.
- STERN-CLYNE offers the finest possible range of equipment and components by all leading manufacturers.
- STERN-CLYNE carry a comprehensive range of transistors, miniature components and transistor radios.
- STERN-CLYNE retail shops, showrooms and demonstration rooms throughout London and the provinces all carrying extensive stocks.
- STERN-CLYNE Mail Order Service—geared to give prompt and efficient attention.
- STERN-CLYNE Hire Purchase facilities available on orders of £10 and over.
- STERN-CLYNE Hi-Fi advisory service to help you in choosing the right equipment.
- STERN-CLYNE after-sales service—complete satisfaction guaranteed.

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WEST END:	18, Tottenham Ct. Rd., W.1.	MUSEum 5929/0095.	Half-day Saturday.
	23, Tottenham Ct. Rd., W.1.	MUSEum 3451/2.	Half-day Thursday.
	309, Edgware Road, W.2.	PADdington 6963.	Half-day Thursday.
CITY:	109, Fleet Street, E.C.4.	FLEet St. 5812/3.	Half-day Saturday.
	162, Holloway Road, N.7.	NORth 8161/5.	Half-day Thursday.
SOUTH LONDON:	9, Camberwell Church St., S.E.5.	RODney 2875.	Half-day Thursday.
CROYDON:	12, Suffolk House, George St.	MUNicipal 3250.	Half-day Wednesday.
BRISTOL:	26, Merchant Street, Bristol, 1.	Bristol 20261.	Half-day Wednesday.
MANCHESTER:	10, Withy Grove, Manchester 4.	BLAck Friars 5379.	Half-day Wednesday.

Mail Orders and enquiries to

Dept. W.W., 162, Holloway Road, London, N.7. NORth 8161/5

**SEE FOLLOWING 4 PAGES FOR DETAILS OF STERN-CLYNE PRODUCTS**

*We are exhibiting at the Radio Communications Exhibition, Stand No. 12*

## Great Britain's Greatest Electronic Hobbies Organisation

# STERN-CLYNE

## MODEL CR3/S TAPE RECORDER

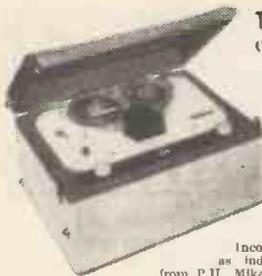


MODEL CR3/S incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1 1/2 in., 3 1/2 in., and 7 1/2 in. speeds. Complete with microphone and 1,200 ft. tape.

KIT OF PARTS **£33.80**  
ASSEMBLED & TESTED **£43.00**

(Carr. & ins. 15/- extra)  
Instruction book and detailed price list available separately at 3/- post free.

## "Model HF/G2R" PORTABLE TAPE RECORDER For Only 22 GNS



(Carriage and Ins. 10/- extra)

INCORPORATES THE LATEST GARRARD "MAGAZINE" TAPE DECK and MATCHING AMPLIFIER. Based on the successful MULLARD TYPE "A" DESIGN and specifically developed to operate the GARRARD DECK. PRICE INCLUDES THE GARRARD TAPE MAGAZINE and 3 in. SPOOL OF DOUBLE PLAY TAPE. A Twin Track Recorder operating at 3 1/2 in./sec. providing up to 1 hour 10 mins. playing time. The outstanding features being excellent performance and simplicity of operation. Incorporates EXT. SPEAKER SOCKET, also operates as independent amplifier for direct reproduction from P.H. Mike or Radio tuner. Weighs only 22lb. ALSO AVAILABLE LESS CABINET AT 19 GNS. Carriage & Insurance 25/- extra. A complete tape recorder chassis ready for easy fitting into cabinet.

Microphone 25/- extra. Instruction book and detailed price list available separately at 2/6 post free.

## A Selection of HIGH-FIDELITY PORTABLE TAPE PRE-AMPLIFIERS

ready to use incorporating our Type "C" TAPE

PRE-AMPLIFIER and choice of Tape Deck in attractive portable carrying case. The control panel is fitted at front of case. T.11 and T.12 both have flat tops and T.1 has slope front as illustrated.

- (T.11) COLLARO STUDIO 3 speed deck **£40.00**
- (T.1) BRENELL Mk. V Series 2, 3 speed deck **£63.00**
- (T.12) WEARITE Model 5A deck **£75.00**

Carriage and Insurance 15/- extra.



## COMBINATION TAPE UNITS

	Kit	Assembled	Assembled with track switch fitted
STP-1 Pre-amp with Collaro Studio Tape Deck	£36 0 0	£42 0 0	£44 2 0
STP-1 KIT with Brenell Mk. 5 Series II with Track Switch fitted	£64 4 0		
	Kit	Assembled	Assembled with deck wired and matched.
STP-1 with Brenell Mk. 5 Series II 1-track Deck	£74 15 0		
Type "C" Pre-amp. with Collaro Studio Tape Deck	£24 10 0	£30 0 0	£32 2 0
Type "C" Pre-amp. with Brenell Mk. 5 Deck Series II	£46 11 0	£53 1 0	£55 3 0
HF/TR3 with Collaro Studio Tape Deck	£24 3 0	£29 10 0	£31 12 0
HF/TR3 with Brenell Mk. 5 Series II	£46 4 0	£51 11 0	£53 13 0

Send S.A.E. for comprehensive price list. Carr. & Ins. 15/- on above units.

## THE MULLARD "3-3RC"

A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN. (Carr. & Ins. 6/6 extra).

KIT OF PARTS **£8.80** ASSEMBLED AND TESTED **£11.10.0**

Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 75 and 1.5 P. records plus a Radio position. Power to drive a Radio Tuner is also available.

Instruction book and detailed price list available separately at 2/- post free.

## MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Designed mainly for the STERN/MULLARD range of monophonic Power Amplifiers, but also suitable for any Amplifier requiring an input signal up to 250 mV. Five inputs, including one equalised for replay direct from high impedance tape head, and one for low output magnetic pick-up. Output for tape record. Separate Bass and Treble controls. High Pass Filter 20 to 160 c/s. Low Pass Filter 5 to 9 Kc/s. Power requirements 250 v. at 6 mA., 0.3 v. at 0.8 amps. Totally enclosed case silver hammered. Size 1 1/2 x 4 1/2 x 4 in. Front panel. Polished perspex in choice Black or white. (Carr. & Ins. 5/- extra)

KIT OF PARTS **£10.00** ASSEMBLED & TESTED **£13.13.0**

Instruction book and detailed price list available separately at 3/6 post free.

## MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIERS but also perfectly suitable for other makes.

- ★ Equalisation for the latest R.I.A. characteristic
- ★ Input for Crystal Pick-ups and variable reluctance magnetic types.
- ★ Input (a) Direct from High Imp. Tape Head, (b) from a Tape Amplifier or Pre-Amplifier.
- ★ Sensitive Microphone Channel. Wide range BASS and TREBLE Controls.

KIT OF PARTS **£6.6.0** (Carr. & Ins. 5/- extra) ASSEMBLED AND TESTED **£9.10.0**

Instruction book and detailed price list available separately at 2/- post free.

## MULLARD "5-10" MAIN AMPLIFIER

For use with MULLARD 2 or 3 valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS AND MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer.

COMPLETE KIT (Parmeko Output trans) **£10.00**  
ASSEMBLED AND TESTED **£13.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra. (Carr. & Ins. 4/6 extra)

Instruction book and detailed price list available separately at 2/- post free.

## COMBINED PRICE REDUCTIONS

- (a) The KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-valve Pre-Amplifier. (Carr. & Ins. 8/6 extra) **£15.15.0**
- (b) The KIT OF PARTS to build the "5-10" Main Amplifier and 3-Valve Pre-Amplifier. (Carr. & Ins. 8/6 extra) **£19.10.0**
- (a) The "5-10" and the 2-valve Pre-amplifier both Assembled and Tested **£21.10.0**
- (b) The "5-10" and the 3-Valve Pre-Amplifier both Assembled and Tested **£25.10.0**

With PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

## STEREO TAPE PRE-AMPLIFIER

Model STP-1. For use with current TRU-VOX, BRENELL or COLLARO "STUDIO" and 1-track Stereo Decks. Incorporates Ferroxcube Oscillator, 4-speed Equalisation Signal Level Meter and separate Gain Controls Includes separate Power Unit.

KIT OF PARTS **£22.0.0** ASSEMBLED AND TESTED **£28.0.0**

(Carr. & Ins. 8/6 extra)

Instruction book and detailed price list available separately at 5/- post free.

## MULLARD TYPE "C" TAPE PRE-AMPLIFIER

Suitable for most 1-track Mono Tape Decks. Incorporates Ferroxcube Push-Pull Oscillator and 3-speed equalisation. Includes separate Power Unit

Kit of parts **£14.0.0** Assembled **£19.10.0**

(Carr. & Ins. 7/6 extra)

Instruction book and detailed price list available separately at 3/6 post free.

## MULLARD TAPE AMPLIFIER (Model HF/TR3)

Based on Mullard's Type "A" design and suitable for most 1-track Mono Tape Decks. Incorporates Ferroxcube Push-Pull Inductor-Gilson Output Transformer, and 3-speed equalisation. Includes separate Power Unit using PARTRIDGE Mains Transformers

Kit of parts **£13.13.0** (Carr. & Ins. 7/6 extra.)

Assembled **£19.0.0** Instruction book and detailed price list available separately at 3/- post free.

## THE MULLARD "5-10RC" AMPLIFIER

The popular "5-10" complete incorporating Passive Control Unit providing up to 10 watts high quality reproduction with an input of 600 mV. Specified components and new MULLARD VALVES include PARTRIDGE MAINS TRANSFORMERS and choice of the latest PARMEKO or PARTRIDGE Output Transformers. Surplus power available for tuner.

Price: COMPLETE KIT **£12.0.0** ASSEMBLED AND TESTED **£16.0.0**

(Carr. & Ins. 7/6 extra)

With PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

Instruction book and detailed price list available separately at 2/- post free.

# GREAT NEWS!

We have pleasure in giving advanced details of the

## NEW STERN

### DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

A new conception in the field of audio engineering by Stern Clyne development engineers.

The most up-to-date circuitry is used in the double feature pre-amplifier. It has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay. This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck.

**Brief Specifications:**

**JL10 POWER AMPLIFIER** incorporates the latest triode/pentode ECL86 valves in push-pull, PARTRIDGE ultra linear output transformer, PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner output impedance 3-7.5-15 ohms.

**DOUBLE FEATURE PRE-AMPLIFIER**

Inputs for microphone, crystal or magnetic pick-ups, tuner unit. Push-button switching for 3-tape speeds equalized. Tape erase Bias Oscillator circuit incorporating ferroxcube transformer. Function switch, separate base, treble and volume controls, level control and latest 6M87 magic eye level indicator. The pre-amplifier is totally enclosed in a steel case, finish in silver hammer and an attractive perspex front panel carefully designed to blend in with modern wood finishes complete the presentation. Offers superb reproduction from all sources at low cost. Available shortly. Prices: JL10 Power amplifier kit of parts £11 gns., ready built 14 gns. Carr. & Insurance 7/6. Double feature pre-amplifier kit of parts £17, ready built 21 gns. Carr. & Insurance 5/-. Prices if both units purchased together: Kits of parts £27/10/-, ready built 32 gns. Carriage & Insurance 10/-.

### THE "MONO-GRAM"



A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls, PARTRIDGE Output Transformer producing up to 3 watts undistorted output.  
**KIT OF PARTS £4.10.0** *Instruction book and detailed price list available separately at 2/6 post free.*  
**ASSEMBLED £6.0.0** *C. & I. 3/6*

The "MONO-GRAM" is perfectly suited for Portable Installations for which purpose we offer... PORTABLE CASE £3/10/-, the AMPLIFIER (Kit) and 8"x6in. SPEAKER (£1). All for £9. Alternatively with ASSEMBLED AMPLIFIER £10 C. & I. 5/-.

The case quoted above will accommodate some 4-speed Single Record Units. A larger model for autochanger is available for extra 10/-. With this Equipment a COMPLETE PORTABLE RECORD PLAYER CAN be built for £14.



### RECORD PLAYERS

- GARRARD Model SRP10 Single Record Player fitted with high output crystal pick-up **£5.9.1**
  - THE NEW GARRARD "AUTOSLIM" 4-speed Autochanger with crystal pick-up **£6.10.0**
  - GARRARD "AUTOSLIM DE LUXE" 4-speed Autochanger, incorporates transcription Pick-up Arm **£11.8.0**
  - THE COLLARO "C80" 4-speed Autochanger unit with Studio "O" pick-up **£6.19.6**
  - B.S.R. Model UA14 a 4-speed Mixer Autochanger with crystal pick-up **£5.19.6**
  - The new GARRARD 4EP High Quality Single Record Player fitted with the latest T.P.A. 32 pick-up arm and G.C.S. crystal Cartridge **£16.17.6**
  - PHILIPS Model AG1016. A 4-speed Player which can be operated both manually and automatically. Suitable for Mono or Stereo operation. **£12.12.0**
- Carriage and Insurance on each above 5/- extra.*



### THE "HILTON"

#### DO-IT-YOURSELF HI-FI EQUIPMENT CABINET

A cabinet of unique design and outstanding quality typified in pre-picked, ready to assemble form complete with all accessories including 12in. legs with adjustable brass ferrules, handles, hinges and stays. A first-class space-saving Hi-Fi cabinet can be constructed in an incredibly short space of time as each section of 3/4in. maple veneered block board is completely finished. The only tool required is a screwdriver, and when completed the cabinet will house most Hi-Fi equipment and make a neat and pleasing addition to any room setting especially where space has to be considered. Size assembled: Overall height 31 1/2in., length 36in., depth 10in.

**PRICE 12 GNS.** Carriage and Packing 15/-  
 (Also available in Oak, Walnut or Teak at 14 gns.) Can also be supplied polished at 3 gns. extra. Send S.A.E. for illustrated leaflet.

### STEREO AMPLIFIERS

#### MULLARD "10+10" STEREO AMPLIFIER

A HIGH FIDELITY DESIGN PROVIDING UP TO 10 WATTS (per channel) SUPERB REPRODUCTION, FREQUENCY RESPONSE FLAT TO WITHIN 3dB FROM 3 c/s to 50 Kc/s at 50 mA.W. TOTAL HARMONIC DISTORTION AT 10 WATTS, 0.1%.



(a) ASSEMBLED AMP-LEVER (as illustrated) **£24.0.0** C. & I. 7/6. (b) A complete KIT OF PARTS for **£20.0.0** Built to the highest technical standards and presented strictly to MULLARD'S Specifications. Two specially designed GILSON ULTRA LINEAR OUTPUT TRANSFORMERS with 20% taps are used.

We can also supply the assembled MAIN AMPLIFIER only for operation with our DUAL CHANNEL PRE-AMPLIFIER; this provides for a more versatile installation and is essential if a low output Pick-up is to be used. When ordering specify loudspeaker impedance.

(a) THE ASSEMBLED MAIN AMPLIFIER and **£34.0.0** *Instruction book and detailed price list available separately at 3/- post free.*  
 (b) KIT OF PARTS for both Units **£27.0.0** C. & I. 10/6.

#### MULLARD DUAL CHANNEL PRE-AMPLIFIER

A four Valve design for both STEREO-PHONIC and MONOPHONIC operation. Operates equally well with any make of Amplifier requiring input of up to 250 mV. **KIT OF PARTS £12.10.0** *Instruction book and detailed price list available separately at 2/6 post free.*



ASSEMBLED **£15.0.0** *separately at 2/6 post free.* and TESTED C. & I. 5/-

### THE "TWIN THREE" STEREO AMPLIFIER

ASSEMBLED AND TESTED for **£9.0.0** (Carr. & Ins. 7/6 extra)

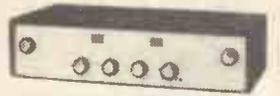


Based on a recent design by MULLARD LTD. It is ideally suited for use in PORTABLE RECORD PLAYERS for which purpose we offer a specially designed case. It incorporates MULLARD ECL86 Valves, separate BASS and TREBLE CONTROLS PARTRIDGE output transformer producing up to 3 watts per channel. Frequency response is 40 c/s to 35 Kc/s, size 11 1/2in. x 3in. x 5in.

To construct a STEREO PORTABLE RECORD PLAYER we offer— Assembled AMPLIFIER with two BOLA 8in. x 3in. LOUSPEAKERS and PORTABLE CABIN for £16/10/0 (Carr. & Ins. 7/6 extra).

### The "TUDOR" STEREO AMPLIFIER

PRICE ONLY **£15.0.0** (Pkg. & Carr. 7/6)



A self-contained shelf mounting Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS. The Cabinet is finished in black crackle. Size 11 x 8 x 4in. Send for full specifications.

### MULLARD FOUR CHANNEL MIXING UNIT

Well-powered Cathode Follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.



**KIT OF PARTS £8.8.0** ASSEMBLED **£11.10.0** *Alternative Model 1/L provides for one input matched for moving coil or ribbon mike £11/7/- extra. Instruction book and detailed price list available separately at 2/6 post free.*

### HIGH FIDELITY LOUSPEAKERS BY GOODMAN'S, WHARFEDALE and W.B. STENTORIAN

A few recommended examples:

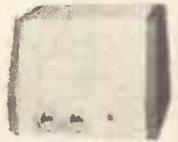
8 INCH TYPES	12 INCH TYPES
GOODMANS "AXIETTE" £5 5 7	GOODMANS "AXIOM 201" £10 7 0
W.B. HF.816 £5 19 6	GOODMANS "AXIOM 301" £14 10 0
WHARFEDALE "SUPER" £6 14 2	W.B. Model HF1214 15 watts £10 5 6
10 inch TYPES	WHARFEDALE "V12/RS" £10 15 0
GOODMANS "AXIOM 10" £6 5 11	WHARFEDALE "Super 12/RS/DD" £17 10 0
W.B. Model HF1016 £7 0 0	
WHARFEDALE "GOLDEN" £7 17 5	

### LEAK and QUAD AMPLIFIERS

- LEAK "TL12 PLUS" POWER AMPLIFIER with the "POINT ONE PLUS" PRE-AMPLIFIER... 14 watts rated output... **£31.10.0**
- LEAK "TL23 PLUS" with the "POINT ONE PLUS" PRE-AMPLIFIER... 24 watts rated output... **£37.16.0**
- LEAK "STEREO 20" POWER AMPLIFIER with the "VARISLOPE STEREO" PRE-AMPLIFIER... 22 watts (11 watts per channel)... **£55.9.0**
- QUAD II. POWER AMPLIFIER with QUAD II CONTROL UNIT 15 watt output... **£42.0.0**

### STERN INTER-COMM. or BABY ALARM

A small versatile Unit employing the new MULLARD ECL86 valve and designed to provide two (or three) way conversation up to extreme distances. Operates from A.C. mains 200 to 250 volts and as in all our designs only new high-grade and guaranteed components are incorporated. PRICE—MASTER UNIT and ONE EXTENSION. **KIT OF PARTS £6.17.6** ASSEMBLED **£8.0.0** C. & I. 5/-  
 The equipment consists of a MASTER UNIT, size only 8 1/2in. x 5 1/2in. x 6in. and ONE EXTENSION (a second extension may be added at any time). The Master Unit incorporates switching and power supply and with the chassis completely isolated from the mains is operated in absolute safety. Attractively presented in a case covered in quality leatherette. *Instruction book and detailed price list available separately at 2/- post free.*



SEE PAGE 81 FOR ADDRESSES OF STERN-GLYNE BRANCHES

# Great Britain's Greatest Electronic Hobbies Organisation

# STERN-CLYNE

## NEW LOW PRICES—NOW YOU CAN AFFORD A CAR RADIO!

### THE "HIGHWAYMAN"

OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE.



Look at these features—  
 ★ Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valve types EBF83 and ECH81. ★ No buzz, high output and sensitivity. ★ Printed circuit (latest type). ★ 12-volt operation. ★ Compact size, measures only 7 x 7 x 2in. deep. ★ Easy assembly, supplied with dial and drive already mounted. Special inclusive price of **ONLY £7.19.6** Plus 5/- P. & P.  
 All parts available separately. Individually priced parts list and comprehensive instruction booklet 2/6 post free. (Deducted from cost if complete parcel purchased later.)

### THE "TRAVLER" MK. II

Introducing our new ready built transistorised car radio for only **9 1/2 Gns.** P. & P. 5/-



Including 7 x 4in. speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions.  
 H.P. Terms: £2.19.6 deposit (Plus P. & P.) and 7 monthly payments of 2/6

#### STAR FEATURES:

★ Handsomely Styled. ★ Mullard Valves and Transistors. ★ Push Buttons. ★ 11 watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily Fitted. ★ Radio Luxembourg; (and many other foreign stations). 12-volt Positive Earth Only (applies to 98.8% of cars on the road). ★ Dimensions 7 x 2 x 7in. depth. Optional extras, 3 section chromium plated weather proof telescopic aerials type 117/44 19/6, type 2 27/45 29/6, both plus p. & p. 2/6 if purchased separately.

### THE "AIR KING"

Our highly successful six-transistor luxury portable with the "SLIM Line" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as car radio, with full M.W. and L.W. coverage.

#### LOOK AT THESE FEATURES:



★ 500 milliwatt output to high flux 7 x 3 1/2in. high fidelity loudspeaker. ★ Six selected MULLARD TRANSISTORS in latest super-sensitive circuit. ★ Germanium diode. ★ Compact size only 9 1/2 x 3 1/2 x 6 1/2in. high. ★ Attractive three-tone cabinet, black, dark grey, and silver grey with gilt control knobs and all gilt fittings. ★ Co-ax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal Ferrite rod aerial. Special inclusive price for all required components. **ONLY £7.19.6** P. & P. 4/-  
 Alignment service available. Full assembly details. and individually priced parts list, all of which are available separately. Price 1/6 post free.

### THE STEELMAN TAPE RECORDER FROM U.S.A.

Fully portable, all transistor 2-speed Tape Recorder. Carry it like a camera and capture the sound of any event when it happens, where it happens. Big set fidelity. For business or pleasure.



★ Fully transistorised. 7 Transistors—2 diodes. ★ 2 standard speeds, 3 1/2 for music, 1 1/2 for voice. ★ Over 1 hour on a single reel of tape. ★ Recording level indicator. ★ Precision made. Jewelled and Oilite bearings require no lubrication. ★ Illuminated overload and battery life indicators ensure uniform quality performance. ★ Heavy duty 4in. speaker. ★ Sensitive crystal microphone. ★ Compact size 6 1/2 x 9 1/2 x 2 1/2in. Wt. under 6 1/2 lb. less batteries. ★ Many other refinements. Supplied complete with free set of Mallory Mercury Long Life batteries complete with tape and microphone in solid leather case with shoulder strap. Illustrated instruction manual. In manufacturer's cartons. Fully guaranteed **ORIGINAL LIST PRICE 55 GNS** (less batteries). **OUR PRICE 24 Gns.** Plus 7/6 plus carr. and ins. Limited PRICE supply. Buy now! H.P. available. (including batteries) MAINS UNITS AVAILABLE for operation on 200/250 v. A.C. Enquiries invited also for other accessories.

### SPECIAL CHASSIS BARGAIN

Latest printed circuit. THREE WAVE. Long, Medium and Short. Extremely sensitive, ferrite rod aerial. 4 valve output Valve line up: ECL82, EZ80, EBF89, and ECH81. Tape and gram inputs. Tone control. Attractive dial (size 12 1/2 x 4 1/2in.) in maroon with gold lettering. Overall chassis size 12 1/2 x 4 1/2 x 7 1/2in. high. A.C. 200/250 volts Fully guaranteed.  
**SPECIAL PRICE £9.19.6**

Plus 5/- P. & P. H.P. available



### BUILD YOURSELF AN INEXPENSIVE TAPE RECORDER!

LATEST COLLARO STUDIO TAPE TRANSCRIBER. Incorporating Record Interlock Lever, 3 motors, 11, 31, 71 lbs. tapes 7in. spools. Push button controls. **NEW LOW PRICE OF £10.10**—ONLY plus 7/6 P. & P. Post 11/-

#### NEW TAPE RECORDER AMPLIFIER

TYPE 8311-V. Sub-assembled—anyone can build. Printed Circuit, all component-mounted and dip soldered. Already tested. Each lead cut to length. All that is required to complete with tape recorder is a few components to be mounted in the cabinet and the free end of the leads soldered to terminals which are clearly marked, everything supplied, all you need is solder, iron, pliers and screw-driver. Valve line-up: EBF89, ECH81, 2 x EL84, EZ81 and EM34 magic eye. Monitoring facilities, output socket for feeding to high quality amplifier can be used as a substitute for record reproduction. **EQUALISING ON TWO SPEEDS. OUTSTANDING VALUE AT £11.11**—plus 2/6 P. & P. including all necessary instructions.



ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE. Suitable for above amplifier and Collaro Studio deck. Fitted 9in. x 5in. High Flux P14x P14 speaker for high quality reproduction. Inclusive price £5/5/- plus 5/- P. & P. Full list of competitively priced prices, and stands on request. The above 3 items purchased at one time **SUPPLIED CARRIAGE PAID.**

LOW AVAILABLE: **FOUR-TRACK STUDIO DECK AS ABOVE FITTED WITH HI-FI FOUR TRACK HEADS. PRICE £13/19/6**, plus 7/6 P. & P. Four track heads supplied separately complete with mounting bracket for Studio Deck at 20/00 pair, plus 2/6 P. & P.

**TAPE RECORDER AMPLIFIER 8311-4V** exactly as 8311-V but four-track, suitable for hi-fi four track heads. Price £12/12/- plus P. & P.

N.B. Four-track deck and amplifier fit the above case without any modification whatsoever. **PRE-AMPLIFIER KIT TYPE 8312-CP.** Complete high quality pre-amplifier kit for use with Collaro Studio Deck. Price £8/8/- plus 2/6 P. & P.

### RECORDING TAPE BARGAINS!

"BEL-CLEER" FOR THE FIRST TIME IN THIS COUNTRY CANADA'S HI-FI MAGNETIC RECORDING TAPE—MADE BY "BEL-CLEER" OF CANADA.

Following sizes available—others to follow. **BRAND NEW—NOT SUB-STANDARD.** High grade acetate base. Attractively boxed fitted leaders, fully guaranteed.  
 5in. 600ft. 12/8; 5in. 900ft. 15/-; 3 1/2in. 1,200ft. 18/6; 7in. 1,200ft. 18/6; 7in. 1,800ft. 25/-

"LAFAYETTE" **AMERICAN RECORDING TAPE. MYLAR BASE.** Brand new and boxed. Fully guaranteed.  
 3 1/2in. 600ft. 11/6; 5in. 1,200ft. 15/-; 7in. 1,200ft. 15/-; 7in. 800ft. 20/-; 7in. 2,400ft. 27/6

**MESSAGE TAPES.** British manufacture. Polythene. 3in. 130ft. 3/6; 3in. 240ft. 5/6; 3in. 300ft. 8/- P. & P. 6d. per spool, 3 or more post free (bona fide trade enquiries invited)

**PLASTIC SPOOL CONTAINERS** for spool sizes. 5in. 1/6; 5 1/2in. 2/-; 7in. 2/3. **PLASTIC TAPE SPOOLS.** Best quality. 3in. 1/3; 4in. 2/-; 5in. 2/-; 5 1/2in. 2/3; 7in. 2/6. Any single ten plus 6d. P. & P. Orders over £2 post free.

### THE SINCLAIR SLIMLINE

A new 2-TRANSISTOR printed circuit pocket radio. Completely portable—the smallest ever—only 2 1/2in. x 1 1/2in. x 1/2in. Uses Micro-Alloy Transistors and with built-in ferrite aerial will receive all stations on M.W.—B.C.E.—208, etc. Easy to assemble—no alignment problems. All required components, including earpiece **ONLY 49/6** P. & P. 1/6

All parts sold separately

2WW-130 FOR FURTHER DETAILS.

### MODEL TK20A

Size 3 1/2 x 2 1/4 x 1 1/2in. Meter size 2 1/2 x 1 1/2in. Sensitivity 1,000 o.p.v. on both A.C. and D.C.I. A.C. and D.C. volts 0/15, 0/100, 0/1,000 volts D.C. current 0/150 mA. Resistance 0/100K. Complete with test leads, battery and full instructions.

**OUTSTANDING VALUE AT ONLY 39/6** Plus 1/6 P. & P.

### MODEL TK50

Size 5 x 3 1/2 x 1 1/2in. 1,000 ohms per volt. D.C. current 1-250 mA. D.C. and A.C. volts 10,250, 500 and 1,000 v. Resistance: 0-10K, 0-100K. Complete with test leads, battery and full instructions. Outstanding battery at **57/6** Plus 2/6 P. & P.

### MODEL 200H 20,000 OPV

RANGES: A.C. VOLTS: 10, 50, 100, 500 and 1,000 volts (1,000 op.v. o.p.v.). D.C. VOLTS: 5-25, 50, 250, 500 and 2.5K (20,000 op.v.). D.C. CURRENT: 0-50 micro-amps, 0-2.5 mA., 0-250 mA. RESISTANCE: 0-6k, 0-6 meg. (300 ohms and 30k. at centre scale). CAPACITANCE: 10p.f. to 1,000mfd., .001mfd. to 1mfd. DECIBELS: -20 to +22db. A fully guaranteed pocket size meter, knife edge pointer, top quality, supplied complete with test leads and full operating instructions at **£5.5.0** ONLY Post free Actual size 4 1/2 x 3 1/2 x 1 1/2

### MODEL 500

30,000 OHMS PER VOLT

9-ranges D.C. voltage to 1 kV, 7 ranges A.C. voltage to 1 kV, 3 ranges D.C. current to 12 amp., 3 ranges resistance to 50 meg. Incorporates internal buzzer for audible warning of direct shorts and blocking condensers for A.F. output. Capacity -20 +5%. Measurements 3 1/2 x 6 1/2 x 2 1/2in. Outstanding value at **£8.19.6** H.P. available.

**LEATHER CARRYING CASE** for Model 500. Price 30/- only.

### ALL BRITISH PRECISION TEST METER (to build yourself)

Designed for test bench and produced for us by one of Britain's leading technical training organisations this instrument covers the following nineteen basic ranges: D.C. voltage, 0-2.5, 0-10, 0-50, 0-100, 0-500, 0-1,000 (all ranges 5,000 ohms per volt). A.C. Voltage 0-10, 0-50, 0-100, 0-500, 0-1,000 (all ranges 5,000 ohms per volt). D.C. Current, 0-200 microamps, 0-10 mA., 0-100 mA., 0-250 mA., 0-500 mA. A.C. current, 0-200 microamps. Resistance, 0-200,000 ohms (easily extendible to 2 megohms). Accuracy 3% of F.S.D. on D.C. ranges, 4% on A.C. ranges, any frequency between 15-20,000 C.P.S. (sine wave), 5% on resistance range. Positive range selection by means of plug and socket. Easily constructed, full instructions being given with each assembly. All necessary components offered at the **ABSURDLY LOW PRICE OF 59/6** P. & P. 2/6.



# THE WORLD AT YOUR FINGERTIPS!!

## THE HE-30 4-BAND COMMUNICATION RECEIVER



Outstanding Bandspread Selectivity and sensitivity with a built-in Q-multiplier combine to make the HE-30 one of the finest general coverage bandspread Receivers available at this price. Covering 150 kc/s-1600 kc/s., 4.8 Mc/s-14.5 Mc/s., 1.6 Mc/s-4.8 Mc/s., 10.5 Mc/s-30 Mc/s. For amateur bands an illuminated slide rule dial is provided, calibrated every 5 Kc/s on 80 and 40 metres taking 18 revolutions of the bandspread dial to cover each of these bands, every 20 Kc/s. on 20 and 15 metres and every 15 Kc/s. on 10 metres plus an edgewise 8-metre. For the SWL a 0-100 logging scale for instant reset plus coverage from 0.55-30 Mc/s. The 8 valve plus Rectifier superhet-circuit provides an RF stage with an Aerial Trimmer for peak performance plus 2 IF Stages for improved sensitivity of 1.0 microvolts for 10db S/N ratio. The BFO variable pitch control can be used to separate CW stations whilst the Q-multiplier adds the selectivity needed for crowded phone band operation. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier), Frequency (BFO), Band Selector, IF gain, Trimmer, AVC-MCV Switch, Ant Switch, Main Tuning, Bandspread Tuning and Head-phone Jack, Selectivity—6db to 10 Kc/s., 0.8 Kc/s. at 6db (with Q-Multiplier), IF—455 Kc/s., External F.M. Speaker req'd. 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. **PRICE 40 Gns.** Size 10in. x 10in. x 7in. Grey crackle finish. Full instructions and circuit diagram supplied. Carr. & Pkg. 15/-

## THE HE-40 4-BAND COMMUNICATION RECEIVER



Completely built and ready to go. Not a Kit. High sensitivity Superheterodyne receiver covering 350 Kc/s-1,600 Kc/s., 1.6 Mc/s.-4.8 Mc/s., 4.4 Mc/s.-11 Mc/s., 11 Mc/s.-30 Mc/s. Covers all amateur, government aircraft and broadcast stations between 550 Kc/s. and 30 Mc/s. Electrical handspread tuning. Slide-rule type tuning dial giving accurate logging of stations. Internal ferrite rod aerial for medium waveband reception and a 50in. 10 section chromium plated telescopic whip aerial for the short wave bands. Sockets for optional outdoor aerial. Internal high flux monitor loudspeaker. Latest modern miniature B7G base valves. High Q coils and I.F. transformers. Headphone socket (may also be used for external loudspeaker). Automatic noise limiter (ANL) for reduction of external interference. Beat frequency oscillator (BFO) for reception of CW (morse) signals. Receive/Stand-by switch. Signal strength meter calibrated in "S" units and reads to 89 + 10db 220/240 volt A.C. mains, 50-60 cycle operation. Handsome styled cabinet with grey crackle finish and handsome front panel with chrome and satin chrome fittings. Size 13in. x 8in. x 5in. Wgt. 11 lb. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and short wave listeners of all ages. Concise and hear this wonderful receiver at any of our many branches. **£24.15.0** Carr. & Pkg. 12/6

## INTRODUCTION OFFER!! AVAILABLE SHORTLY THE TUDOR STEREO HI-FI SYSTEM



FOR ONLY **48 Gns.** Plus Carr. & Pkg. 15/-



Comprising a Self-Powered AM/FM Tuner, Stereo Pre-amplifier, 12 watt per Channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal Cabinets for shelf mounting, with silver metal dials and matching knobs. SPECIFICATIONS: Tuner—outstanding quality providing full VHF/FM long and medium waveband coverage, frequency range FM 87.5-108.5 Mc/s, AM MW 522-1630 Kc/s. LW 145-270 Kc/s., 100mV output mains supply 105/240 A.C. Valve line up: 6CX85, 6CH81, 6BF89, 6F50, 6BQ1, 6X4, 6XG3. Multiplex outlet provided. Pre-Amplifier—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pickups, direct play from Tape Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion 1% tape output 100 mV from 90 K ohm source, inputs—Microphone 5mV, Tape 3.5mV, E.I.A.A. 4.3mV, at 250mV. Tuner 100mV. Valve line up: 2-6F86, 4-6XG33. Power Amplifier—14 watts per Channel, sensitivity 1 volt r.m.s. for 14 watts output, frequency response  $\pm 0.5$ db 20 c.p.s.—20 Kc/s. Speaker impedance 4, 8 or 16 ohms, surplus power available for tape pre-amplifier, mains supply 105/240 v. A.C. valve line-up, 2-6XG33, 4-EL84, 1-GZ34.

## STEREO TAPE DECK WITH BUILT-IN PRE-AMPLIFIER

A professional addition to your Hi-Fi Stereo System consisting of two basic Units, the Tape Deck and Pre-amplifier, which employs 4 Transistors and 4 Valves. The unit will record and playback 1 track stereo or 1 track mono at either 7 1/2 i.p.s. or 3 1/2 i.p.s. both speeds being fully equalised. Features: Track System: 1 track 2 channel stereo or monoaural record and playback. Reversing single channel recording on either channel while playback on other channel. Head Type: 1 track 2 channel in-line stereo and associated erase heads. Low loss laminated pole pieces. Level Indicators: 2 Meters, 1 per channel. Digital Counter: 3 digit tape position indicator. Automatic Stop When tape runs out or breaks. Inputs: Microphone 1mV (50K ohms impedance). Gram/Tuner 50mV (high impedance). Output: (athetole follower). Monitor Sockets: 2 x 50Kohms impedance. Audio Output: 500mV. Oscillator Pushpull 80 kc/s. S/N Ratio: +5db or better at 7in. tape speed. Separation: 45db or more between stereo channels. Frequency Response: 40 to 15,000 cycles per sec. at 7 1/2 i.p.s. 40 to 9,000 cycles at 3 1/2 i.p.s. Sizzle Motor: 4 pole heavy duty induction type. Power Supply: 240v. A.C. 50 cycles. Size 13in. x 10in. x 15in. Tape Size: Up to 7in. Line Up: 4-28B173 transistors, 2-12A7, 1-12AU7, 1-12BH7 Valves. **PRICE 42 Gns.** Carr. & Pkg. 15/-



## POCKETCORDER TRANSPORTISED RECORDER



Why be bothered with a notepad? Take a Pocket Corder with you on those business trips, the mighty Midget is ideal. Simple to operate, a unique 4-way push-button Switch for record/playback, etc., ensures complete ease of handling. A remote Control Switch is also included for discreet recording, fully adjustable speed through the life of Batteries and the volume and Tone from the 2 1/2in. internal speaker is outstanding. All accessories included such as Leather Case and Accessory Case, Remote Control switch and Crystal Earpiece. Tape, Batteries and Microphone, no other extras required. Up to 34 mins. recording time, operates on 1.9 volt PP3 and 2 1/2 volt U12 Pen Batteries. Size 5 1/2 x 4 x 2in. Weight 24 ozs **PRICE 12 Gns.** P. & P. 4/-

## HI-FI STEREO HEADPHONES

For the connoisseur who requires perfection. Each Earphone consists of a 2 1/2in. Dynamic Loudspeaker with a full frequency range, fitted with foam rubber Ear Pads for added comfort, to keep out noise and to maintain an excellent bass response. The resistance Junction box with change-over switch provides simple transfer from Phones to Speaker. Specifications: Frequency Range 25-15,000 c.p.s. Input Impedance—16 ohms. Power Rating—1/2 watt Weight—13 ozs. **PRICE 5 Gns.** P. & P. 2/6 Junction box 15/- extra.



## STEREO STETHOSCOPE HEADSETS

Enjoy personal listening in absolute comfort with the new lightweight Stethoscope Headsets suitable for stereo or monoaural. Available in either magnetic low impedance or high impedance crystal complete with 6ft. of Cable and Stereo Jack Plug. **PRICE 25/-** P. & P. 3/6

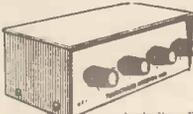


## ACOS MONAURAL STETHOSCOPE HEADSETS

Suitable for Tape Recorders, or monitoring tape recordings. 100 ohm impedance, magnetic. Complete with lead. Originally 21/-. **OUR PRICE 12/6** P. & P. 1/6

## THE NEW R.C. TRANSISTOR TAPE TUNER

May be used with most Tape Recorders. Full medium wave coverage, ferrite rod aerial sensitivity control. Attractive case, size only 3 1/2in. x 2 1/2in. x 1 1/2in. deep. Carried components for easy identification. Solder, wiring wire, PP3 battery and step by step instructions supplied. **SPECIAL INCLUSIVE PRICE FOR ALL COMPONENTS, inc. battery 27/6** P. & P. 2/6



**TRANSISTORISED SOUND MIXER**  
Mixing 4 channels from a high impedance source, giving professional results, inputs for high impedance Microphone, Tuner, Gram and/or Tape Recorder. Compact and beautifully styled, size 6in. x 2 1/2in. x 2 1/2in. Standard Jack socket inputs. **PRICE 79/6** Including PP3 battery circuit diagram and instructions. P. & P. 2/6

## DUVIDAL DE LUXE TWO-WAY BATTERY OPERATED INTERCOM

Ideally suitable for either a Baby Alarm, Office use or the Catering Trade, having ample output for use of the above purposes, operating on PP3 9 volt Battery, attractively finished in 2 tone Black and Cream. This Unit has a two-way calling system between Slave and Master. Complete with 20 yards of PP3 cable and battery. **PRICE 89/6** P. & P. 3/6



## SPECIAL PURCHASE! THE SHURE MODEL M3D

Professional Dynamic Stereo Cartridge with diamond Stylus, the Shure Dynamic Moving Magnet System combines the most faithful and distortion free reproduction with complete reliability. Specifications: Diamond Stylus: 0.7 thou. Load Imp.: 470K ohms. Output: 5mV. Range: 20-15,000 c/s  $\pm 3$ db. Stylus pressure: 3-4 grammes. **PRICE 12 Gns**

## THE DUVIDAL TWO-WAY 2 TRANSISTOR BATTERY INTERCOM

A completely Portable Intercom ideally suitable for the office or as a Baby Alarm—being battery operated it is completely safe. Two-way calling system and volume on/off switch, housed in attractive plastic cabinets with chrome stands. Replacement PP3 Battery costs only 2/6. Complete with battery and 25 yds. lead with plugs. **PRICE 69/6** P. & P. 3/6



**ARE YOU PLANNING TO INSTAL HI-FI? AND UNCERTAIN OF THE TYPE OF EQUIPMENT TO USE—OUR WIDELY EXPERIENCED TECHNICAL STAFF WILL WITH PLEASURE PUT FORWARD RECOMMENDATIONS.—STATE TYPE OF INSTALLATION CONTEMPLATED AND APPROX. PRICE LEVEL. CREDIT SALE TERMS are available on all equipment over £10. Fully descriptive leaflets available, advise items of interest and enclose S.A.E. OUR INTERESTING LITTLE BOOKLET "WHAT IS HIGH-FIDELITY?" is also available together with suggested Budget Hi-Fi Systems list. Sent on receipt of S.A.E.**

SEE PAGE 81 FOR ADDRESSES OF STERN-CLYNE BRANCHES

# Great Britain's Greatest Electronic Hobbies Organisation

# LASKY'S RADIO

## LONDON'S LARGEST STOCKS OF EQUIPMENT & COMPONENTS SPEEDY MAIL ORDER SERVICE

**TRANSISTORISED  
PORTABLE Tape RECORDER**

### The "TRAV-LER"



Dimensions: 10 x 8 x 3in., weight 9lb. Speed 37in. per sec. Wow and flutter better than 4 r.m.s. Battery life 60 hours. Amplifier 400 mW. Uses 6 Mullard transistors. Speaker: 3 ohm High-flux, 7 x 4in. Playing time 44 min. using 3in. spools double play tape. Rewind time 2 1/2 min. New record level indicator, pause control, loudspeaker switch. Can be run off main power. Socket for external power supply. With Lustraphone LD66 moving coil microphone, 840ft. tape and spool. Brand new and in original maker's casing. List price £30/9/-.

**SPECIAL REDUCED PRICE 13 gns.**  
Carr. & insurance 17/6  
A.C. mains unit available 39/6. Post 3/6.

### LARGE SELECTION OF OTHER TRANSISTOR RECORDERS STOCKED

The "CLARION" PHONOTRIX  
A fully transistorised battery operated recorder. With leather case. Carr. 7/6. **16 gns.**

Very latest "PHONOTRIX"  
with push-pull output. Carr. 7/6. **20 gns.**  
Full details of these Recorders, see previous adverts.



**CLARION "TWINSET"**  
Transistor amplifier with 7in. x 4in. speaker in a portable case. Listed at 8 gns.  
LASKY'S PRICE 7 gns. P. & P. 5/-

The 'MINY' TRANSISTOR TAPE RECORDER  
A self-contained Battery Recorder. Size only 8 x 7 1/2 x 2 1/2 in. Weight 3 1/2 lb. Takes 3in. spools, twin track, 3 1/2 i.p.s. With tape, mic. and batteries. LASKY'S PRICE 7 1/2 gns. P. & P. 5/-

**BUILD A HIGH QUALITY TAPE RECORDER**  
Using the famous Collaro "STUDIO" deck and MARTIN pre-assembled amplifiers 2 or 4 Track Models.

**COLLARO STUDIO TAPE DECK**  
Latest model. 3 speed 3 motors. Takes 7in. reels. Fitted with half-track heads. LASKY'S PRICE £10 10/-. New and Unused. Carr. and Pack. 7/6.

**COLLARO STUDIO TAPE DECK.** As above but fitted with the latest quarter-track heads. LASKY'S PRICE £13/9. 6. Carr. and Pack. 7/6.

**MARTIN TAPE RECORDER AMPS.** Designed for use with Collaro Studio Tape Deck. In sub-assemblies for immediate installation. 6-valve circuit. Comprehensive instructions make final assembly as simple as possible. Everything supplied, including valves, etc. Monitoring facilities. 3-ohm output, speed equalising, etc. For 200-250 v. A.C. mains.

PRICE 1-Track Model £11 11/-, 4-Track Model £12 12/-. P. & P. 2/6. Portable carrying case designed to take the Collaro studio tape deck and the Martin tape amplifier. Fitted with 9 x 5in. speaker. Price complete with speaker £5/5/-. P. & P. 5/-.  
See Special Privilege Parcel Offer.

## Hear and compare the very latest HI-FI EQUIPMENT

Visit our spacious showrooms at 33 Tottenham Court Road or 207 Edgware Road, whichever is most convenient. in our Demonstration Studios you can see, examine, hear and compare the very latest products in the realm of high-fidelity reproduction.

- TAPE RECORDERS ● TAPE DECKS ● MICRO- PHONES ● AMPLIFIERS ● CONTROL UNITS ● AM/FM TUNERS ● RECORD PLAYERS ● AUTOCHANGERS ● TRANSCRIPTION TURNTABLES ● PICK-UPS ● LOUDSPEAKERS ● SPEAKER SYSTEMS ● CABINETS AND ENCLOSURES ● TRANSISTOR RADIOS

- |             |             |            |
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| ARMSTRONG   | GRUNDIG     | RESLO      |
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| CHAPMAN     | H.M.V.      | SIMON      |
| COLLARO     | JASON       | SOUND      |
| CONNOISSEUR | KORTING     | STELLA     |
| COSSOR      | LEAK        | STUZZI     |
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| E.A.R.      | LINEAR      | TANNOY     |
| ELIZABETHAN | LORENZ      | TELEFUNKEN |
| FERROGRAPH  | LOWTHER     | THORENS    |
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| GARRARD     | ORTOPHON    | VORTEXION  |
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We stock a complete range of  
**RADIOGRAM CHASSIS A.M. & F.M.**  
and also TUNERS by  
**ARMSTRONG, DULCI, CHAPMAN, Etc.**  
We are stockists of the full range of JASON Kits.

Details on request

**SPECIAL OFFER. RADIOGRAM CHASSIS**  
Makers' Surplus. 6 valve AM/FM chassis. Covers long, medium and V.H.F. bands. Gram input, tone control, etc. 200/250 volts. A.C. New and guaranteed £13/19/6. Carr. and pack. 12/6.

"ORION" RADIOGRAM CHASSIS. Long, medium and short wave bands. 6 valve circuit. Piano key selection. Pick-up and speaker sockets. Size 13 1/2 x 9 1/2 x 7in. Volume and tone controls. With 9 x 5in. speaker. LASKY'S PRICE £10/19/6. Carr. and pack. 12/6 extra.

**All BRENNEL Tape Equipment stocked:-**  
Mark V Series II Tape Deck from 31 gns.  
Mark 510 Series II Tape Deck from 43 gns.  
Mrk V Series II Record/Play Amp. from £26.  
Mark V Series II Tape Recorder, 69 gns.  
Mark V Series II Tape Recorder with meter 75 gns.  
S.T.B. 1/5/2 Recorder, £120.

**All ARMSTRONG equipment stocked.**  
A.F.208, £21/4/-.  
Model 227M £33/18/-.  
Stereo 55 £29/18/-.  
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T.4.c. £17/19/-.  
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A.20 Stereo Amp. £23/12/6.  
P.C.U. 25 Stereo Pre-Amp. £21.

## HI-FI FURNITURE by

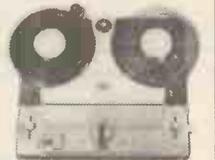
### RECORD HOUSING



The full range of Record Housing equipment cabinets, speaker enclosures, etc., stocked. Delivered anywhere. Catalogue FREE on request.

### FIRST TIME AVAILABLE TO THE HOME CONSTRUCTOR

The latest E.M.I. tape deck. Four tracks; 2 speeds 3 1/2 and 7 1/2 i.p.s.; 3 motors; clock position indicator. Full facilities for 4 track stereo and mono. Frequency response 30-20,000 cfs. at 7 1/2 i.p.s. 3dB. Wow and flutter < 0.15% at 7 1/2 i.p.s. For 200-250 volt 50 c.p.s. Mains capstan drive, fast forward and fast re-wind. Unit plate size 13 1/2 x 12 1/2 in., depth below top of plate 3 1/2 in. Takes 7in. diameter spools. Pause control.



Today's list value 28 gns. LASKY'S PRICE **£17.19.6** Carr. and pack. 10/6 extra.  
Brand new and unused in makers' original cartons.

**JUST RECEIVED, a further stock of the "CONET" transistor tape recorder.** As previously advertised. **19 gns.**  
P. & P. 5/-

## 100 PAGE HI-FI CATALOGUE Latest Edition PRICE 3/6 Post free.

Refunded on your first hi-fi purchase of £5 or over from the catalogue. A superb production illustrating and providing technical data of all the latest equipment. 11 1/2 x 8 1/2 in., in photogravure and colour.

**SEND FOR OUR LATEST COMPONENTS CATALOGUE**  
Completely new edition of over 100 pages, 8 1/2 x 5 1/2 in., copiously illustrated, packed with money-saving bargains! Invaluable for the "ham" or service man. Price 2/-. Post 6d. Our latest 20-page "Bargain Bulletin" included free (separately by post, 6d.).

**PROMPT MAIL ORDER SERVICE** to all parts of the British Isles, the U.S.A. and overseas. Enquiries invited. We also operate the official purchase tax-free plan for overseas visitors-the PERSONAL EXPORT SCHEME

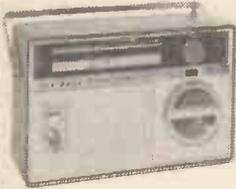
## LASKY'S RADIO FOR COURTEOUS SERVICE & TECHNICAL ADVICE

# THE FINEST RANGE OF TRANSISTOR RECEIVERS

We consider our Construction Parcels to be the finest value available on the home construction market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.

# LASKY'S RADIO

## LASKY'S NOW OFFER to the HOME CONSTRUCTOR—FULL Short wave COVERAGE THE SKYROVER and the SKYROVER DE LUXE



Can be built for  
**£10.19.6**  
Postage and packing 5/- extra.

**GENERAL SPECIFICATION:**

7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 torch batteries.

The SKYROVER and SKYROVER DE LUXE cover the full medium waveband, and Short Waveband 31-94 M, and also 4 separate switched band-spread ranges, 13M, 16M, 18M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions.

**SPECIFICATION:** Superhet, 470 Kc/s. Uses 4 U2 batteries. Easy to Read Dial Scale. 500 MW Output.

All Mullard Transistors and Diode. 5in. Ceramic Magnet P.M. Speaker. Band Spread Tuning. Telescopic Aerial and Ferrite Rod Aerial.

**WAVEBAND COVERAGE 180-576 M:** and Band Spread on 13, 16, 18 and 25 metre Bands.

**THE SKYROVER.** Controls: Waveband Selector, Volume Control with on/off Switch, Tuning Control. In plastic cabinet, size: 10in. x 6 1/2in. x 3 1/2in., with metal trim and carrying handle.

**THE SKYROVER DE LUXE** Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11 1/2in. x 6 1/2in. x 3in. covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.



Can be built for  
**£12.19.6**  
Postage and packing 5/- extra.

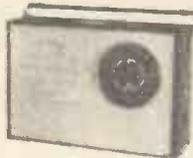
All Components Available Separately. Data for each receiver, 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries, 2/8 extra. Four Leak-Proof Batteries 3/4 extra.

## "REALISTIC SEVEN"

Fully tunable long & medium bands. Uses 7 Mullard Transistors; plus Diode OA70.

**STAR features**

★ 7 Transistor Superhet. ★ 350 Milliwatt output 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5 1/2in. x 3 1/2in. In one complete assembly. ★ Plastic cabinet, with carrying handle, size 7in. x 10in. x 3 1/2in., in blue/grey. ★ Easy to read dial. ★ External socket for car aerial. ★ I.L.-frequency 470 Kc/s. ★ Ferrite rod internal aerial. ★ Operates from P.P. or similar batt. ★ Full comprehensive data supplied with each Receiver. ★ All coils & I.F.s., etc., fully wound ready for immediate assembly. An outstanding Receiver.



Can be built for  
**£5.19.6**  
P. & P. 4/6.

**REALISTIC SEVEN DE LUXE**

By popular request a De Luxe version of the well-proven Realistic Seven now available. With the same electrical specification as standard model—PLUS A SUPERIOR WOOD CABINET IN CONTEMPORARY STYLING covered in attractive washable material, with super-chrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. ALL FOR ONLY £1 EXTRA. Battery 3/6 Extra. (All components available separately.) Data & instructions separately 2/6, refunded if you purchase parcel.

## THE SPRITE

★ 6-Transistor Superhet Mini Personal Pocket Radio. ★ Long & Med. wavebands. ★ Uses P.P. batt. ★ Ferrite Rod aerial. ★ I.F. Freq. 470 Kc/s. ★ 3in. speaker. ★ Printed circuit 2 1/2in. x 2 1/2in. ★ Slow motion Drive. ★ Plastic case, size 4in. x 2 1/2in. x 1 1/2in. In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver & Output stages, ready built with all components ready mounted on the printed circuit. The SPRITE (pre-assembled) plus cabinet, speaker and all components for final construction. CAN BE BUILT FOR 79/6. Post & pack. 3/6 extra. Data & instructions separately, 2/6. (Refunded if parcel is purchased.) Real calf leather case, wrist strap, personal earphone, case for earphone and battery, 12/6 the lot extra. Make no mistake—this is a SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit. CAN BE BUILT FOR 79/6 P.P. 3/6 extra.



**TV TURRET TUNERS.** Famous British make 38 Mc/s. I.F. with a few coils. Uses PCC84 and PCF80 valves. Less valves LASKY'S PRICE 5/-. P. & P. 2/- (No data or circuit available).

**FULLY GUARANTEED TAPE AT RECORD NEW LOW PRICES**

Famous make. P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.

1,200ft. on 7in. spool	15 0
1,800ft. on 7in. spool	19 6
1,200ft. on 5 1/2in. spool	17 6
800ft. on 5 1/2in. spool	11 6
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2,400ft. D.P. on 7in. spool	4 11
2,400ft. D.P. on 7in. spool	32 6

All other makes, types and sizes of tape in stock including E.M.I. and Scotch.



**MINIATURE EARPIECES for Transistor Radios.** Transparent ear-inserts with 3in. cord, sub-min. jack and socket. Fully guaranteed. Post free.

CR.5. Crystal, high imp.	5 0
MR.4. Magnetic, low imp.	6 6

**MULTI TEST METERS**

All new and unused and complete with test leads. The finest imported makes, also by AVO, TAYLOR, etc. Write for FREE LIST.

**ACOS CRYSTAL STICK MIC.** Type MIC.39/1 complete with Cable. List £6/5/- Post 1/-. LASKY'S PRICE 32/6. Post free.

**Crystal Hand or Table Mic, 15/-.** Post free.

**LAPEL TYPE MP110.** High imp. xtal mic. 1 1/2in. dia. x 1/2in. thick. 15/- Post 1/-. Post free.

**TYPE NP100.** Tie clip mic. 1 x 1/4 x 1/2in. High imp. xtal, 22/6. Post 1/-. Post free.

**1,800 FT. ACETATE TAPE on 7in. reel.** by famous American manufacturer. 15/-. Post and Pkg. 1/-. Post free.

**SPECIAL OFFER.** Verdict "Quality Ten" Hi-Fi amplifier and pre-amplifier. Listed at £21. LASKY'S PRICE £14/19/6. Post and Pkg. 7/6. VERDICK MK. III with "High-Gain" Pre-Amplifier. 15j gns. Post and pkg. 7/6. VERDICK Mk. V. amp. and pre-amp. 15j gns. Post and Pkg. 7/6.

## LASKY'S CAR RADIO



Tuned R.F. stage 12 v. operation. Transistor output. Medium and Long waves. Permeability tuning. T.C.C. Printed Circuit. Small size, will fit any car. CAN BE BUILT COMPLETE WITH SPEAKER FOR £9/19/6. Post 3/6. Booklet 2/6 (refunded if you order).

## CRYSTAL PICK-UP CARTRIDGES

LOWEST PRICES EVER!

All Complete with Styli, L.P. and Standard (and Stereo where shown) fully guaranteed, Standard Fitting, will fit most P.U. Arms and Heads. Postage 1/- extra each.

**MONO Type C.T.1.** By well-knowns manfr. With 2 sapphire styli

Garrard Ceramic G.C.E.4	9 6
Garrard Magnetic T.O.M.2	15 0
Acos G.P.59	14 0
Acos GP.65/3	15 0
Acos GP.65/1	17 0
Acos GP.67/1	14 0

**STEREO Acostereo 73/1.** with 2 sapphires

Acostero 73/2, with Diamond LP/Stereo and sapphire Std.	25 0
Collaro type C Turnover, with 2 sapphires	19 11
Coller S.C.1, Turnover, with 2 sapphires	19 11
Coller S.C.1, Turnover, with Diamond LP/Stereo and sapphire Std.	25 0
Ronette Stereo O.V. Turnover, with 2 sapphires	25 0
Ronette Stereo type 105 and 106 with 2 sapphires	35 6
Ronette Stereo type 105 and 106 with Diamond LP/Stereo and sapphire Std.	39 6

**TRANSFILTERS by BRUSH CRYSTAL Co.**

Available from stock.

TO-01B 465 kc/s. ± 2 kc/s.	<b>6/6</b> EACH P. & P. 6d.
TO-01D 470 kc/s. ± 2 kc/s.	
TO-02B 465 kc/s. ± 1 kc/s.	
TO-02D 470 kc/s. ± 1 kc/s.	

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

# LASKY'S RADIO

## 4-SPEED AUTO-CHANGERS



- R.S.R. Type UAH/1A20..... £5 19 6
- COLLARO Studio C50 wired for stereo with monaural p.u. .... £6 19 6
- MAGNAVOX-COLLARO latest model, 4 speed Stereo Auto changer. Fitted diamond stylus and record dust-cleaning attachment. Stereo ..... £17 19 6
- GARRARD
- Auto-Slim Mono ..... £6 10 0
- Auto-Slim Stereo ..... £7 10 0
- Auto-Slim Mono Plug-in-head ..... £7 7 0
- Auto-Slim De Luxe Mono AT6 ..... £11 9 0
- Auto-Slim De Luxe Stereo AT6 ..... £12 5 0
- Lab. Model "A" Mono ..... £19 14 0
- Lab. Model "A" Stereo ..... £20 10 0
- Postage on all above 3/-
- SINGLE PLAYERS
- Auto start and stop. With pick-up and crystal cartridge.
- GARRARD T.A. Mk. II Mono ..... £7 17 3
- GARRARD SRP10, latest model single player with G.C.R. .... £5 9 11
- E.M.I. 4-speed STEREO ..... £3 19 6
- Post on all above 5/-
- COLLARO JUNIOR 4-speed motor and pick-up 69/6. 6 volt battery version, 4-speed with pick-up 69/6.
- R.S.R. T10, non-auto. Turntable and pick-up, 59/6.

- ### STAAR KINDER RECORD PLAYER
- 45 r.p.m., 6 v. Batt. operated. Comp. with pick-up fitted crystal cartridge. Size only 7 1/2 x 6 in. Fitted auto. stop and start. New and perfect.
- LASKY'S PRICE 49/6/- P. & P. 2/6.
- 2 speed model for 33 1/2 and 45 r.p.m. 79/6 P. & P. 2/6.

**TRANSISTOR AMPLIFIER.** 300 m/w output. Uses 2 OC71 and 2 OC72. Vol. and tone controls. Fully assembled, size 3x2x2in: 39/6. Post 2/6. Knobs 3/6 extra. Speaker 30 ohm 7x4in. Match to amplifier 25/- Post 1/6.

**CELLULOSE WADDING.** For lining the interior of loudspeaker enclosures. Width 36in. Any length cut to nearest 6in.

LASKY'S PRICE 2/11 per sq. yard and P. & P. extra.

**BONDED ACETATE FIBRE** as recommended by Wharfedale for acoustic lagging 36in. wide 5/11 per sq. yd. and pro rata. P. & P. extra.

**AUTOMATIC CAR AERIALS**

Electrically operated automatically extends and retracts at touch of a button. Opens to 72in. Easily fitted. Heavy chrome plated. 12 volt only. LASKY'S PRICE £7/19/6.

**TRANSISTORS**

ALL NEW and GUARANTEED

GET S1, GET S5, GET S6 2/6; 837A, 874P 3/6; OC 45, OC 71, OC 81D 4/6; OC 44, OC 70, OC 76, OC 81 (match pair 10/6), 5/6; AF 117, OC 72, OC 75, OC 170, OC 171, OC 200 6/6; OC 25, OC42, OC 43, OC 73, OC 82D 7/6; OCP 71 9/6; OC 28, OC 201, OC 204 15/-; OC 205, OC 206 19/6.

★ LARGEST and most COMPREHENSIVE STOCKS of all COMPONENTS, TEST GEAR, etc., and FINEST VALUES IN GREAT BRITAIN

## BY FAMOUS BRITISH MANUFACTURER STEREO AMPLIFIER

Self-contained integrated stereo amplifier, including combined control unit, pre-amplifier. Designed to provide high quality stereo and mono reproduction with a rated output of 6 watts per channel stereo 12 watts mono. Input sockets are provided for the direct connection of most types of tuners and pick-ups, plus tape heads and high quality microphones including moving coil and ribbon. Separate output for feeding a tape recorder available on each channel. Facilities include inputs for Mtc, 3 m/s; tape 4 m/s.—equalised for OC18; R1AA. 4.3 m/s; flat 250 m/s; radio tuner 100 m/s. Overall response 60 cycles—20,000 cycles. Controls fitted are bass, treble, balance, volume, phase reverse, stereo sense and selector. Outputs 4, 8 and 16 ohms. Mains voltage 100-240 v. A.C. Attractively styled in free-standing metal case, finished in silver and black. Size: 14x8x4 inches. Suitable for use with any good quality tuner, speaker system, record player, etc. Will form the basis of a high fidelity stereo system. Brand New and Unused in maker's original cartons.



LASKY'S PRICE  
**£15**

Carriage & Packing 7/6

**SUB-MIN TRANSISTOR AMPLIFIER**

NPN-PNP Transistors. Smallest ever, size 1in. x 1in. x 1in. Output 125 MW from 9 v. batt. Output impedance 30-60 ohms. Freq. range 100 cycles. 23 Kc/s. Uses 3 transistors. Single-ended push-pull output. Fully assembled on printed circuit with full data and instructions. 29/6 complete, post 2/6.

**ADAstra 3-3 AMPLIFIER**

Adstra 3-3 amplifier. Three watt output, built to the well known 3-3 design with volume bass and treble controls. Size 9in. x 7in. x 4in. With attractive esutechone. Ready built. LASKY'S PRICE £4/19/6. P. & P. 2/6.

- ### "LINEAR" AMPLIFIERS
- "Diatonic" 10-14 watt ..... 12 Gns.
  - "Concord" 30-watt ..... 16 Gns.
  - L45, 4-5 watt ..... £5 19 6
  - LT45 Tape Deck Amp. .... 12 Gns.
  - L10 10 watt with pre-amp. .... 15 Gns.
  - L50 50-watt ..... 22 Gns.
  - L5/5 Amplifier and Pre-amp. .... 12 Gns.
  - LPI Tape Pre-amp. .... 9 Gns.

**HI-FI TAPE RECORDER HEADS**

High Impedance Record/Play. Low impedance erase. Price **Lasky's 29/6**

Upper or lower track. Post free

State track required when ordering. Per pair.

MARRIOTT "X" Type 3 track heads, Record/play and erase. 4 GNS. pair.

3 Track heads record/play and erase 59/6 pair.

- ### TRANSCRIPTION MOTORS
- GARRARD 4HF, stereo or mono £16 19 6
  - GARRARD 301 ..... £20 12 0
  - GARRARD 301 (Strobe) ..... £22 0 0
  - GARRARD A with GC8 ..... £19 14 0
  - GARRARD A with GSC10 ..... £20 10 0
  - PHILIPS AG/1016 ..... £12 12 0
  - BRAUN PC4L Stereo ..... £12 9 6
  - Carr. & Ins. 5/- Also Lenco, Connoisseur, etc.

## TWO LOUDSPEAKER ENCLOSURES

The "Accadia" A beautifully designed cabinet for a 13x8in. speaker and 4in. tweeter. Finished in medium walnut (incl. back panel) size 12in. x 14in. x 27in. high, 3/4in. thick. Fully lagged interior. Piano gloss finish. LASKY'S PRICE £6/19/6. Less Speakers. Carr. and pack. 12/6 extra.

A PAIR OF SPEAKERS and a cross-over capacitor (3 ohms) 52/6 complete. Post 3/6.

The "Sharon" reflex enclosure with 10x6in speaker and 4in. tweeter. Finished semi-matt medium mahogany. Size 11in. x 11in. x 26in. high, 3/4in. thick. Fully lagged interior. Fitted with 15 ohm speakers, and cross-over capacitor. LASKY'S PRICE £9/19/6. Complete with speakers. Carr. & pack. 12/6 extra.

NOTE. If you wish to change the impedances of the above speaker systems we can supply a suitable impedance matching transformer at 13/6.

## PRIVILEGE PARCELS

A "Privilege Parcel" allows you to purchase the Audio System of your choice at a worth-while cash saving. Some examples are listed below, but we shall be pleased to quote our "Privilege Parcel" Prices for any selection of equipment of your own choice. Send us details of your requirements.

- Tudor Stereo Amplifier ..... £15 0 0
- Connoisseur Craftsman, 2-speed transcription player ..... £16 6 6
- Decca FF88 Stereo Pick-up ..... £18 18 0
- Total ..... £50 4 6

"Privilege Parcel" Price: £47/10/-

- Tudor Stereo Amplifier ..... £15 0 0
- Braun PC4L Stereo Transcription Unit ..... £12 9 6
- 2x Sharon Loudspeaker Systems ..... £18 19 0
- Total ..... £47 8 6

"Privilege Parcel" Price: £45/-

- Collaro Studio Tape Deck 4 track model £10 10 0
- Lasky's Tape Amplifier ..... £8 19 6
- Portable Case ..... £3 15 0
- 7 x 4in. speaker ..... 15 6
- Total ..... £24 0 0

"Privilege Parcel" Price £22/10/-

- Collaro Studio Tape Deck 4 Track Model £13 19 6
- Martin Tape Amplifier, 4 track model ..... £12 12 0
- Portable Case with Speaker ..... £5 5 0
- Total ..... £31 16 6

"Privilege Parcel" Price: £30.

Carriage and Packing on all the above parcels, 10/6 extra.

## MODEL SR40 COMMUNICATIONS RECEIVER



Covers medium wave band and 1.6-4.4 Mc/s., 4.5-11.0 Mc/s., 11.0-30.0 Mc/s. in separate switched band spread ranges. Controls include B.F.O. Sensitivity, A.N.L., Receiver-Standby Switch, Tone Switch, S-Meter. For 200/250 v. A.C./D.C. Internal loop and telescopic antennae fitted. Valve line up. 12BE6, 12BA6, 12AV6, 50C5, and metal rectifier. Size 13 1/2 x 8 1/2 x 5 1/2 in. LASKY'S PRICE £24/15/- Carr. and Ins. 15/- Instruction manual included.

## ELECTRIC MOTORS

Brand new tape recorder motors. Single phase, fully shrouded. 200-250 v. A.C. 3 x 1/2 in. spindle with detachable pulley, fitted switch. Suitable for tape decks, record players and many other uses.

P. & P. 3/6. **14/11**

**33 TOTTENHAM COURT ROAD, W.1.**

2 mins. Oxford Street. Nearest Station, Goodge Street. MUSEum 2605

**207 EDGWARE ROAD, W.2.**

Few yards from Praed Street. PADdington 3271/2

Both addresses open all day Saturday. Close 1 p.m. Thursday.

ELECTRONICS (FLEET ST.) LTD.

**152/3 FLEET STREET, E.C.4.** FLEet St. 2833.

Open all day Thurs. Closed 1 p.m. Sats.

PLEASE ADDRESS ALL MAIL ORDERS TO OUR HEAD OFFICE:—207 EDGWARE ROAD, W.2.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

# LASKY'S RADIO

## IDEAL PRESENTS BOYS TRANSISTOR RADIO—

Ready built, 2 transistor pocket radio. In attractive plastic case. Size only 4in. x 2 1/2in. x 1in. Fitted with 2in. loudspeaker. Socket for personal earpiece and telescopic aerial. Works from single PP3 type battery. Fully tunable over full medium waveband. Supplied complete with earpiece, telescopic aerial, carrying purse and 9-volt battery. Ideal Birthday or Christmas Present.

Price **45/-** P. & P. with all accessories. 2/6.



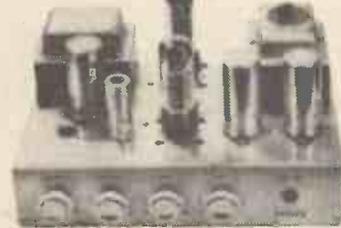
complete with all accessories. P. & P. 2/6.

6 Transistor pocket radio fully built, in plastic case, 4in. x 2 1/2in. x 1in. with 2 1/2in. speaker. Uses single PP3 type battery. Supplied complete with personal earpiece and leather case. Tunable over full medium waveband.

**LASKY'S PRICE 79/6**

## Hi-Fi "TWENTY"

20 watt amplifier with integrated pre-amp/control unit. Valve line-up: E.P.86, E.C.F. 80, 2-EL 34 and metal rectifier. Size: 12in. x 9in. x 5in. High and low gain



inputs with a separate volume control for each. Bass and treble controls fitted. 13 ohms output. Socket with spare H.T. and L.T. for tuner, etc. An excellent amplifier for guitar and P.A. work. Carr. & Pack. 7/6.

**LASKY'S PRICE £14.19.6**

## AN OUTSTANDING OFFER OF MAKERS' SURPLUS TAPE RECORDERS BY A WELL KNOWN BRITISH MANUFACTURER

Two versions available: Model 20 is a twin track machine with speeds of 1 1/2 and 3 1/2 i.p.s. and Model 40 is a quarter track version with speeds of 3 1/2 and 7 1/2 i.p.s.



Specification for both models is as follows—  
Frequency Response: at 7 1/2 i.p.s. (19 cm.) 40-14,000 c.p.s. at 3 1/2 i.p.s. (9.5 cm.) 40-10,000 c.p.s.  
Signal to Noise Ratio: -40 dB. at the higher speed of each model  
at 7 1/2 i.p.s. (19 cm.) better than 0.25%  
at 3 1/2 i.p.s. (9.5 cm.) better than 0.3%.

**4 WATT OUTPUT TRUVOX DECK.**  
Reel size: 7in. Rola Cestelon Loudspeaker, 7in. x 4in. Automatic Stop operates if tape breaks and at end of tape (no foil required). Pause control. Single knob tape control. Independent Mixer Input Controls. Monitoring through speaker whilst recording. Tone control. Magic eye level indicator. Connection for extra loudspeaker—3 and 15 ohms. Connection for external amplifier. 4-digit counter. Storage for two extra reels. Superimposition. Supplied with microphone spool of tape and empty reel. Dimensions: 17in. x 13in. x 7in. Beautifully styled portable carrying case, with lid and carrying handle covered in grey washable material. Weight: 22 lbs. Voltage: 200/240 volts, 50 cycles, A.C. all models. List Price 39 GNS.

**LASKY'S PRICE MODEL 20. 18 gns.**  
**MODEL 40. 23 gns.**  
Carriage and insurance 15/- each extra.

# HUGE PURCHASE OF TAPE-RECORDERS

All Brand New and Unused, in perfect working order. Supplied complete with crystal microphone, reel of tape and empty spool, also screened lead for recording from radio, pick-up, etc.



### SPECIFICATION

**MODEL A** Studio Deck, Four Track. Speeds: 1 1/2, 3 1/2 and 7 1/2 i.p.s. Spool capacity: 7in. Wow and Flutter: Less than 0.16% total. Playing Time: up to 18 hours. Frequency Response: 12,000 c.p.s. at 7 1/2 i.p.s. Mains Voltage: 200-250 v. 50 c/s A.C. Output: 3 watts.

Carriage and Insurance **LASKY'S PRICE 27 gns.** 15/- extra.

### MODEL B

**STUDIO DECK, TWO TRACK**  
Specification as for Four Track model above, except that this is fitted with Two Track Studio Tape Deck.  
Maximum Playing Time, up to 9 hours from one reel of tape.

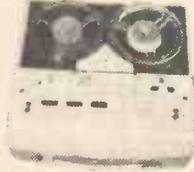
Carriage and Insurance **LASKY'S PRICE 25 gns.** 15/- extra.

The following specifications are common to all three models: Tone Control Visual Recording Indicator. Inputs: Microphone, Radio, Record-Player, Radiogram, Telephone Adaptor. Fully Automatic Erase. Facilities: Fast spooling, forward and reverse. Valves: Latest Mullard Miniature types. Rectifier: S.T.C. or Westinghouse Metal Rectifier. Loudspeaker: Standard 3 ohm with extension speaker socket. Microphone: new super sensitive crystal in the new easy to hold microphone case.

Carrying Case: Portable case with detachable lid, harmonising gold trim and automatic safety locks. Storage cubby for microphone and accessories covered in. New type washable scratch resistant Vinyl.

Size for Models A and B: 14 1/2 x 14 x 6 1/2in. Size for Model C: 14 x 12 1/2 x 6 1/2in.

**LASKY'S PRICE 18 gns.**



### MODEL C

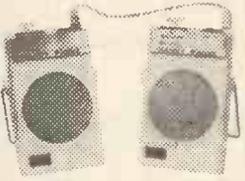
Fitted with B.S.R. Deck, two-track version. Specification: Single speed, 3 1/2 i.p.s. Freq. response, 10,000 c.p.s. at 3 1/2 i.p.s. Spool capacity: 5 1/2in. Mains Voltage: 200-250 v. 50/60 c/s A.C. Wow & Flutter: Less than 0.2% total. Output: 3 watts. Playing time: up to 3 hours. Carriage and Insurance 15/- extra.

## Fully transistorised—INTERCOM BABY ALARM

In 2 compact units, each size 4in. x 2 1/2in. x 1in. Internal loudspeakers give ample volume. Complete ready for immediate use. Works from PP3 battery.

**LASKY'S PRICE 69/6** P. & P. 2/6.

Complete with battery and sixty feet of connecting wire.



## THE RAINBOW INTERCOM

A high powered 2 station intercom—ideal for shops, offices, etc.

**LASKY'S PRICE £6.19.6** P. & P. 3/6.

## DISTLER MINIATURE MOTORS

6 volt battery operated

P. & P. 2/6. **7/11**

A.K.G. Moving coil stereo head-phones. Lightweight with ear pads. 7 GNS. per pair.  
FOSTER Stereo moving coil head-phones. 79/6 including ear pads. P. & P. 2/6 pair extra.

## THE PARMAN "SYMPHONIA"

HIGH FIDELITY TAPE REPRODUCER AND RECORDER  
A FEW ONLY

Comprises a Hi-Fi 10-watt (undistorted) push-pull amplifier, with Truvox Mk. VI tape deck and Wharfedale loudspeaker, in an attractive cabinet. The speaker is mounted within the cabinet in an acoustic chamber. Bass and treble controls are fitted, together with a moving coil record level meter. Comprehensive control is provided on The Symphonia throughout the chain from signal input to output from the speakers.  
Extra power is provided for feeding a radio tuner unit, and space is available on the top panel to fit such a unit.  
GENERAL SPECIFICATION. For 200-250 volts A.C. Mains. Two-track recording to International standards. Speeds 7 1/2 and 3 1/2 i.p.s. Push button controls, will take 7in. spools. Pause control, fast forward and rewind, digital rev. counter.  
Amplifier Response: 25 c/s—25 kc/s + 1 dB at 1 watt; 30 c/s—18 kc/s + 3dB at 10 watts. Distortion less than 0.15% + 1 kc/s at rated output.  
Separate inputs provided for Radio, Pick-up and Microphone.  
Socket for external loudspeaker fitted. A further output socket is provided for feeding additional amplifier or to dub recordings through another recorder.  
Power output H.T. 300 volts at 30 m/a D.C. and 6.3 volts at 2 amps. A.C.  
Wharfedale 8 inch high quality loudspeaker fitted.  
The Symphonia can also be used as a High-Fidelity reproducer from either mic. or record player, and the output recorded at the same time. Full mixing facilities from two inputs.  
The hinged lid is controlled by a pneumatic stay. Size 30in. wide, 16in. deep, 28in. high. The Instruction Booklet will be sent for your examination on deposit of 10/6 (returnable).



**LASKY'S PRICE 49 Gns.** BRAND NEW REEL OF TAPE. Carriage and insurance extra. (Quotations on request)

PARMAN EXT. LOUDSPEAKER SYSTEM. Comprising a Special 10in. Goodmans loudspeaker and Goodmans 3 1/2in Tweeter with crossover. Mounted in an acoustic chamber—size 15 1/2in. x 13 1/2in. x 5in. The chamber is fitted on a baffle—24in. x 18in. Attractively covered in gold anodised expanded aluminium with legs for floor standing. 15 ohm impedance. Few only. Special offer £3.19.6. Carr. & Pack, 7/6.



**MULTI-RANGE TESTMETERS**

Caby M1 ...	£2 14	0
Caby B20 ...	£6 10	0
Eagle EP10K	£4 12	6
Model 200H	£5 5	0
Eagle EP50K	£9 19	6
Caby A10	£4 17	6
Taylor 127A	£10 0	0
Eagle TK20A	£2 9	6
Eagle EP30K	£6 19	6

**PORTABLE TAPE RECORDER.** Fully transistorised, battery operated, dual track, complete with all accessories. Of the finest quality construction. A4 transistor plus diode, push-pull amplifier, built-in loudspeaker, £9/19/6.

**STEREO AMPLIFIER,** beautifully styled, ultra compact, 4 watts per channel, wide range tone and volume controls, £9/10/-.

**STEREO AMPLIFIER,** 7.5 watts per channel, accommodates stereo magnetic cartridges as well as crystal ceramic cartridges, tuner, tape mic. and auxiliary input, bass and treble controls, £16/10. Radio Tuner, suitable for use with amplifiers and tape recorders, complete with standard Jack plug, covers medium waveband with instructions, 29/- each.

**TRANSISTORS INTERCOM.,** suitable as a baby alarm or for communications in home, offices, shops etc., transistorised, a 2-way buzzer-call system, beautifully styled in moulded plastic cases, complete with battery, connecting wire, instructions etc., £4/4/-.

**MICROPHONES:**

Acos Mic 39/1	£1 12	6	Acos Mic 40	19	6
Floor stand adaptor			BM3 Microphone	£2	5 0
	12	6			
Acos Mic. 45	19	6	Floor stands MS4	£2	19 6
Table Stand	12	6	3 sections		
Mic 100C	£1 19	6	Table top stand		8 0
Table Stand	7	6			

**AMERICAN RECORDING TAPE.** Standard play 5in. spool, 600ft., 9/6; 5½in. spool 850ft. 11/9; 7in. spool 1,200ft. 14/9; long play 5in. spool 900ft. 12/6; 5½in. spool 1,200ft. 15/-; 7in. spool 1,800ft. 19/6.

**RADIO TUNER,** suitable for use with amplifiers and tape recorders, complete with standard Jack plug, covers medium waveband, with instructions, 29/- each.

**GRAMOPHONE UNITS**

BSR TU12 unit, with Mono TC8H Cartridge, £3/19/6.

BSR GU7 unit, with TC8M or TC8H Cartridge, Mono, £4/15/-.

BSR GU7 unit, with TC8S c'ridge, Stereo, £5/5/-.

Garrard Autoslim, automatic, with GC8 Mono Cartridge, £7/15/-.

Garrard Autoslim, automatic, with EV26 Stereo Cartridge, £8/10/-.

Garrard Autoslim de luxe with GC8 Mono Cartridge, £11/5/-.

Garrard Autoslim de luxe, with EV26 Stereo Cartridge, £12.

BSR Monarch UA14, with TC8 Mono C'ridge, £6/6/-.

BSR Monarch UA16, with TC8 Mono Cartridge, £6/19/6.

BSR Monarch UA16, with TC8S Stereo Cartridge, £7/19/6.

**SETS OF TRANSISTORS**

Set 1. Comprising OC44, 2 x OC45, matched pair OC81 ... 32/6 set

Set 2. Comprising OC81 Driver, matched pair OC81 ... 15/6 set

**TERMS:** Cash with Order or C.O.D. Postage and Packing Charges extra. Single valves 9d., Minimum Parcel Post charges 2/-. Please include sufficient postage with your order. Minimum C.O.D. fee and postage 3/6. These Postal Rates apply to U.K. only. For full terms of business see inside cover of catalogue. Personal Shoppers 9 a.m. to 5 p.m. Mon. to Friday, Saturday 10 a.m. to 1 p.m.

**ADASTRA 3-3 AMPLIFIER.** Specification: Controls—Volume, Treble, Bass with on/off. Valves—EZ80 rectifier, ECL86 amplifier and output. Output power—3 watts at 3.5 ohms impedance. Input sensitivity—200 millivolts. Frequency response—75-20,000 c/s. Hum and noise—70 db. Feedback—10 db. For 200-250 volts A.C. 50 c/s. Well finished in blue with a smart panel with gold markings. Specially made of good components and performs exceptionally well for the price, £4/19/6.

**TRANSISTORS AND DIODES**

Mullard	AF126	10/-	OC72	8/-
	AF127	9/6	2-OC72	16/-
	OC16W	35/-	OC74	8/-
AC107	14/6	OC19	25/-	OC75
AD140	25/-	OC26	25/-	OC78
AF102	27/6	OC42	8/-	OC81
AF114	11/-	OC44	9/3	OC81M
AF115	10/6	OC45	9/3	OC82
AF116	10/-	OC45M	9/3	OC83
AF117	9/6	OC47	9/3	OC83
AF118	20/-	OC45M	9/3	OC170
AF124	10/-	OC70	6/6	OC171
AF125	10/6	OC71	6/6	

**DIODES**

BY100	13/-	OA90	3/-	GEX34	4/-
OA70	3/-	OA91	3/-	GEX35	4/-
OA79	3/-	OA95	3/6	GEX36	10/-
OA81	3/-	OA210	9/6		

**VALVES**

DK96	7/9	PCC84	7/6	PCL82	9/-
DAF6	6/9	PL82	7/6	6V6G	4/-
DF96	6/9	PY83	7/6	6K7G	2/-
DL96	6/9	UABC80	7/6	6AM6	3/6
ECC81	5/-	UAF42	7/6	EB91	3/-
ECC82	5/6	UBF80	7/6	1R5	5/3
ECC83	6/-	UCH42	7/6	1T4	3/6
ECC84	7/6	UL41	7/6	1S5	4/6
ECC85	7/6	EY51	8/-	35A	5/6
ECH81	7/6	PL81	8/6	6K8G	4/9
EBC41	7/6	PL36	9/6	6L6G	7/6
EF41	7/6	PCL83	9/6	6Q7G	5/6
ECL80	7/6	PCF82	9/6	6X5G	5/-
PCF80	7/6				

**ALPHA RADIO SUPPLY CO. 103 Leeds Terrace, Wintoun Street, LEEDS, 7**

2W W-136 FOR FURTHER DETAILS.

**Radio Spares Ltd.**  
FOR ELECTRONIC COMPONENTS-BY RETURN



2W W-137 FOR FURTHER DETAILS.

**AERIAL MASTS**

**20FT. TELESCOPIC MAST**

NEW all steel tubular 4 section Masts suitable for Roof or Wall fixing, as well as Base location, can be extended to full height or locked at any position by special Roller Cam locking rings. Drilled plate at the top allows for guying if necessary. Bottom section approximately 1½in. diameter and the whole was intended to slip into a vehicle mounted socket. Copperised and Sprayed finish. Weight 16lb.

**Price £5.0.0** Carr. 7/6.

**40FT. TELESCOPIC MAST**

New 5 section Tubular Steel Mast, with guying points at top of each section, if needed. Each 8ft. section is locked in extended position by a Steel Pin. Bottom section approx. 2½in. dia. Ideal for Roof or Wall fixing, or sunk into Cement Base. Sprayed anti-corrosive finish. Wt. 38lb.

**Price £10.0.0** Carr. 12/6.

Both Masts can be used as School or Club Flagstaffs.

**LIMITED QUANTITY 36FT. TELESCOPIC MAST.**

Complete with built-in hand winding winch for easy, rapid extension. Finest quality brass. Non-rusting. Base diameter 2½in. Provision for bracing stays. Winds down to 9ft. One of the best masts ever produced.

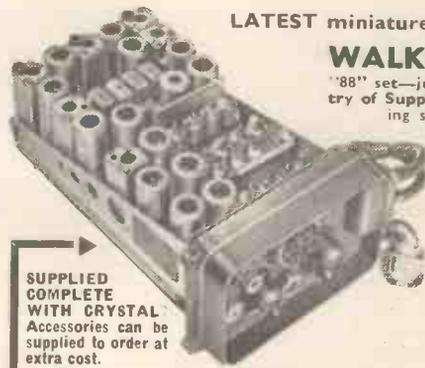
**Price £35.0.0** Carr. 30/-.

**LATEST miniature**

**WALKIE TALKIE**

'88" set—just released by Ministry of Supply. Produced to exacting specifications by leading manufacturers E. K. Cole & Co.

Only **£10** Each



**SUPPLIED COMPLETE WITH CRYSTAL** Accessories can be supplied to order at extra cost.

This Transmitter/Receiver weighs only 5½lb. (approx.) and measures 3½in. x 5½in. x 3½in. It is a 4 frequency channel set, crystal controlled 38-40/40-42 Mc/s., and operates from a Standard Dry Battery—H.T./L.T. 90 v./1.3 v. (i.e. Ever Ready/Barec B 136). 14 of the current series of B7G valves are employed: 1-3A4, 6-IL4, 4-1T4, 1-1S5, 2-1A3. Each set in first-class condition. Special quotations for quantities.



**The Irongate (M.O.) CO. LTD**

Dept (WW 50) IRONGATE WHARF ROAD, PRAED STREET, LONDON W.2 PADDINGTON 2233

2W W-138 FOR FURTHER DETAILS.

# NEW TEST EQUIPMENT

## HEAVY DUTY 20 AMP. L.T. SUPPLY UNIT

by S.T.C.



Normal cost over £100. Essential equipment for Electronic Engineering. Research Laboratories, Schools. Ideal for battery charging, etc. Guaranteed for 20 amps.

Output: D.C. variable up to 20 amps. and 24 v. or trickle charge 125/350/700 m. A/H. Input: A.C. 100/260 v. 45/65 cycles. Size: 16 x 24 x 32in. high. In attractive grey cabinet.

ONLY **£27.10.0**

## CONSTANT VOLTAGE TRANSFORMER DUAL VOLTAGE MAINS STABILIZER



provides perfectly stabilized constant voltage for all laboratory equipment.

★ Completely protected from damage if appliance is short-circuited, output voltage reduces to nil.

★ NO MOVING PARTS.

Spec.: Input: 180-260 v. A.C. & 85-125 v. A.C.

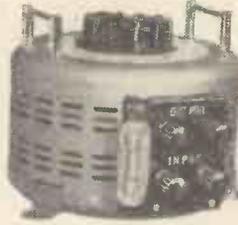
Output: 240 v. A.C. and 115 v. A.C. —50/60 cycles.

Capacity: 250 v.A. Accuracy: ±1% Size: 8 x 8in. Weight: 21lb.

Complete with lead and plugs, in attractive vented metal case with leather handle.

**£11.10.0**

## WORLD FAMOUS "SLIDUP" VARIABLE TRANSFORMERS



Output: 0-260v. 2.5 Amp. Input: 230 V.A.C. 50/60~.

A SHROUDED FULLY VARIABLE TRANSFORMER FOR BENCH OR PANEL MOUNTING.

Size: Approx. 5in. Cube Weight: 8 lb.

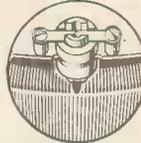
2.5 Amp. .... **£5.17.6**

5 Amp. .... **£9. 0. 0**

10 Amp. .... **£18. 5. 0**

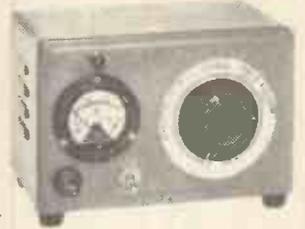
20 Amp. .... **£32. 10. 0**

Inset shows latest type brush gear enabling 1 volt variation to be made.



## PORTABLE VARIABLE A.C. POWER SUPPLY UNIT

Output: 0-260 v. 1½ amps. Input: 230 v. A.C. 50/60~. Unit fitted with fuse, voltmeter, safety indicator, on-off switch and lead.



PRICE **£7.15.0**

# IMMEDIATE DELIVERY

ALL ITEMS FULLY GUARANTEED—CARRIAGE FREE

## DIELECTRIC BREAKDOWN TESTER HIGH-VOLTAGE TEST SET



★ **RANGE:** Infinitely variable up to 3,000 volts and can be accurately set.

★ Entirely Suitable for Continuous testing.

★ Built-in Automatic safety cut-out.

INPUT: Mains voltage.

Robustly constructed for bench use with 4½in. x 4in. modern styled meter, placed at an easy to read angle. Complete with input and test leads with clips.

Model T30, 0-3,000 V.A.C. **£32.0.0**

Model T50, 0-5,000 V.A.C. **£40.0.0**

## TRANSISTORISED MEGOHMMETER

BATTERY OPERATED. 500 v.-1,000 Megohms.

This most advanced insulation and continuity tester incorporates these outstanding advantages:

★ One-handed push-button operation.

★ 4in. A.C.-D.C. Voltmeter with fine Zero adjustment.

★ Stable and accurate readings.

★ Easy-to-read scaling.

★ Metal case 7in. x 5in. x 3in.

Complete with probes and carrying case.

ONLY **22 GNS.**

Model MT-500. 500 v. 0-500 meg-ohms insulation Tester.

Mains operated. Suitable for bench use, complete with lead

**25 GNS.**



## TRANSISTOR TESTER

READING ACCURACY = ±3%



MEASUREMENT RANGES:

Ico (Icbo) and the reverse current of diodes.

PNP & NPN—0~50µA (1µA per scale)

POWER—0~1mA (20µA per scale)

85-200 (5 per scale)

Bias current—

(1mA on PNP & NPN)

(5mA on POWER)

α 0.9-0.995 (from β =  $\frac{\alpha}{1-\alpha}$ )

Terminals: Spring Sockets and Screw Terminals.

Meter: 4in. 50µA moving coil.

Size and Weight: 8in. x 4in. x 8in., 2½ lb.

Powered by pen-cells.

Model AT-1 **£9.17.6**

The **Irongate** (M.O.) CO. LTD

Dept. (WW49) IRONGATE WHARF ROAD, PRAED STREET, LONDON, W.2 PADDINGTON 2233

# ARMSTRONG RADIOGRAM CHASSIS



£21-14-0

## AF/208 AM/FM RADIOGRAM CHASSIS (Carriage free)

- Full VHF Band (87-108 Mc/s). Medium Band, 187-570 m.
- 5 watts Output. Perfect quality.
- 15dB Negative Feedback. 7 valves.
- Separate wide range Bass and Treble Controls.
- 2 Compensated Pick-up Inputs.
- Frequency Response 30-22,000 c.p.s. ±2dB.
- Tape Record and Playback Facilities.
- Continental Reception of Good Programme Value.

For 3, 7½ and 15 ohm Speakers.

## BARGAIN SALE PRICES

New boxed VALVES 90-day guarantee.

OZ4	5/-	6K76	5/-	8B91	4/-	PCL32	10/-
1R5	6/-	6K80	5/-	8B04	8/-	PL84	10/-
1S5	6/-	6L6	8/-	8C81	8/-	PL81	10/-
1T4	3/-	6N7M	8/-	8BF80	9/-	PL83	8/-
2X2	2/-	6Q7G	6/-	8CH42	9/-	PY33	15/-
384	7/-	6SN7	5/-	8CH81	9/-	PT80	7/-
3V4	7/-	6V8G	6/-	8CL30	9/-	PT81	8/-
3Q5	7/-	6X4	5/-	8CL82	10/-	PT82	7/-
3U4	6/-	6X5	6/-	8E85	6/-	QF85	7/-
5Y3	6/-	12A7	6/-	8F89	8/-	SP41	3/-
5Z4	9/-	12AU7	6/-	8L32	5/-	SP61	3/-
6AC7	4/-	12AX7	7/-	8L84	7/-	U22	7/-
6AM6	4/-	12BH7	7/-	8Y51	9/-	UBC41	8/-
6AT6	6/-	12E7	5/-	8Y88	9/-	UBC81	9/-
6BA6	7/-	12EX8	14/-	8Z40	7/-	UBF80	9/-
6BE6	5/-	12G7	5/-	8Z80	7/-	UGH81	9/-
6BW6	7/-	25Y5G	9/-	8Z81	7/-	UCL82	10/-
6C4	5/-	35L6	9/-	HAB8C10	10/-	UCL33	12/-
6D6	5/-	35Z4	5/-	HV82A	5/-	UP89	9/-
6E6	4/-	854	2/-	KT333	8/-	UL41	9/-
6H6	3/-	DAF95	8/-	KT76	8/-	U41	7/-
6K5	5/-	DF93	8/-	MU14	7/-	U785	7/-
6J6	5/-	DK96	8/-	PC834	8/-	U9	7/-
6J7G	6/-	DL83	8/-	PCF83	8/-	VR130/007	7/-
6K6	5/-	EAB8C8	8/-	PCF82	8/-	W81	6/-

## NEW ELECTROLYTICS FAMOUS MAKES

TUBULAR	TUBULAR	CAN TYPES	
1/350v.	2/- 50/350v.	5/6 8/800v.	9/-
2/350v.	2/3 100/35v.	2/- 18/800v.	12/-
4/350v.	2/3 350/25v.	2/6 16/450v.	5/-
8/450v.	2/3 500 12v.	2/- 32/350v.	4/-
16/450v.	3/- 1,000/12v.	3/- 50/450v.	6/6
32/450v.	3/6 5,000/6v.	5/- 32+32/350	5/-
25/25v.	1/6 8+8/450v.	3/6 32+32/452	6/-
25/150v.	2/- 8+16/450v.	3/6 50+50/350	7/-
50/25v.	2/- 16+16/450v.	4/3 64+120/350v.	11/6
100/50v.	2/- 32+32/350	4/6 100+200/275v.	12/6

TINNED COPPER WIRE 16 to 22 s.w.g. 1 lb. 3/-.  
 COPPER ENAMEL WIRE 16, 18, 22 s.w.g. 2/9 24 to 36 s.w.g. 3/6 32 to 44 s.w.g. 4/6 D.C.C. 28 7/4 36 s.w.g. 1/6 2/8

## CRYSTAL MIKE INSERTS. High output

Miniature size, 1½in. dia. x ¾in. ....	6/6
ACOS STACK MIKE 39-1 .....	35/-
T.S.L. DE LUXE STACK MIKE .....	25/-

HORSE KEY 4/6; BUZZER 4/6.  
 VALVE HOLDERS. EA50 6d. B12A. CRT. 1/3. Engr. and Amer. 4, 5, 6 and 7 pin 1/-.  
 MOULDED Int. Oct. or Mazda Oct. 6d.; B7G, B8A, B8G B9A 6d. B7G with can 1/6. B8A with can. 1/9. Ceramic EF50, B7G B8A Int. Oct. 2/-. B7G, B8A cans 1/1. each. Valve base plugs B7G B8A 2/3 each.

## C.R.T. BOOSTER TRANSFORMERS

For Cathode Ray Tubes having heater Cathode chbr. circuit and for C.R. Tubes with full hot emission tube instructions. Mains input 10/6 each.  
 LOW LEAKAGE WINDINGS. OPTIONAL 25% cur. sec. BOOST OR SECONDARY 1 V. OR 4 V. OR 6.3 V. OR 12 V. OR 15 V. (State tube type required.)

HEADPHONES 4,000 ohms 15/- pair.  
 HEADPHONES, moving coil 100 ohms 10/- pair  
 SWITCH Cleaner fluid squirt sprout, 4/6  
 SPEAKER-FRET. Gold Green or Maroon 6½" x 17" x 25 v. 5-12/25/36in. 10/- Tyan various colours, 8½in. wide. Int. 10/ 11. 25in. wide. 10m 5/- 11. Sam. los. F.A.E.  
 Expanded Metal, Gold, 19 12in. 1/-.

## MINIATURE PANEL METERS

Size 1½in. sq. Precision jewelled bearings. 2% accuracy, silvered dials, fine pointers, zero adjustment. 0-1mA 27/6; 0-5mA 27/6; 0-300 v. 27/6; 0-50mA 39/6; 0-500mA 32/6. "S" meter 35/-.

## CABY MULTIMETER M1, etc.

0-1200 v. A.C.-D.C. Ohms 0-100K, 54/-

## MAINS TRANSFORMERS

200/250 AC Post 2/- each

TANDARD 250-0-250 80 mA, 6.3 v., 3.5 a., tapped 4 v., 4 a., Rectifier 6.3 v. 1 a. Tapped 5 v. or 4 v. 2 a.	22/6
Ditto 350-0-350 .....	29/6
MINIATURE 200 v., 20 mA., 6.3 v., 1 a. ....	10/6
MIDGET 220 v., 45 mA., 6.3 v., 2 a. ....	15/6
SMALL 220-0-220 50mA, 6.3 v., 2 a. ....	22/6
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HEATER TRANS. 6.3 v., 11 a. ....	7/6
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GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 9, 9, 10, 12, 15, 18, 24 and 30 v., at 2 a.	22/6
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AREBEKO MAINS TRANSFORMER. Made for special contract the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. A.T. 300-0-300 v. 50 mA. LT. 6.3 v. 1.8 a. Weight 6 lb. Price 17/6, post 2/6.  
 MULLARD "510" MAINS TRANS. TO SPEC. 38/6

J.P. TRANSFORMERS. Heavy duty 50 mA., 4/6. Miniature 3V4, etc., 5/8. Small, pentode, 4/6. Multi-ratio 7/6. Multi-ratio heavy duty push-pull 10 w., 15/6. Goodmans heavy duty 10/20 w. 6K push-pull, 30/-.  
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 INTERVAL TRANSFORMERS, 1-1, 5-1, 9/- each.  
 L.F. CHOKES 15/10 H., 80/65 mA., 5/-; 10 H. 85 mA., 10/6; 10 H. 120 mA., 12/6; 10 H. 150 mA., 14/-.  
 FULL WAVE BRIDGE CHARGER RECTIFIERS. 2, 6, or 12 V., 11 a., 8/8; 2 a., 11/3; 4 a., 17/6.

Free charger circuit.  
 CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 11 a., 15/6; 2 a., 17/6; 4 a., 22/6. Ammeter 0 to 5 a., 9/6.  
 4 AMP. CAR BATTERY CHARGER with Ammeter, Lead: Fuse, Case, etc., for 6 v. or 12 v., 69/6. Ready built.

## BOOKS (List S.A.E.)

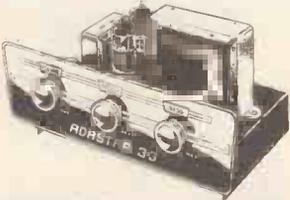
"W. W." Radio Valve Data	6/-
High Fidelity Speaker Enclosures	5/-
Valves Transistors, CRT Equivalents	9/6
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Coil Design and Construction	5/-
Transistor Sub-Miniature Receivers	5/-
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High Fidelity Stereo Gramophone	5/-
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Principles of Colour T.V. (Patchett)	16/-
Boys' Book of Crystal Sets	7/6
Stroboscopic Disc 31, 45, 78 r.p.m.	1/-
Realistic High Fidelity (Hartley)	5/-

CRYSTAL DIODES. G.E.C. 2/-; GEX34 4/-; OA81 2/-.  
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 CRYSTAL SET BOOKLET 1/- CRYSTAL SET KIT 2/6.  
 Brimistors CZ1 3/6; CZ2 2/6; CZ3 1/6.

## RADIO AND TELEVISION SPARES

All leading makes, volume controls, etc., line output transformers, etc., B.V. valves (current and obsolete types). Send S.A.E. for quotation.

## ADASTRA 3-3 AMPLIFIER 3 Watts



ADASTRA 3-3 Hi-Fi Amplifier  
 READY BUILT, WIRED & TESTED  
 A.C. only, 200-250 V. Valves ECL86 and EZ80, 3 ohms quality output. Mullard tone circuits. Controls: bass boost, treble and volume. Separate engraved front-panel with de luxe finish. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. Bargain Price £4/19/6. Details S.A.E.  
 "Performs agreeably well!"  
 (The GRAMOPHONE)

# BAKER'S 'Selhurst' RADIO



Quality Loudspeakers

CHOOSE

THE BEST AND SAVE POUNDS

12in. Stalwart 15w. 45/12000 c.p.s., 3 or 15ohms 90/-  
 12in. Stereo, foam suspension, 15 ohms £6/17/6  
 12in. Standard H.D. 20 w. 40-14,500 c.p.s. £8  
 12in. De Luxe foam, 15 w. 25-17,000 c.p.s. £9 10  
 12in. Bass 25 w. 20-18,000 c.p.s. £12/12/-  
 12in. Ultra Twelve, 20 c.p.s. to 25 kc/17/10/-  
 15in. Baker Bass Auditorium 35 w. Mk. II £18  
 Ideal for Bass Guitars.  
 Details and Enclosure Plans S.A.E.

LOUDSPEAKERS. PM 3 OHM FAMOUS MAKES 2½in. 3in., 4in., 5in., 6in., x 4in. 15/6 each; 8in. 17/6; 6in. 18/6; 10in. 30/-; 12in. 30/-; (15 ohms 35/-); 10in. x 6in. 99/6; E.M.I. Double Cone 13½in. x 8in. 35/-.  
 STEREO/IONIA. T388 5 or 15Ω 30/-; Crossover CX3000 30/-; 10in. HF1012 87/6; 8in. HF812 72/6.  
 TWIN GANG CONDENSERS "0-0" Transistor 24pF and 178 pF with trimmers and screen, 10/8 each; 85 pF miniature 1½ x 1½in. x 1½in. 10/-; 500 pF standard with trimmers, 9/-; midgel, 7/6; midgel with trimmers, 9/-; 500 pF slow motion drive, standard or midgel, 2/-; enamel 3 gang, 500 pF, 17/6. Single 10 pF, 25pF, 50 pF, 75pF 100pF 180pF 6/8 each. Can be ranged together. Couplers 6d each.  
 TUNING AND REACTION CONDENSERS. 100pF, 6d each. 500 pF, 3/6 each. solid dielectric.  
 CONDENSERS. 0.001 mfd., 7kV. T.C.C., 5/6; ditto 50 kV. 9/6; 0.1 mfd., 7 kV., 9/6; 100 pF, to 500pF. Micas, 6d. Tubular 50 v., 0.001 to 0.05 9d.; 0.1, 1/-; 0.25 1/6; 0.1/350 v. 9d.; 0.5/350 v. 1/8; 0.01/2,000 v. 1/9; 0.12/2,000 v. 3/8.  
 CERAMIC CONDENSERS. 500 v. 0.3 pF, to 0.01 mfd. 2/6. High voltage pulse ceramics. 100pF., etc., 12 kV., 2/6.  
 SILVER MICA. 10% to 500pF. 9d.; 800 to 3,000 pF. 1/-; close tolerance (plus or minus 1 pF.), 2/2 to 47 pF., 1/-; ditto 1/1, 50 to 815 pF. 1/-; 1,000 to 5,000 pF., 1/8.

## 465-470 Kc/s. SIGNAL GENERATOR

Price 15/-. Uses B.F.O. Unit ZA 30c38 ready made with valve 1S5. POCKET SIZE 2½in. x 4½in. x 1½in. Only one resistor to change! Full instructions supplied. Battery 8 extra. 69 v. + 1/-. Details S.A.E.

## WAVE-CHANGE SWITCHES

2 p., 2-way, or 2 p. 6-way, long spindle .....	3/6
3 p., 2-way or 1 p. 12-way, long spindle .....	3/6
4 p., 4-way or 4 p., 3-way long spindle .....	3/6
6 p., 6-way 2 water long spindle .....	6/6
Wavechange "MAKITS" - Waters available; 1 p. 12-way 2 p., 6-way, 3 p., 6-way, 4 p., 2-way, 6 p., 2-way. Prices with click spindles adjustable stops, etc.	
1 water, 8/6; 2 water, 12/1; 3 water, 16/-. Additional waters up to 12, 3/6 each.	
TOGGLE SWITCHES. 4 p., 2/-; 4 p., 3/6; 4 p.d., 4/-; Rotary Toggles s.p., 3/6; 4 p. 4/6. Min. Size D.F. 3/6.	
JACKS. English open-circuit 2/6, closed-circuit 4/6. Grundig type 3-pin, 1/3; Grundig Lead Type 3/6. Photo Plugs 1/-; Sockets 6d.	
JACK-PLUGS, 3/-; REVERSE 4/-; Grundig 3-pin 3/6.	
BULBS. NON-REVERSIBLE PLUGS and SOCKETS. P7 2-pin 4/6; P73 3-pin 4/6; P104 6-pin 6/6; P880 3-pin 4/-; Main selector same with plug 1/-.	

## JASON F.M. TUNER COIL SET 29/-

d.f. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s. detector transformer and heater choke. Circuit book using four 6AM6 2/6.

## COMPLETE JASON FMT1 KIT

Jason chassis calibrated dial, tuning gang £2/12/- or complete FMT1 Kit with 4 valves, £6/5/-.

## COMPLETE JASON FMT2 KIT

with New Jason Cabinet, all components Power Pack and 5 valves. £10. Or less Power Pack £8/5/-.

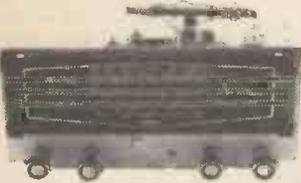
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# RADIO COMPONENT

Our written guarantee with every purchase. Busier 133 or 68 pas door S.K. Stn. Selhurst.

FOR — IMMEDIATE — DESPATCH — PHONE — US — TODAY

1963 RADIOGRAM CHASSIS



Three Wavebands S.W. 16 m-50 m. M.W. 200 m.-500 m. L.W. 800 m.-2,000 m. Latest Mullard ECH91, EF89, EBC81, EL94, EZ80 12-month guarantee. A.C. 200-250 v. 4-way switch. Short-Medium-Long-Gram. Ferrite Aerial. A.V.C. and Negative Feedback. 5 warts 3 ohm. Chassis 13 1/2 in. x 7 in. high x 3 1/2 in. deep. Glass dial size 1 3/8 in. x 4 in. horizontal wording. Two Pilot Lamps. Four Knobs. Walnut or Ivory. Aligned and calibrated. Chassis isolated from mains.

**BRAND NEW £8.19.6** Carr. 4/6 Matched Speakers 8in. 17/6; 10in. 25/-; 12in. 30/-.

**Volume Controls 80 ohm Cable Coax**  
Lark spindles. Midret 5K ohms to 2 Meg. Stereo L/S 10/6. D.P. 14/6. Linear or Log Tracks. Semi-air spaced 6d. yds. 40 yds. 17/6; 60 yds. 25/-.

**CAR AERIAL PLUGS 1/6.** Ditto sockets 1/3. COAXIAL PLUG 1/- TRIPLEXERS. Bands I, II, III 12/6 PANEL SOCKETS 1/- LEAD SOCKET 2/- COAX. OUTLET BOXES, SURFACE OR FLUSH 4/- BALANCED TWIN FEEDER 6d. yds. 80 or 360 ohms. TWIN SCREENED FEEDER 1/6 yds. 30 ohms. EXTENSION SPKR. CONTROL 10 ohm 3/- 25 ohm 8/6. TELESCOPIC CHROME AERIALS. 13in. extending to 43in. 8/6 each. 5in. to 32in. 7/6.

**RESISTORS.** Preferred values. 10 ohms to 10 meg. 1 w. 1/2 w. 4 1/2 w. 6d.; 1 w. 8d.; 2 w. 1/- HIGH STABILITY. 1/2 w. 1/- 2/- Preferred values, 10 ohms to 10 meg. Ditto 50, 10 ohms to 22 meg., 9d. 5 watt WIRE-WOUND RESISTORS 1/6 10 ohms-10,000 ohms 2/- 15K to 47 K. 10 w. 3/-

**I.F. TRANSFORMERS 7/6 pair** 465 kc/s. Slug Tuning. Miniature Can. High Q and good hand. Data sheet supplied. Standard size Weyrad 1 1/2 in. sq. x 3 1/2 in. 10/6 pair.

**WIRE-WOUND Pots. 3 WATT.** Pre-set Min. TV Type. All values 10 ohms to 20K, 3/- ea. 30K, 50K, 3/-; Carbon 30K to 2 meg., 100K, 7/6.

**TRIMMERS.** Compression ceramic 30, 50, 70 pF. 9d.; 100 pF. 150 pF. 1/3; 250 pF. 1/6; 600 pF. 750 pF. 1/3; Philips 0 to 10 pF. 3 to 30 pF. 1/- each. T.V. etc. 1000 pF. with knob, 2/-; RADIO SCREWDRIVER, 5in., 6d. Test Prods 2/9 ea. Neosid Trimming tools 1/9. NEON MAINS TESTER-SCREWDRIVER, 5/-.

**SDR MULTICOSE 4d. yds. SAVBIT DISPENSER 2/8.**

**HIGH GAIN TV PRE-AMPLIFIER BAND 1 B.B.C.** Tunable channels 1 to 5. Gain 18 dB. ECC84 valve Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred).

**BAND III I.F.A. — same price.** Tunable channels 8 to 13. Gain 17 dB. Set of coils and circuit only. 9/6. Band I or III.

**PAXOLIN PANELS.** 1/2 in. x 10 in. x 3/8 in. 2/- RECTIFIERS. RM1 5/-; RM2 6/-; RM3 8/-; RM4 10/-; RM5 10/-; 14A10 10/-; 14A116 10/-; K3/25 5/- MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA. 7/6; 250 v. 60 mA. 8/6; 250 v. 85 mA. 9/6; 200 mA. 21/-; 300 mA. 27/6; Full Wave Bridge 250 v. 75 mA. 10/-; 120 mA. 15/-; Silicon 250 v. 450 mA. 5/- FULL WAVE RECT. Popular type. 300 v. 85 mA. 5/- OSMOR MIDGET "Q" type, adj. dust core, from 4/- each. TELETRON D.W.R. L and Med. T.R.F. reaction, 4/-; Medium only DR. 3/6. COILS. Wearite "P" type, 3/- each. FERRITE ROD AERIALS M.W. 8/8; M. and L. 12/6. FERRITE ROD AERIALS L. and M. for transistor circuits. OSMOR 10/- each. WEYRAD 12/6 each. FERRITE RODS 8" x 1" 3/-; 6" x 1" 3/-; 8" x 1/2" 2/-.

**QMAX CHASSIS CUTTER**

The cutter consists of four parts; a die, a punch, an Allen screw and key.

3in.	1 1/4 in.	18-	2in.	34/3
3in.	1 1/4 in.	18 1/2	2 1/2 in.	37/9
3in.	1 1/4 in.	20-	2 3/4 in.	44/9
3in.	1 1/2 in.	20-	1 in. sq.	31/6
3in.	1 1/2 in.	20 1/2	1 1/2 in. sq.	28/-

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P. charge 1/-, Full list, 1/-, C.O.D. 2/- extra. (Export welcome. Send remittance and extra postage, no C.O.D.)

**ALUMINIUM CHASSIS.** 18 s.w.g. Plain, undrilled, 4 sides, riveted corners, lattice fixing holes, 2 1/2 in. sides, 7in. x 5in., 4/6; 8in. x 7in., 5/9; 11in. x 7in., 6/9; 13in. x 9in., 8/6; 14in. x 11in., 10/6; 15in. x 14in., 12/6. **ALUMINIUM PANELS.** 18 s.w.g. 12in. x 12in., 4/6 14in. x 9in., 4/-; 12in. x 8in., 3/-; 10in. x 7in., 2/3; 8in. x 6in., 2/-.

**H.F. CHOKES 2/8.** Osmor OC1 6/9. T.R.F. COILS A/H/F. 7/-; pair HAX 3/-; HAXL 3/6; REPANCO DRRE 4/6. DRX1 2/6. Purple Cores 5in. 6d ALADDIN FORMERS and cores. 5in. 8d., 6in. 10d. 0.3in. FORMERS 5937 or 8 and cans TV1 or 2, 1in. sq. x 2 1/2 in. or iron sq. x 1 1/2 in. 2/- with cores. **SLOW MOTION DRIVES.** Epicyclic ratio 0.1, 4/3. SOLON IRON, 25 v. 200 v. or 230 v., 24/- 85 v. 29/- A.N.T.E.X. PRECISION sub-miniature iron. 200 or 240 v. 29/6. Stands for A.N.T.E.X. irons 12/6 extra. Spares in stock for above irons.

**EAGLE 4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER** Size 3 x 1 1/2 x 2 1/2 in.

Powerful ready built miniature push-pull amplifier with output transformer, 4 transistors. Ideal for use with record players, intercoms, or "BABY ALARM." Complete with full instructions and circuit.

PRICE 47/6 9 v. Batt. 2/6. 2 1/2 in. SPEAKER 15/- Xtal Mike insert, 6/6.

**MAINS DROPPERS.** Midret. With adj. sliders. 0.3A 1,000 ohms, 5/- 0.15A 1,500 ohms, 5/- 0.2A 1,200 ohms, 5/- 0.1A 2,000 ohms, 5/-.

**BARGAIN SINGLE PLAYER KIT 200/250 v. A.C.**

**£5.15.0** (less cabinet) post 5/-

WITH 2-STAGE AMPLIFIER 3-VOLT 2-VALVES UCL82, UY85, HIGH-FLUX 5in. SPEAKER. 4-SPEED E.M.I. TURNTABLE, 16, 33, 45, 78 R.P.M. CRYSTAL PICK-UP FOR L.P./STD. RECORDS, 7in., 10in., 12in. Cut out Mounting board 12 1/2 x 9 1/2 in.

**ARDENTE TRANSISTOR TRANSFORMERS** D3035, 7.3 CT: 1 Push Pull to 3 ohms for OC72 ..... 9/6 D3034, 1.75:1 C.T. Push Pull Driver for OC72 ..... 8/6 D3055, 11.5:1 Output to 3 ohms for OC72, etc. .... 9/6 D167, 13:2:1 Output to 3 ohms for OC72, etc. .... 12/- D239, 4.5:1 Driver, 3in. x 3in. x 3in. .... 10/- D240, 8.5:1 Driver, 3in. x 3in. x 3in. .... 10/- **ARDENTE TRANSISTOR VOLUME CONTROLS.** VC1548, 5K or 1 meg. with switch dis., 9in., 5/3. VC1760, 5K with switch, dis., 7in., 10/6. DEAF AID EARPIECE Xtal or magnetic, 7/6. **SUB-MIN. JACK and PLUG, 3/8 pair.** MIKE TRANSFORMERS 50:1, 3/9. P.V.C. CONN. WIRE, single or stranded, 2d. yd. TWIN P.V.C. FLEX, 2 amp., 4d. yd. SLEEVING 1 or 2 mm., 9d.; 4 mm., 3d.; 6 mm., 5d. yd. Bib Cutters 3/6. Insulated Side Cutters, 8/6. Panel mounting fuse-holders 2/-. Fuses 60 mA. to 5A. 5d.

**FERRODYNAMICS AMERICAN "BRAND FIVE" PLASTIC RECORDING TAPE**

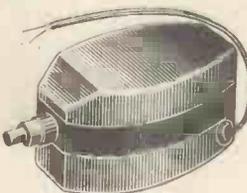
Double Play 7in. reel, 2,400ft. 42/-	Spare Spools
5in. reel, 1,200ft. 25/-	3in. 1/6
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	6 1/2 in. 2/-
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	Leader Tape 4/6
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**FAMOUS MAKES**  
7in. reel, 1,800ft. 22/6  
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"EASYSPLICER" Tape Splicer 5/-.

Screws 1 gross assorted 6BA. 6/6, 4BA. 8/6. Nuts and Washers 1 gross ea., 6BA 6/6, 4BA 6/6.

**THE "INSTANT" BULK TAP ERASER AND RECORDING HEAD DEMAGNETIZER**



200/250 v. A.C. 35/- Leaflet S.A.E.

**BUILD YOUR OWN RECORD PLAYER**

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4 Speed Autochange or Single Player units supplied with Brand New 2-tone Portable Cabinets 17 x 15 x 8 1/2 in. Strong carrying handle, tilt finish clips and hinges. As used by Famous Wake for 20 ans. models. Ready cut-out motor board 14 x 13in. Front baffle with 6 x 4 in. high flux loudspeaker and 2 watt 2 valve UY85, UCL82 2-stage amplifier ready built on metal chassis 12 x 3 1/2 in. Quality 3 ohm output transformer, low hum level circuit. Volume and Tone controls. 3-core safety mains lead. All items fit together perfectly. Special instructions enable assembly in 30 minutes. Only 5 wires to join! 12 month written guarantee. Available separately or package deals as below:

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E.M.I. Junior ..... £9/10/6 P.P. 5/  
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**OR SEPARATELY**  
Cabinet with cut out board ..... £3/9/6 P.P. 3/6  
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**TRANSCRIPTION UNITS Stereo/Mono**  
Garrard 4HP ..... £16/10/0 P.P. 5/  
Philips AG1016 ..... £12/5/0 P.P. 5/  
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B.S.R. Autochange UA12 Stereo/Mono ..... £7/10/0 P.P. 3/6  
Replacement sapphire styli available from ..... 5/3  
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**"0 + 1" TRANSISTOR RADIO**

First-class components to make a 6-transistor 2-waveband superhet chassis. Idea for portable or table radio. All parts including BVA transistors, ferrite aerial, printed circuit, 8 1/2 in. x 2 1/2 in., but EXCLUDING speaker and cabinet, 35 ohm output. Simple instructions 1/6 (free with kit). Speakers 35 ohm., 7 x 4in., 21/- **£4.5.0** 5in., 17/6; 3 1/2 in., 15/6.

**NEW MULLARD TRANSISTORS**

OC71 6/-; OC81D 7/6; OC44 8/9; OC17110/6; OC72 7/6; OC81 7/6; OC45 8/6; AF117 9/6. Sub-miniature Condensers (15 v.) 1 mfd., 2 mfd., 4 mfd., 5 mfd., 8 mfd., 16 mfd., 25 mfd., 30 mfd., 50 mfd., 100 mfd., 216. 1 mfd. 30 v. 1/3. Diodes OA81 3/-; GEX34 4/-.

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**TRANSISTOR SUPERHET TRANSFORMERS, COILS, PRINTED CIRCUIT AND FERRITE ROD AERIAL, Long and Medium Wave Aerial — RASW with CAR AERIAL COIL.** On 6in. rod, 1/4 in. diameter, 208pF. tuning ..... 12/6  
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1st and 2nd I.F. Transformers—P50/200, 470 Kc/s. 1/4 in. diameter by 1/2 in. high, ea. .... 5/7  
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Printed Circuit—PCAL. Size 2 1/2 in. x 3 1/2 in. Ready drilled and printed ..... 8/6  
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35 ohm Speakers 3in. 15/6, 5in. 17/6, 7 x 4in. 21/-  
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Set of 6 Mullard Transistors and diodes ..... 42/6  
Constructor's Booklet with full details. .... 10/8  
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Details S.A.E.

**B.B.C. 2 TRANSISTOR + DIODE**  
M.W. and L.W. Radio, Kit 22/6; Earpiece 7/6; Battery 2/3. Circuit and Details 6d. Real performance. Idea! Beginners, 500 coils, etc.

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Only 3 pairs of soldered joints plus mains. **AUDIOTRON HI-FI TAPE RECORDER KIT** Build a high quality recorder in the £70 class for only



**25 1/2** GNS. Can be assembled in 1 hour OR DEPOSIT £2.13.9 and 12 monthly payments of 44/- Cash price if settled in 3 months.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIBER THE AUDIOTRON HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7x4in. LOUDSPEAKER. Reel of Best Quality TAPE. Spare Tape Spools, a Portable Cabinet, size approx. 14 1/2 x 15 1/2 x 8 1/2in., finished in durable and attractive du-tone Polimeric and connection diagram for wiring amplifier to transcriber.

FEATURES INCLUDE: ★ 3 SPEEDS ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZING FOR EACH SPEED ★ OUTPUT 4 WATTS ★ MAGIC EYE RECORDING LEVEL INDICATOR ★ 3 MOTORS. Fast rewind ★ TAPE MEASURING AND CALIBRATING DEVICE ★ TAKES FULL 7in. DIAMETER REELS OF TAPE ★ NEGLIGIBLE HUM ★ ENTIRELY EFFERATIVE AUTOMATIC ERASURE. Send S.A.E. for leaflet.

**HI-FI 10 WATT AMPLIFIERS** BRAND NEW CARTONED MANUFACTURERS' DISCONTINUED **£7.19.6**

MODEL A REMARKABLE OPPORTUNITY. Carr. 4/6. Push-pull output. Latest high efficiency Mullard valves. Dual separately controlled inputs for mike and gram. Separate bass and treble controls. High-sensitivity. Output for 3 ohm or 15 ohm loudspeaker. Guaranteed tested and in perfect working order. For 200-250 A.C. mains.

**SUPERHET RADIO FEEDER UNIT**

Design of a high quality Radio Tuner (especially suitable for use with any of our Amplifiers). Q Triode Heptode F/Changer is used. Pentode I.F. and (double D)ode Second Detector. Delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W. Ch. Sw. incorporates Gram. position. Controls are Tuning, W. Ch. and Vol. Output will load most Amplifiers requiring 500mV input depending on A.C. location. Only 250 v. 15 mA. H.T. and L.T. or 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9.8-7in. high. Send S.A.E. for illustrated leaflet. Total building cost of £4/15/- Point-to-point wiring diagrams and instructions on 2/6.

**CRYSTAL MICROPHONES.** Hand type 14/9. Hand or Desk R.T.C. 19/9. Acos Mic. 45 29/9. Mic 39 Stick 39/9. BMS stick with table stand 59/9.

**LINEAR TAPE PRE-AMPLIFIER** Type LP/L. Switched negative feedback equalisation. Positions for Record 1 1/2in. 3 1/2in., 7 1/2in. and Playback. EM84 Recording Level indicator. Designed primarily as the link between Collaro Tape Transcriber and high fidelity amplifier but suitable almost any Type Deck. 9 GNS. Send S.A.E. for leaflet.

**LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER.** Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2 1/2 ohm speaker. Three miniature Mullard valves. Size only 6 x 5 x 3 1/2in. high. Chassis fully isolated from mains. Guaranteed 12 months Only **£5.19.6** Or Deposit 22/- and 5 monthly payments of 22/- Send S.A.E. for leaflet.

**EXTENSION SPEAKERS.** In handsome, walnut veneered cabinets. All standard 2-3 ohms 6 1/2in. 29/9. 8in. 35/9.

**CABY MULTIMETERS.** M1. Sensitivity 2,000 ohms per volt. A.C. and D.C. 54/- A10. Basic meter, sensitivity 155 microamp. A.C. and D.C. ranges £4/17/6. B20. Sensitivity up to 10,000 ohms per volt A.C. and D.C. £8/10/- TMK500 30,000 ohms per volt. A.C. and D.C. £8/10/6. Send S.A.E. for leaflet.

**STOCKISTS OF ARMSTRONG CHASSIS, GOODMAN'S, W.B. and FANE SPEAKERS, LINEAR, LEAK, VERDIK, ROGERS, and DULCI AMPLIFIERS. CASH OR H.P.**

**THE SKYFOUR T.R.F. RECEIVER**

A design of a 3-valve 200-250 v. A.C. mains L.T. and H.T. wave T.R.F. receiver with selenium rectifier. It employs valves 6K7, 8P61, 6V6 and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-Point wiring diagram instructions and parts list 1/9. This receiver can be built for a maximum of £4/19/6 including veneered walnut cabinet.

**R.C.A. 20-WATT RE-ENTRANT SPEAKERS.** Matching for 3, 15 200 and 600 ohms only 4 GNS.

**TRANSISTOR SALE**  
Littoral OC71 3/9. OC45 4/11. OC44 4/11. OC72 4/19. OC81 4/11. OC101 8/9. Ediswan XA101 XA112 XB113 XB101A XC101A 3/9 ea. Postage 6d. for up to 3 Transistors.

**JASON F.M. TUNER** Type FMT1. All parts including Dial, Escutcheon, Punched Chassis & Valves Power supply required 180 v. 25 mA. and 6.3 v. 1.5 a. .... £7/19/6 Type FMT2 ... 29/17/6

**EX GOVT. SELENIUM RECTIFIERS** 12 v. 15 amp. F.W. (Bridge). Only **19/9**

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60 mA. 10 h. 400 ohms 3/11. 100 mA. 10 h. 100 ohms 6/9. 150 mA. 10 h. 100 ohms 10/11. 120 mA. 12 h. 100 ohms 9/9. 200 mA. 5 1/2 h. 100 ohms 11/9. 280 mA. 5 h. 50 ohms 10/9.

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Type BM1. An all-dry battery eliminator. Size 8 1/2 x 4 1/2 x 2 1/2in. approx. Completely replaces batteries supply 1.4 v. and 9V v. where A.C. mains 200-250 v. 50 c.p.s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 9V v. This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 48/9. Type BM2. Size 8 x 5 1/2 x 2 1/2in. Supplies 120 v. 90 v. and 60 v. 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2 v. ACCUMULATORS** when connected to A.C. mains supply 200-250 v. 50 c.p.s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit with diagrams and instructions. 48/9 or ready for use 58/6.



**POWER PACK KITS.** Only 19/11. Fully smoothed H.T. output of 250 v. 60 mA. and L.T. supply of 6.3 v. 1.5 amp. Consisting of Double Wound Mains Transformer 230/250 v. 50 c.p.s. A.C. primary. Selenium Rectifier. Smoothing Choke. Double Electrolytic Condenser. Aluminium Chassis and Circuit.

**DERBY 26 Osmostat Road The Spot** Another new branch now open

**SENSATIONAL STEREO OFFER**  
Complete kit of parts to construct a 3-3 watt good quality stereo amplifier providing realistic reproduction. Suitable for all stereo pick-up heads. Ganged vol. and tone controls. Pre-set balance. For 200-250 v. A.C. mains only. Fully isolated chassis. **4 GNS.** Carr. 4/6. Or including Stereo Head 19/9 extra.

**R.S.C. STEREO TEN HIGH QUALITY AMPLIFIER KIT**

Valves 6Z61, ECC 83, ECC83, 6L4, EL84. Separate bass and treble controls giving "cut" and "boost". Sensitivity 50 mV. 9 watts high quality output on each channel. Can be used as straight 10 v. 2 v. accumulator. Controls: Stereo/Monaural switch, ganged volume, ganged treble, ganged bass and balance. Outputs for 3 ohm speakers. Point-to-point wiring diagrams and instructions. Illustration full wiring details and priced parts list 1/8. Or supplied assembled and tested 58/9 extra. Carr. 7/9.

**R.S.C. Battery Chargers & Kits for 200-230-250 v. 50 c/s. A.C. Mains Guaranteed 12 mths.**

**HEAVY DUTY KIT**  
6/12 v. variable charge rate up to 6 amps. Consisting of Mains Trans. F.W. (Bridge), Selenium Rectifier, 0.7 amp. meter. Variable Charge Selector. Fuses, fuse-holders, panels, plugs and circuit. Only 59/9 Post 4/6.

**CHARGER TRANSFORMERS**  
200-230-250 v. 50 c/s.  
0-0-15 v. 14 a. .... 12/9  
0-0-15 v. 23 a. .... 14/9  
0-0-15 v. 3 a. .... 16/9  
0-0-15 v. 5 a. .... 19/9  
0-0-15 v. 6 a. .... 23/9  
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**BATTERY CHARGER KITS**  
Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, fuse-holders, grommets, panels, battery clips and circuit. Carr. 2/10 extra.

6 v. or 12 v. 1 amp. .... 22/9  
As above with ammeter ... 28/9  
6 v. 2 amps. .... 19/9  
6 v. or 12 v. 2 amps. .... 25/9  
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6 v. or 12 v. 4 amps., with variable charge rate selector and ammeter ..... 52/9

**CHARGER AMMETERS**  
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3-12v. 1A. less meter 27/9  
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6-12 v. 3 amp. with variable charge rate selector and ammeter. 59/9.

**D.C. SUPPLY KITS.** Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s. 12 v. lamp, selenium rect. (F.W. Bridge), 2 fuse-holders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number. 29/11.



**VALVES:** Full range at really competitive prices.

**HEAVY DUTY SELENIUM RECTIFIERS.** 24 v. 20 amp. Full wave (bridge). **49/9** Brand new.

**R.S.C. POWER PACKS, 200-250 v. A.C.** Completely enclosed in louvered enamelled case, 8 x 5 1/2 x 2 1/2in. Output fully smoothed 250 v. 60 mA. and 6.3 v. 2 a. 39/9.

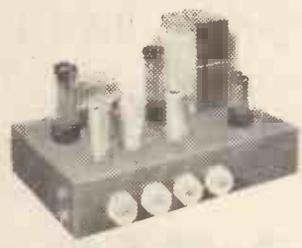
**R.S.C. BABY ALARM or INTERCOMM. UNIT KIT**

For 200-250 v. A.C. mains. Includes all parts, diagrams and instructions. High sensitivity. Completely safe. Controllable at either end. Housed in two cabinets of pleasing design. 89/8. Carr. 5/6. Or assembled and tested 6 gns.



## R.S.C. A10 30 WATT AMPLIFIER

HIGH FIDELITY  
ULTRA LINEAR  
PUSH-PULL  
OUTPUT



SIX VALVES: 6X4, 6BE6, 6X5, 6AR5, 6X4, 6X4, 6X4. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolt minimum input is required for full output. THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP. Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associate vol. control is provided so that two separate inputs such as "mike" and gram, etc. can be simultaneously applied for mixing purposes. AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20mA and 6 v. 1.5 A. FOR A RADIO FEEDER UNIT. Price in kit form with easy to follow wiring diagram.

ONLY 11 Gns. factory built using latest EL34 output valves and with 12 Carr. 10 months' guarantee. 14 Gns. TERMS ON ASSEMBLED UNITS. Protective Cover 19/6. Type 897 output valves are used with High Quality Sectionally Wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE. Frequency response  $\pm 3$  D.B. 30-20,000 c/s. Tone Controls  $\pm 12$  D.B. at 50 c/s.  $\pm 12$  D.B. at 1,000 c/s. hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12" x 8" x 9" approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohm speakers. EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS, SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.

LOUDSPEAKERS. 21in. to 18in. at keen prices. 12in. 6-watt 3 ohms 29/11. 12in. 10-watt 12,000 lines 3 ohms or 15 ohms 59/9. TWEETERS. 4in. I.A. 3 ohms 25/9. R.A. 15 ohms 25/9. W.B. 15 ohms 31/9. Pane 15 ohms, Pressure type 23/15/-.

VHF AM/FM STEREO, RADIO-GRAM CHASSIS by leading manufacturer. Three wavebands V.H.F. Medium and long. Piano-key waveband-selector, and On-Off/Tone Control Tuner. Two independent vol. controls. All on each sound channel to give perfect stereo balance. Eight valves are incorporated and internal ferrite rod aerial for A.M. Really attractive Dial Scale size 14" x 7", chassis size 15in. x 6in. x 7 in. high. For 200-250 v. A.C. mains. Made for inclusion in a luxury Radio-Gram Limited number. Brand new. Guaranteed 12 months. 26 Gns. Carr. 10/-, or deposit 5/9 and 12 monthly payments of 45/6.

## FULL RANGE OF FANE SPEAKERS STOCKED.

### R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIERS

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolt input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. 500-3000 c/s. D.B. negative feedback is used. I.C.T. of 300 v. 26 mA. L.T. of 200 v. 1.5 A. available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alloy. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish and point-to-point wiring diagram and instructions. Exceptional value at only 24/15/- or assembled ready for use 25/- extra, plus 3/6 carriage. Or deposit 22/- and five monthly payments of 22/- for assembled unit.

### R.S.C. TRANSFORMERS Fully Guaranteed. Interleaved & Impregnated.

**MAINS TRANSFORMERS.** Primaries 200-250 v. 50 c/s. FULLY SHROUDED. UPRIGHT MOUNTING.

350-0-350 v. 100 mA., 6.3 v. 2a., 0-5-3 v. 3a.	17/11
425-0-425 v. 200 mA., 6.3 v. 2a., 0-5-3 v. 3a.	27/11
500-0-500 v. 100 mA., 6.3 v. 4a., 0-5-3 v. 3a.	27/11
500-0-500 v. 140 mA., 6.3 v. 4a. ct., 6.3 v. 1a. For Mullard 510 Amplifier	33/9
350-0-350 v. 100 mA., 6.3 v. 4a., 0-5-3 v. 3a.	33/11
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425-0-425 v. 200 mA., 6.3 v. 4a., 0-5-3 v. 3a.	59/9
450-0-450 v. 250 mA., 6.3 v. 5a., 4 v. 3a.	69/9

**TOP SHROUDED DROP-THROUGH TYPE**

250-0-250 v. 70 mA., 6.3 v. 2a., 0-5-3 v. 2a.	17/9
250-0-250 v. 100 mA., 6.3 v. 3.5a.	19/9
250-0-250 v. 100 mA., 6.3 v. 2a., 6.3 v. 1a.	21/9
300-0-300 v. 80 mA., 6.3 v. 2a., 6.3 v. 1a.	21/11
250-0-250 v. 100 mA., 6.3 v. 4a., 0-5-3 v. 3a.	26/9
300-0-300 v. 100 mA., 6.3 v. 4a., 0-5-3 v. 3a.	26/9
300-0-300 v. 130 mA., 6.3 v. 4a., 0-5-3 v. 3a. 1a. suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4a., 0-5-3 v. 3a.	26/9
350-0-350 v. 150 mA., 6.3 v. 4a., 0-5-3 v. 3a.	26/9
425-0-425 v. 200 mA., 6.3 v. 4a., 5 v. 3a.	55/9

**MIDGET CLAMPED TYPE.** Primaries 200-250 v.

250-0-250 v. 60 mA., 6.3 v. 2a., 2 1/2 x 2 1/2 in.	12/9
250 v. 60 mA., 6.3 v. 2a., Size 2 1/2 x 2 1/2 in.	11/9

**FILAMENT TRANSFORMERS 12 v. 1a.**

6.3 v. 1.5 a.	5/9
6.3 v. 3 a.	8/11
6.3 v. 6 a.	17/9
6.3 v. 2 a.	7/6
6.3 v. 6 a.	12/9 or 24 v. 1.5a. 17/9

**AUTO (Step Up/Step Down) TRANSFORMERS**

50-50 watts 110-120 v./230-250 v.	13/9
150 watts 110-120 v./200-250 v.	27/9
250 watts 110-120 v./200-250 v.	39/9

**OUTPUT TRANSFORMERS**

Rectifier Battery Pentode 66.1 for 354, etc.	4/6
Small Pentode 3,000 $\Omega$ to 3 $\Omega$	5/6
Scum-bard Pentode 3,000 $\Omega$ to 3 $\Omega$	4/6
Standard Pentode 7,000 $\Omega$ to 3 $\Omega$	5/9
Push pull 8 watts EL84 to 3 $\Omega$	8/9
Push pull 8 watts EL84 to 15 $\Omega$	8/9
Push pull 10-12 watts 6V6 to 3-5-8 or 15	16/9
Push pull EL84 to 3 or 15 $\Omega$ 10-12 watts	17/9
Push pull Ultra Linear for Mullard 510, etc.	20/9
Push pull 15-15 watts sectionally wound 614.	23/9
KT66, etc., for 3 or 15 $\Omega$	23/9
Push pull 20 watt high-quality sectionally wound, EL34, 614, KT66, etc. to 3 or 15 $\Omega$ fully shrouded	47/9

**MICROPHONE TRANSFORMERS**

120-1 High quality, clamped	5/9
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**SMOOTHING CHOKES**

250 mA., 5 H., 100 $\Omega$ 11/9	8/9
150 mA., 7-10 H., 250 $\Omega$ 11/9	8/9
100 mA., 10 H., 200 $\Omega$ 8/9	8/9

**AUDIOTRIPE HIGH FIDELITY SPEAKER SYSTEMS**

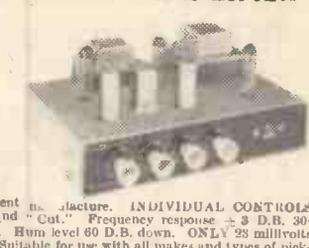
Designed to provide a smooth frequency response from 40-20,000 c/s. consisting of 12in. 19,000 line 15 ohm speaker. Crossover Unit and Tweeter. Highly recommended for use with any High Fidelity Amplifier. 10 Watt Unit 24/19/6 or Deposit 11/3 and nine monthly payments of 11/3. 20 Watt Unit 26/19/6 or Deposit 12/3 and nine monthly payments of 12/3.

**B.S.R. MONARDECK TAPE DECKS**

Speed 3/1n. per sec. As fitted to most leading make Tape Recorders. Brand New 26/19/6. Carr. 5/-. Suitable Portable Cabinets to take Deck and Tape Amplifier 39/9.

## R.S.C. A11 12-14 WATT AMPLIFIER

HIGH FIDELITY  
PUSH-PULL ULTRA  
LINEAR OUTPUT  
"BUILT-IN"  
PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram, as in A.10 High Fidelity. Includes 5 valves: ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response  $\pm 3$  D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. ONLY 25 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plus provides 300 v. 30 mA. and 6.3 v. 1.5 A. For supply of a RADIO FEEDER UNIT. Size approx. 12" x 9" x 7in. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohm speakers. KH is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 51/6 extra) 8 Gns. Carr. 10/- If required covered metal covers with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9 and 12 monthly payments of 24/9. Send S.A.E. for illustrated leaflet detailing ready-to-assemble Cabinets, Speakers, Microphones, etc. with cash and credit terms.

## R.S.C. BASS-MAJOR 30-WATT GUITAR AMPLIFIER

A Multi-Purpose High Fidelity, High Output Unit for Vocal and instrumentalists Groups. Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in. diameter pole pieces (total flux 220,000 lines). Designed for efficiently handling more than full output of amplifier at frequencies down to 25 c.p.s. One speaker has an aluminium speech coil and dual cone to extend frequency range up to 17,000 c.p.s. Heavily made cabinet of convenient size 24 1/2" x 14in. has an exceptionally attractive cover in two contrasting tones of Vynair. For 200-250 v. 50 c.p.s. A.C. mains operation. EMINENTLY SUITABLE FOR BASS GUITAR AND ALL OTHER MUSICAL INSTRUMENTS. Four jack socket inputs and two independent vol. controls for simultaneous connection of up to four instrument pick-ups or microphones. Separate bass and treble controls providing more than adequate "Boost" or "Cut". Level frequency response throughout the audible range. 39 1/2 Gns. Carr. 17/6 or DEPOSIT 24/3- and 12 monthly payments of 23/9/11. Superior to units at twice the cost. Send S.A.E. for illustrated leaflet.

### R.S.C. JUNIOR GUITAR AMPLIFIER.

5-watt high quality output. Separate bass and treble "cut" and "boost" controls. Sensitivity 15 mv. Two high impedance inputs. 10in. loudspeaker. Handsome strongly made cabinet (size 14 x 14 x 7in. approx.) finished in attractive and durable polychrome. 200-250 v. A.C. mains operation. 28/19/6. Carr. 5/9. Send S.A.E. for leaflet. 28/19/6. Or Deposit 21 and nine monthly payments of 21/-.

### LINEAR TREMOLO PRE-AMP. UNIT.

Designed for introducing the Tremolo effect to any amplifier fitted with a reserve power supply point for smoothed H.T. and 6.3 v. A.C. This applies to practically all amplifiers of our manufacture and to those of several other manufacturers. The unit plugs into power supply point and any input socket of amplifier. Controls are Speed (frequency of interruptions), Depth (of heavy or light effect), Volume, and Switch (three sockets are for 2 inputs and Foot Switch. Only 4 Gns.

### R.S.C. SENIOR 14 WATT GUITAR AMPLIFIER.

High-quality push-pull output. Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-up can be used at the same time. Two loudspeakers are incorporated, a 19in. high flux 14-watt bass unit and a 6 x 4in. elliptical for treble. Cabinet well made and finished as Junior Model. Size approx. 18 x 18 x 8in. Or DEPOSIT 37/- and 9 monthly payments of 37/-.

Carr. 10/- Send S.A.E. for leaflet.

### LOUDSPEAKERS IN CABINETS

12in. 10 WATT. Walnut Veneered. Cabinet size 15 x 15 x 8in. approx. High quality 12in. 10 watt 12,000 line speaker. 3 ohms or 15 ohms. 24/19/6. Carr. 5/-. Or Deposit 11/3 and nine monthly payments 11/3	4/6
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15in. 30 WATT Heavy Duty High Flux Speaker. Suitable for BASS GUITAR. Cabinet 24 x 21 x 15in. Heavy construction covered in attractive Rexine and Vynair in two contrasting tones of grey. Only 19/9 Gns. Or Deposit 37/6 and 12 monthly payments 37/6	16/9
15in. 30 WATT. 14,000 line speaker with 3in. diameter speech coil, 15 ohms impedance, in Substantial Two-tone Rexine and Vynair covered cabinet of pleasing appearance. Acoustically lined. IDEAL FOR BASS GUITAR. Size 30 x 24 x 16in. APPROX. ONLY 29 Gns. Or Deposit 23/15/- and twelve monthly payments 50/-	17/9

### R.S.C. STANDARD BASS REFLEX CABINET. For 12in. Loudspeakers.

acoustically lined and ported. Size 20in. x 14in. x 13in. Beautiful walnut veneer finish. Especially recommended for use with Speaker system below. 25/19/6. Set of four legs can be supplied with brass ferrules for 19/6.

**AUDIOTRIPE CORNER CONSOLE CABINETS.** Strongly made. Beautiful polished walnut veneered finish. Pleasing design.

**JUNIOR MODEL.** To take up to 8in. speaker. Size approx. 20 x 11 x 8in. Only 49/9.

**STANDARD MODEL.** To take up to 10in. speaker. Size 27 x 15 x 12in. 24/11/9.

**SENIOR MODEL.** To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30 x 30 x 15in. (Recommended for use with Audiotripe speaker system).



**BASS REFLEX CABINET.** Designed for above speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18 x 12 x 10in. Strongly made. Handsome appearance. Ensure superb reproduction for only 23/19/6.

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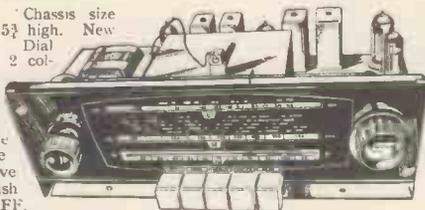
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A.C. ONLY. Chassis size  
15 x 6½ x 5½ high. New  
manufacture. Dial  
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Speaker, Ae  
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Sockets. Five  
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L.W., M.W., F.M. and Gram. Aligned and tested. With all valves  
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Valves EZ80 rect., ECH81, EF89, EABC80 EL84, ECC85.  
Speaker and Cabinet to fit chassis (table model), 47/6 (post 5/-).  
10 x 6in. ELLIPTICAL SPEAKER 25/- to purchasers of this chassis.  
TERMS: (Chassis) £3/10/- down and 5 monthly payments of £2 4/- or  
with Cabinet and Speaker £4 down and 6 monthly payments of £2 4/-.

ALTERNATIVE DESIGN. LW 1000-3000M; SW 17-30M (6-17 mc/s); MW 200-  
550M; VHF 87-100 mc/s; gram position. Dial dark brown and gold. Otherwise  
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### "SCALA" 6-TRANSISTOR and DIODE SET FANTASTIC VALUE

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Brand New—attractive cabinet—choice of 6 colours:  
8½ x 2 x 5½ in. high. Ferrite aerial, printed circuit,  
good styling, 3½ in. speaker, fully tunable L.W.  
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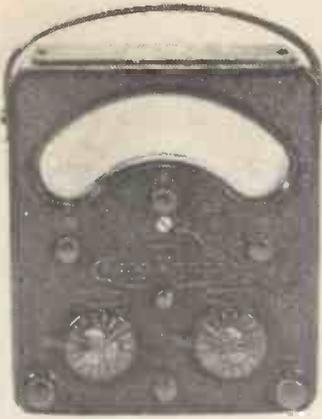
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AVOMETER MODEL 7

**AVO MODEL 7 £11-0-0**

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**MARCONI UNIVERSAL IMPEDANCE BRIDGE TF868.** Inductance from 1 microH to 100H.—Capacitance 1 pF to 100 mFd.; Resistance from 0.1 Ohm to 10 Megohm. Recent equipment in as new condition. £65.

**BC221 FREQUENCY METER** 125 Kc/s. to 20 Mc/s. This crystal controlled heterodyne frequency meter is too well known to need further description. Those we offer are complete with correct individual calibration book and are carefully tested and guaranteed. Condition is very good. Carr. 10/- **£16**

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Panel meter 0-1 milliamp. Flush mounting circular. Barrel diameter 2 1/2 in., outside diameter 3 1/2 in. Dials are scaled 0-100. Resistance is 75 ohms. Fe & NfE. BRAND NEW. 25/-, P. & P. 1/-.  
Meter Rectifiers (S.E.I.). 1 mA. 8/6. Westinghouse 5 mA. 8/6.

**MICROAMMETERS**  
R.C.A. 0-500 microamps. 2 1/2 in. circular flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the No. 19 set. 15/-

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Escutcheons (Windows). 10/6.  
Knobs. Medium size. Set of 8. 15/-.  
Block Condenser (3 x 4 mfd.). 15/-.  
P. & P. 2/6.

**CONSTANT VOLTAGE TRANSFORMERS.** Input 190 to 260 volts. 50 c.p.s. Output 115 volts at 2 kVA. A pair of these will give a constant output of 230 volts at 4 kVA. Price £15 each, plus £1 carriage. Two for £30, carriage paid

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For 200-250 v. A.C./D.C. mains, 300 watts. With 1 1/2 inch diam. twin "V" shape outlets. 2 lengths of hose 4 spare filters and brushes. Suitable for industrial use, forges, etc. Brand new, £4/19/6. Carr. 10/6.

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**INDUSTRIAL METER.** Iron clad. 0 to 300 v. A.C. 50 cycles. Moving iron, 6 in. scale Fl. mtg. BRAND NEW. 59/6. P. 4/-

**STAR DXER SR-40 £24-15-0**

General purpose superhet communications receiver for A.C. mains 220-240 v. covering 550 Kc/s to 30 Mc/s in four switched bands. Slide rule tuning dial, electrical bandspread, internal speaker, panel "S" meter, noise limiter, B.F.O. phone jack; ferrite and whip aerials. Handsome grey crackle cabinet 13 1/2 x 8 1/2 x 5 1/2. Weight 12 lbs. Full instructions manual. **BRAND NEW. CURRENT MODEL.**

**RECEPTION SETS R120/R220**  
Consists of TWO identical receivers in one cabinet. EACH receiver is complete with 14 modern miniature valves (3 x 6AK5, 1 x EF91, 3 x EF92, 2 x EB91, 2 x 12AT7, 1 x Q570/20, 1 x EL91, 1 x 5U49) its OWN stabilized A.C. mains power supply and speaker. One fixed frequency between 60-100 Mc/s, depending on crystal used, but ideal for conversion to 72 Mc/s or 144 Mc/s. BRAND NEW. Price complete £7/10/0, carriage £1; or individual receiver (less Cabinet) £3/19/6, plus 7/6 carr. Circuit supplied.

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AVO. Capacity 5 pfd. to 50 mfd. Resistance 5 ohms to 50 Megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. A.C. mains operation. Tested and guaranteed and in superlative condition. £9/10/-, plus 5/- P. & P.

**RCA AR-88 SPEAKERS**  
A high quality 3 ohm unit fitted into heavy gauge black crackled steel cabinet, size 10 1/2 x 11 1/2 x 6 in. Fitted with rubber feet and 6ft. lead. Ideal for extension speaker CR100, etc. In original cartons. BRAND NEW. 65/-, Post 5/-.  
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25 positions, 8 bank double wipers, 50 volt operation. Ex-equipment and tested. 45/-, Post 2/6.

**SEARCH RECEIVER**  
Type AN/APR4. Covers 38 to 1,000 Mc/s. with 3 Plug-in R.F. Heads. TN 16 (38-95 Mc/s), TN 17 (74-320 Mc/s) and TN 18 (300-1,000 Mc/s). Self-contained power supply for 115 v. 50-2,600 c.p.s. Thoroughly reconditioned as new. In 100 per cent. mechanical and operational order. £100.

**ELECTRONIC FREQUENCY CONVERTER CV-253/ALR.** Ex U.S.A. equipment of recent design (1956). Covers 38 to 1,000 Mc/s in four switched bands as follows: 38 to 130, 130 to 300, 300 to 550 and 550 to 1,000 Mc/s. Can be directly used with the APR-4 search receiver or, if a power supply is provided, into any 30 Mc/s receiver or IF strip. Directly equivalent to all three tuning heads as used in the APR-4. **BRAND NEW. £45.**

**PCR COMMUNICATION RECEIVERS**  
Made by Philips these compact 6-valve receivers incorporate an RF, two IF and a full size output stage for loud-speaker use. There is a phone jack for moving coil phones. All sets are in PERFECT WORKING ORDER and give very fine results on short waves.

**TYPE PCR** has a self-contained speaker and covers 850 to 2,000, 200 to 550, and 16 to 50 metres.  
**AS NEW CONDITION..... £6 19 6**  
**TYPE PCR2** requires external speaker and covers 850 to 2,000, 200 to 550, and 13 to 50 metres.  
**USED (GOOD CONDITION)..... £5 19 6**  
**TYPE PCR3.** Requires external speaker. Has medium and two short wave bands. Covers 200 to 550 metres, 2.5 and 7 Mc/s. (120 to 43 metres) and 7 to 23 Mc/s. (43 to 13 metres). **USED (GOOD CONDITION) £8 8 0**  
**CARRIAGE (any type), 10/6.**  
**POWER SUPPLIES.** The above receivers require 250 volts HT and 12 volts LT. We will supply any of the above receivers fitted with a **BRAND NEW INTERNAL POWER SUPPLY** for £2 extra. Fully guaranteed ready for use on A.C. mains.

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Near Leicester Sq. Station. (Opposite Thorn House) Shop hours: 9-6 p.m. (9-1 p.m. Thursdays). Open all day Saturday



**MARCONI TF987/1 NOISE GENERATORS.** DETERMINE NOISE FACTOR of A.M. & F.M. receivers. A.C. mains operation. Stabilised H.T. AS NEW. Tested, £15, carr. 7/6. SLIGHTLY USED (but tested), £8/19/6, carr. 7/6.

**MULLARD CRYSTAL CALIBRATOR.** In neat grey metal case 9 x 7 x 6 1/2 in. Gives 1 Mc/s, 100 Kc/s and 10 Kc/s marker pips and harmonics, as selected. Optional 400 c/s modulation. Complete with five IT4 and 1R5 valves and 1 Mc/s. B7G glass crystal. Requires 60 v. H.T. and 1.5 v. L.T. In original transit case. **BRAND NEW. £4/19/6. Carr. 7/6.**

**COSSOR DOUBLE BEAM OSCILLOSCOPE TYPE 1035**  
A modern oscilloscope in good working order. Limited number only. £45. Carriage 30/-.

**AVO WIDE RANGE SIGNAL GENERATORS**  
Six turret operated ranges covering 50 Kc/s to 80 Mc/s. For use on standard A.C. mains. Packed in original transit cases with accessories. Post-war type in new condition. £15. Carriage 10/-

**MARCONI SIGNAL GENERATOR TF-517.** Three ranges. 18 to 58 Mc/s. in 2 individually calibrated ranges and 160 to 300 Mc/s. by directly calibrated dial. A.C. mains operation. As new condition in original transit cases with instruction book. £10/10/-, Carr. £1.

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Type 1. 250-0-250 v. 80 m/a., 6.3 v. 3 a., tapped at 4 v. 4 a., 6.3 v. 1 a. tapped at 4 v. and 5 v. 2 a.  
Type 2. As above, but 350-0-350 v. 80 m/a.  
Type 3. 30 v. 2 a., tapped at 12, 15, 20 and 24 v., to give 3-4-5-6-8-9-10 v., etc.  
Type 5. 0-5-11-17 v. 4 a. Ideal for chargers.

**CO-AXIAL RELAYS.** (Switch Type 78A). Simultaneously switch two separate inputs to alternate outputs. 24 volt D.C. coils (can be hand operated). Size (approx.) 5 x 3 x 3 in. 8/6. Post 2/6.

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**BRAND NEW. Boxed 27/6. Post 2/6.**



# Portable Transistor Sets

Backed by Super After Sales Service

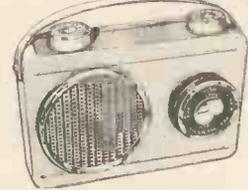
## POCKET FIVE

★ 7 stages—5 transistors and 2 diodes. Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2 1/2 in. moving coil speaker, built into attractive black case with red speaker grille. Size 5 1/2 x 1 1/2 x 3/4 in. (Uses PP4 battery available anywhere.)



Total cost of all parts now only **43/6** P. & P. 3/-. Parts price list and easy build plans 1/6.

## ROAMER SIX

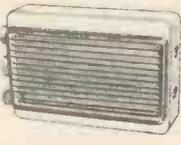


★ 8 stages—6 transistors and 2 diodes. Listen to stations half a world away with this 5 waveband portable. Tunable on Medium and Long waves, Trawler Band and two Short waves. Sensitive ferrite rod aerial and telescopic aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings. Size 6 1/2 x 4 1/2 x 1 1/2 in.

Total cost of all parts now only **£4.19.6** P. & P. 3/6. Parts price list and easy build plans 3/-.

## TRANSONA FIVE

★ 7 Stages—5 transistors and 2 diodes. Covers M. and L. Waves and Trawler Bands, a feature usually found in only the most expensive radios. On test Home, Light, 208, and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and new type fine tone super dynamic speaker, attractive case in grey plastic with red grille. Size 6 1/2 x 4 1/2 x 1 1/2 in. approx. (Uses 1289 battery available anywhere.)



Total cost of all parts. NOW ONLY **43/6** P. & P. 3/6. Parts price list and easy build plans 2/-.

## SUPER SEVEN



★ 8 Stages—7 transistors and 2 diodes. Covers M. and L. Waves and Trawler Bands. Ideal for home, car or can be fitted with carrying strap for outdoor use. Completely portable—built-in aerial for wonderful reception. Special circuit incorporating 2 B.F. stages, push-pull output, 3in. speaker (will drive larger speaker). Size 7 1/2 x 5 1/2 x 1 1/2 in. (Uses PP6 battery, available anywhere.)

Total cost of all parts now only **£3.19.6** P. & P. 3/6. Parts price list and easy build plans 2/-.

## TRANSONA SIX

**NEW!!**

★ 8 Stages—6 transistors and 2 diodes. A top performance receiver covering full M. and L. Waves and Trawler Bands. High-gain powerful magnet 3in. speaker makes listening a pleasure. Push pull transformers for ample power. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6 1/2 x 4 1/2 x 1 1/2 in. (Carrying Strap 2/- extra.) (Uses PP4 battery available anywhere.)



Total cost of all parts **59/6** P. & P. 3/6. Parts price list and easy build plans 1/6.

## MELODY SIX

**NEW!!**



★ 8 stages—8 transistors and 2 diodes. Our latest completely portable transistor radio covering M. and L. waves. Incorporates pre-lagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial, Push pull output. Wonderful reception of B.B.C. Home and Light, 208, and many Continental stations. Handsome leather look pocket size case, only 6 1/2 x 3 1/2 x 1 1/2 in. approx. with gilt speaker grille and hand and shoulder straps.

Total cost of all parts **£4.9.6** P. & P. 3/-. Parts price list and easy build plans 2/-.

## ROAMER SEVEN Mk. III

5 WAVEBAND PORTABLE OR CAR RADIO. AMAZING PERFORMANCE AND SPECIFICATION.

★ 9 Stages—7 transistors and 2 diodes. Covers M. and L. Waves, Trawler Band and two Short Waves to approx. 17 metres. Push pull output for room filling volume from rich toned heavy duty 3in. speaker. Ferrite rod aerial for M. & L. waves and telescopic aerial for 8. Waves. Air-spaced ganged tuning condenser ensures wonderful station selection. Simulated hide case with gilt trim and shoulder and hand straps. Size 9 x 7 x 1 1/2 in. approx. The perfect portable and the ideal car radio. (Uses PP9 Battery available anywhere.)



Total cost of all parts NOW ONLY **£5.19.6** P. & P. 5/6. Parts price list and easy build plans 3/-.

All components used in our receivers may be purchased separately if desired. Parts price lists and easy build plans supplied free with sets of parts or available separately at prices stated. **OVERSEAS POST 10/-.**

# RADIO EXCHANGE

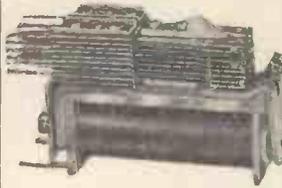
27 HARPUR STREET, BEDFORD  
Phone 2367 ● Opposite Co-op. ● 10-1 p.m. Sats.

2W W—148 FOR FURTHER DETAILS.

# Wilkinsons

EST. 1921

## RELAYS P.O. TYPE 3000



Built to your own specification  
Keen Prices  
Quick Delivery  
Contacts up to 8-Changeover

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Siemens High Speed Sealed  
2.2k $\Omega$ -2.2k $\Omega$  H96A 19/6  
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Comprehensive range available from stock.

## RELAYS MAGNETIC SOLENOID OPERATED

24 volts D.C. 4 make and 4 break 10 amp. contacts. 5C/8944. Brand new, complete with dust cover, 12/6 each, post 2/-.

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**FREQUENCY METERS.** 45-55 cycles per second, 230 volt, 6in. dia. Flush Round. Brand new in maker's box. £10/10/-, post 5/-.

**METER RECTIFIERS** 1 M.A., 5 M.A., F.W. bridge, 8/6, post 6d.

**AMMETER.** 0-3 amps. D.C., by Turner, MC/FR, 6in. 90/-, post 3/6.

**UNI-PIVOT GALVANOMETER,** by Cambridge Instruments, 50-0-50 microamps, 4in. 4in. Knife pointer, mirror scale. Complete with leather carrying case. Ideal for laboratory use, £10, post 3/-.

**PORTABLE VOLTMETER.** 0-160 volts A.C./D.C., accuracy within 2%, 8in. mirror scale, knife pointer, in polished case. A precision moving iron instrument at a very low price, £4 19/6, post 4/-.

**PORTABLE AMMETER.** 0-3 amp. A.C./D.C. 3in. scale in case with handle 35/-, post 2/6.

**AMMETER,** reading 50-0-50 amp., 2in. Flush Square 17/6 each, post 2/-.

**VOLTMETER.** A.C. 0/300 2 1/2 in. Flush Round, 25/-, post 2/-.

**KEY SWITCHES** (3 position). P.O. 212. 2 Change Over each side, 6/6. P.O. 198. 4 Change over each side, 13/6.

Other types available, ask for details.

**STROBOSCOPE.** 125 cycles G.P.O. No. 5, 30/- each, post 2/-.

**RATIO ARM UNITS.** Sullivan 600k $\Omega$  + 600k $\Omega$  50/-, post 3/-.

**HEADPHONES.** Sound powered 1,600k $\Omega$  type DHR 17/6 pair, post 2/3.

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**THERMAL DRYING OVEN.** 60-200°C. with regulator and pilot lamp. Mains Input. Made by Baird and Tatlock. "STABLEC" £35.

**LEAK DETECTORS.** B.T.H. Portable type mains operated. Based on the principle that an increase in the halogen content of the surrounding air causes an increase in the rate of formation of positive ions on a heated surface. £45.

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**MIRROR GALVANOMETERS BB 3000.** N.E.P. Focal length 20 cm. £18.

**RACKS—POST OFFICE STANDARD.** 6in. high with U-channel sides drilled for 19in. panels, heavy angle base.

**RESISTORS EX STOCK IN QUANTITY. WIRE WOUND, HIGH-STABILITY CARBON, ETC. BEST MAKES AT LOWEST PRICES. ALSO POTENTIOMETERS AND CONDENSERS AVAILABLE.**

**AVO TEST BRIDGES.** 220/240 volt A.C. Measure capacities from 5 pf. to 50 mfd. and resistances from 0 ohms to 60 megohms. Valve volt-meter range 0.1 to 15 volts and condensers leakage test £8 19/6, post 5/-.

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**BRIDGE MEGGER TESTING SET SERIES 1.** With resistance box and leads 1,000 v., 0-100 megohms. Usual price £180. Our price £75.

## ONE HOLE FIXING SWITCHES

12/- per dozen 75/- per 100

SINGLE-POLE Double Throw 3 amp. 250 A.C. Can be used as ON/OFF or CHANGE-OVER SWITCH.

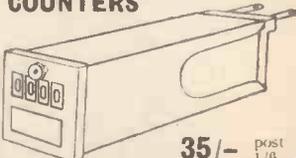


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High Speed Type  
10 IMPULSES PER SEC.  
WITH 4 DIGITS

100v., 50v., 24, 12v., or 6v. D.C.  
WITH SLIDE-ON METAL  
COVER 3 1/2 x 1 x 1 in.

Also supplied with auxiliary contacts normally open, 7/6 extra.



35/- post 1/6.

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**UNIVERSAL AVOMETERS**



Guaranteed perfect working order. Supplied complete with leads, batteries and instructions.  
 Model "D," 34 range... £8 19 6  
 Model "7," 50 range... £11 0 0  
 Registered Post 5/- extra.

**MICROAMMETERS**

0-500 microamps. 2½ in. circular flush panel mounting. Dials engraved, 0-15, 0-600 volts. BRAND NEW. BOXED. 15/-. P.P. 1/6.

**HEAVY DUTY AUTO-TRANSFORMERS**

0-115-230 volt step up or step down. Brand new. Boxed ex: U.S.A., 3 kVA. £7/10/-, carr. 7/6. 7.5 kVA. £15, carr. £1.

**230/250 VOLT A.C. MOTORS**  
 4½ x 3 in. dia., 90 watts, 5,000 r.p.m., ½ in. spindle. 22/6. P.P. 1/6.

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230 v. Pri. 230 v. Sec. Boxed, £5 each. Carriage 10/-.

**VARIAC TRANSFORMERS**  
 24 amp., 230 volt primary, 185 to 250 volt output, £12/10/-. Carr. 10/-.

**TELEPHONES TYPE "H"**

Sound powered, generator bell ringing, 2 line connection. Fully tested, £4/19/6 pair. Carr. 5/-.

**MINE DETECTOR No. 4A**

Will detect all types of metal. Fully portable. Complete equipment supplied fully tested with instructions 39/6, carr. 10/6. Battery 8/6 extra.

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 OA 202 miniature silicon rectifiers 1/- each.  
 Please add postage.  
 Discounts for quantity.

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Suitable for many applications. Generator bell ringing, 2 line connection. With batteries and wooden carrying case, fully tested, £4/19/6 per pair. Carr. 5/-.

**SUB-STANDARD D.C. AMMETERS**

9 ranges, 150 mA., 1.5 A., 3 A., 7.5 A., 15 A., 30 A., 60 A., 300 A., and 450 A. Housed in teak portable case, 8 in. mirror scale. Supplied brand new with all shunts and leather carrying case, £15 each. P.P. 10/-.

**R.C.A. AR88D RECEIVERS**

New release, few only available. Frequency coverage on 6 bands 550 kc/s to 32 mc/s. Operation 110/230 v. A.C. Available in really excellent used condition, fully checked and guaranteed perfect order. £45 each. Carr. £2.



**P.C.R.2 COMMUNICATION RECEIVERS.**

Give excellent performance for very modest outlay. Frequency coverage on 3 bands 800-2,000 metres, 190-550 metres, 6-22 mc/s. Supplied in perfect working order with circuit, £5/19/6 each, carr. 10/6. The receiver can be supplied with internal power unit to operate on 200/250 v. A.C. at 39/6 extra, or plug-in external power supplies are 35/- each.

**AVO WIDE RANGE SIGNAL GENERATOR**

Frequency coverage 50 kc/s. to 80 mc/s. in six turret operated ranges. For use on standard A.C. mains. Packed in original transit cases with accessories. Supplied in as new condition, fully checked before despatch, £15. Carriage 10/-.

**NATIONAL H.R.O. RECEIVERS**



**SENIOR MODEL.** Supplied complete with full set of 9 coils covering 50 kc/s. to 30 mc/s. Each receiver thoroughly checked and available as follows:—

**TABLE MODEL.** As new condition ..... £25 0 0  
 TABLE MODEL. Good used condition ..... £19 19 0

**RACK MODEL.** As new condition ..... £22 10 0  
 RACK MODEL. Good used condition ..... £18 18 0  
 Carriage £1 extra all models.

N.B. Rack model is identical to table model except front panel is extended to mount into 19 in. rack.  
 200/250 v. A.C. power packs for all above receivers, also sold separately, 59/6 each, carr. 5/-.

**PRECISION COMBINATION VOLTMETER/AMMETER**

Two separate instruments housed in polished wood case, 6 in. scales with knife edge pointers. Ranges as follows:—  
 Volts A.C. and D.C.: 0-160-300-600 volts.  
 Amps. A.C. and D.C.: 0-25-50-150-200 amps.  
 Supplied complete with current shunts, leads and leather carrying case. Brand new condition, fully tested. £9/19/6 each, carr. 7/6.

**HALLICRAFTER S-36 V.H.F. RECEIVERS**

F.M./A.M. 27-143 Mc/s. 110 volt A.C. (transformer supplied for 230 v. A.C.). Improved version of S-27. Tested before £40 each despatch. Brand new boxed with instruction manual. Carr. £2

**TELEPHONES TYPE 'L'**

2 line connection, generator bell ringing. Complete telephone inter-communication. Supplied in excellent condition, complete with batteries, fully tested, only 69/6 per pair



Carriage 5/-.

**MODEL RX60 AMATEUR COMMUNICATION RECEIVER**

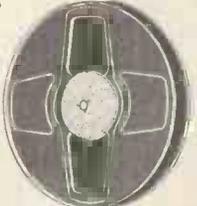
4 Bands, 550 kc/s-30 Mc/s. Special features:—S Meter—AML—BFO—Electrical band spread—internal 5 in. speaker—head set socket—tone control—standby switch—3 aerials loop, wire, telescopic—200/250 volt A.C./D.C. Brand new guaranteed with manual, £24/15/-. post paid.

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Input 200/250 volts A.C. Three H.T. outputs. 2 x 400 volts 175 mA., 350 volts 225 mA., all fully smoothed. 2 x 6.3 v. 5 amp., 6.3 v. 4 amp. 12 v. 5 amp. Supplied in perfect condition. £5/10/- each. Carr. 30/-.

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First grade quality American Recording Tapes, brand new, guaranteed.  
 5 in. std., 600ft. acetate ..... 8/6  
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 5 in. D.P., 1,200ft. mylar ..... 15/-  
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 7 in. std., 1,200ft. Mylar ..... 12/6  
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 7 in. L.P., 1,800ft. Mylar ..... 20/-  
 7 in. D.P., 2,400ft. Mylar ..... 25/-  
 Special discounts for quantities. Postage 2/-, over £3, post paid.



**MARCONI CR100/8 RECEIVERS BRAND NEW**

Packed in original transit cases and complete with handbook/manual. 60 kc/s to 30 kc/s. 200-250 volt A.C. operation. Tested before despatch.

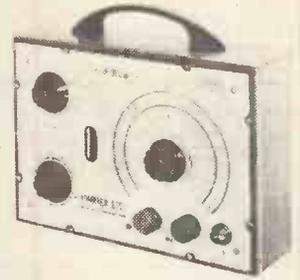
£35 Carriage £2.

A few CR.100 receivers available in good used condition, £21.

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Set of 3, record, play back, erase. Only 29/6 a set. P. & P. 9d.

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1. Transistorised audio generator, 10-100,000 c/s..... £15 2 3
  2. Transistorised Signal Generator, 150 kc/s.—350 mc/s.... £7 18 6
  3. Transistorised C.R. Bridge, 10—100 megΩ, 1 pf.—100µf £7 2 3
  4. Mains operated transistor power unit 1-15 v..... £5 17 0
- S.A.E. for full details.

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- Erskine 13A ..... £27 10
  - Cossor 1035 ..... £45
  - Solartron D300 ..... £30
  - Solartron CT316 ..... £75
  - Solartron CD518 ..... £75
  - Solartron CD568 ..... £75
  - EMI WMS ..... £100
  - EMI WMSA ..... £110
- Carriage extra.

**R.C.A. PLATE TRANSFORMERS**

Pri. 200/250 v., sec. 2,000-0-2,000 v. 500 mA., tapped 1,500 v. New. Boxed, £6/10/-. Carriage 15/-.

**DUMONT K1051P1 DOUBLE BEAM C.R.T.**

Twin Gun. Brand new, boxed, 59/6. P.P. 3/6.

**MARCONI TF-885 VIDEO OSCILLATORS**

25 c/s-5 Mc/s. Supplied in guaranteed as new condition, £45 each. Carr. 30/-.

**MINIATURE PANEL METERS**

For 1½ in. dia. panel hole.  
 0.50µA. 39/6 0-300 v./D.C. 27/6  
 0-500µA 32/6 "S" meter 35/-  
 0-1 mA. 27/6  
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**CONSTANT VOLTAGE TRANSFORMERS**

95/130 v. input 115 v. output 500 watts Can be used in series for 230 volt, £4 each. Carriage 10/-.

**WESTON MICROAMMETERS MOVING COIL RELAYS**

Brand-NEW, boxed, fully guaranteed, 42/6 each. P. & P. 2/-.

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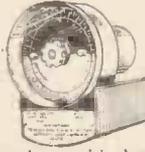
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### GUNFIRE TIME SWITCH 55/- P. & P. 2/6.

Type G509 Mains Operated Time Switch originally supplied for use with Sigmund Pumps in heating installations for standard 200/250 v. A.C. 50 c/s with switch contacts rated at 20A A.C. Consists of synchronous clock motor operating two pre-set on/off contacts which can be positioned to switch on and off at any chosen time once every 24 hours. Pre-setting dial housed in hammer bronze metal case with clear plastic cover and complete unit is mounted over wall fitted push-on socket and terminal holder to facilitate removal and replacement for resetting purposes. Size overall 4 1/2 in. x 2 1/2 in. wide x 3 1/2 in. deep. Brand new in makers cartons.



● WESTINGHOUSE SILICON DIODE. Type RCTD. Max. P.I.V. 1,000 R.M.S. 330 v. Max. current 500 mA. 7/6.

● OC71 TRANSISTOR. Two for 6/6.

● PIEZO CRYSTAL complete element with ribbon contact leads, ten for 12/6.

● IN70 Diode Germanium Point Contact Diode, equivalent OA85. Max. reverse voltage 115 v. Max forward current 150 mA. Two for 2/6.

### CONSTANT VOLTAGE TRANSFORMER 15/- Post and pkg. 1/6

An ingenious and magnificently constructed device by a leading British manufacturer. Consists of a specially wound transformer and Visconol condenser which provides a constant voltage output of 7.5 R.M.S. at 200 mA, with a power factor of 1.0 from any 50 c/s. A.C. input between 5.6 and 9 volts. Size 3 x 2 1/2 x 3 in. high. Unused and fully guaranteed.

★ SEND 1/- FOR 40-PAGE CATALOGUE AND HYDRAULIC PARTS HANDBOOK!

### INFERENCEAL FLOWMETER TRANSMITTER £8

Consist of machined light alloy cylinder containing polished venturi of 3/16 in. minimum diameter, in which a balanced and almost frictionless magnetic impeller is rotated by gas or fluid flow through the bore. An inductive pick-up element screwed into the outside wall of the cylinder is influenced by the rotating impeller, and the resulting signal frequency can be analysed to provide an extremely accurate measurement of flow over a very wide range. Size overall: 7 in. long x 2 1/2 in. wide x 3 1/2 in. high. Fitted with 1 1/2 in. BSP connections at either end. Unused.

### PENN VACUUM SWITCH.

Designed for automatically starting and stopping motor driven vacuum pumps. Two-pole electrical contacts open on pressure increase (vacuum decrease). Effective range is 5 to 29 in. Hg; "cut-in" and "cut-out" point settings can be adjusted as required. Units can be mounted vertically or horizontally. Unused stock manufactured in the U.S.A. and supplied complete with instructions.



27/6 post and packing 2/-.

### HIGH VOLTAGE INDICATOR



High grade Electrostatic meter and heavily insulated probe assembly for voltage measurement up to 11 kv. Meter is slide mounted over insulated probe between two flash-over guards, and is moved to either extremity of slide area to provide twin range facility of 0-5,000 volts and 0-10,000 volts at full scale deflection. 3ft. long x 3 in. diameter probe has insulated rubber handgrip, hang-up loop, and heavy brass tip. Meter is provided with 6ft. long heavy copper braid earth connection terminated in powerful £3 Carriage 5/-. bulldog clip. In wooden transportation case.

2W W-151 FOR FURTHER DETAILS.

### TEST METERS



30,000 OHMS PER VOLT MODEL 500. Reads voltages up to 1,000 D.C. at 30,000 ohms per volt and A.C. at 15,000 o.p.v.; D.C. current to 12 amps; Resistance to 60 Megs.; Decibels from -20 to +36; Incorporates internal buzzer for audible warning of direct shorts and blocking condenser for AF output measurements. Size 3 1/2 x 6 1/2 x 2 1/2 in. £8/19/6.

2,000 OHMS PER VOLT MODEL TP-10. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500mA; Resistance to 1 Meg.; Capacitance to 1µF; Decibels from -20 to +36; Output jack for Audio measurements. Size: 3 1/2 x 5 x 1 1/2 in. £3/19/6.

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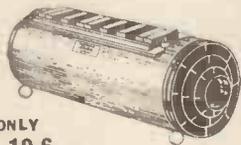
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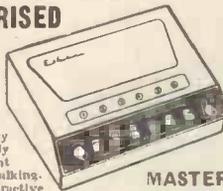
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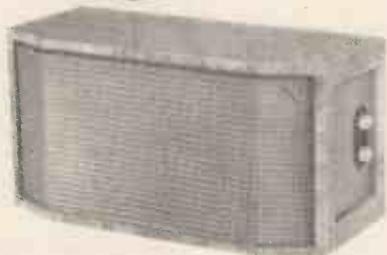
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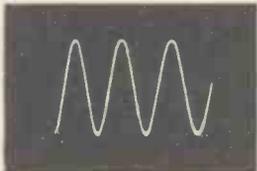
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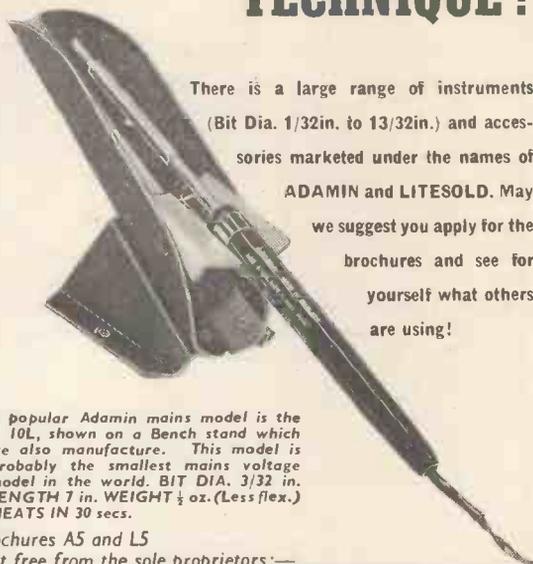
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*“Strikes the right note”*

SAYS DONALD ALDOUS

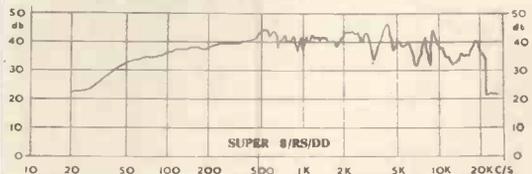
In a review of the Wharfedale Super 8/RS/DD in “Audio & Record Review”, Donald Aldous reported as follows:-



The latest Wharfedale Super 8/RS/DD speaker strikes the right note the moment it is removed from its box. It is beautifully made and finished and looks right.

The unit was tested in a corner enclosure approximately 1½ cu. ft. with the interior heavily lined with carpet felt and a vent of 1½in. wide across the front at the bottom. The bass radiated with this enclosure was smooth and at an ideal level to give balance with the extended top response.

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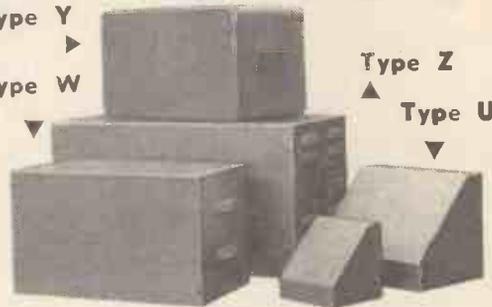


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**PANELS:** Any size up to 3ft. at 4 6 sq. ft. 18 s.w.g.: (16 s.w.g. 5/3). Plus post and packing, over £2 free.

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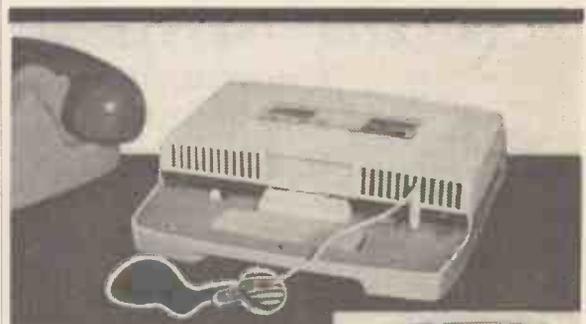
ALUMINIUM SILVER HAMMERED FINISH

Type	Size	Price
U	4 x 4 x 4"	9/6
U	5 1/4 x 4 1/4 x 4 1/4"	14/6
U	8 x 6 x 6"	20/-
U	15 x 9 x 9"	42/6
W	8 x 6 x 6"	19/6
W	12 x 7 x 7"	32/6
W	15 x 9 x 8"	42/-
Y	8 x 6 x 6"	25/-
Y	12 x 7 x 7"	39/-
Y	13 x 7 x 9"	44/-
Y	15 x 9 x 7"	46/-
Z	17 x 10 x 8"	63/-
Z	19 x 10 x 8 1/2"	67/6

\*Height.  
 Type Z has removable back and front panels. Type Y all-screwed construction.

287/289 EDGWARE RD., LONDON, W.2 Tel: Paddington 5891/7595

2W W-161 FOR FURTHER DETAILS.



Why pay over £50 FOR A DICTATING MACHINE?

### JUST ARRIVED—THE UNIQUE 'AIWA' TP.40 TRANSISTOR PORTABLE

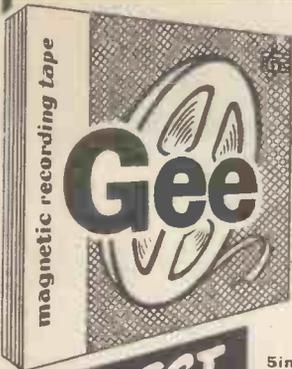
Hours saved by pre-recording your letters, notes, etc. Ideal for the Busy Executive, Rep's, Secretaries, Reporters, at the office whilst travelling, or at home. Slips easily into briefcase, always ready for instant use. Precision engineered, rim drive, 2 motors. 4 transistor amplifier, double track recording, automatic erase, up to 30 mins. play back through powerful internal speaker. Beautifully styled in two-tone shades. Earpiece included for personal listening.  
 5% DISCOUNT on minimum of 6 Units!



**9 GUINEAS COMPLETE**  
 with Microphone, batteries, tape and personal earpiece—Extra tapes available. Post & Pkg. 7/6.  
 Recently reviewed at 16 gns

**HORNTONS ELECTRONICS**  
 1 NAVIGATION ST. (Next to Queen's Hotel) BIRMINGHAM 2  
 TELEPHONE — MID 0972

2W W-162 FOR FURTHER DETAILS.



# FIRST QUALITY TAPE FACTORY FRESH

**LOWEST EVER PRICES**

5in. Std.	600ft.	Mylar	8/6
7in. Std.	1,200ft.	Mylar	12/6
5in. L.P.	900ft.	Acetate	10/-
5in. L.P.	900ft.	Mylar	12/6
5½in. L.P.	1,200ft.	Acetate	12/6
5½in. L.P.	1,200ft.	Mylar	15/-
7in. L.P.	1,800ft.	Acetate	15/-
7in. L.P.	1,800ft.	Mylar	20/-
4in. D.P.	600ft.	Acetate	9/-
5in. D.P.	1,200ft.	Mylar	15/-
5in. D.P.	1,800ft.	Mylar	22/6
7in. D.P.	2,400ft.	Mylar	25/-

**AMERICAN "SHAMROCK" TAPE EXCLUSIVE TO GEE'S**  
 7in L.P. 1,800ft. 15/6  
 Professional quality

**"GEE'S" SUPER QUALITY MESSAGE TAPES**  
 3in. Std. 150ft. 3/9, 3in. L.P. 240ft. 5/-; 3in. D.P. 400ft. 10/-. On brightly coloured spools in neat plastic cassettes. Ideal for gifts or messages.

**COLLARO "STUDIO" TAPE TRANSCRIBERS.** Brand new in original cartons. 3 speeds, 1½, 3½, 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spools, instructions and fixings. A.C. 200/230 v. operation. **SPECIAL PRICE 10 GNS.** Carr. paid.

Where not stated, please add P. & P. 2/- per order. (Orders over £3 post free.) Many other types available including "SCOTCH", "EMI", "BASF", "Synchronape," etc. Send S.A.E. for our huge money-saving literature on Tapes and Accessories.

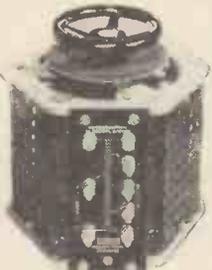
**SPECIAL DISCOUNT FOR TAPE QUANTITIES**

**MICROPHONE FLOOR STAND (Telescopic).** HEAVY 9in. dome, chromium base, chromium stand with screw top. Extends to approx. 6ft. 55/- Carr. 5/-.

**15 WATT TRANSISTOR POWER AMPLIFIER**  
 A new transistor Audio Frequency Amplifier of new modern design incorporating a number of additional practical features. Operates on 12 volts. Power output 15 watts. Output impedance 25, 15, or 3.75 ohms. Inputs for mike and gram. Frequency response 100 c/s. to 10 kc/s. Incorporates on/off switch, volume control, tone control, pilot lamp. Complete in pale green hammer finish metal case, size 6 x 3½ x 5½in. Weight 4½ lbs. Made in England. Brand new and fully guaranteed. All parts replaceable. **ONLY £21.**

**"POWERSTAT" VARIABLE TRANSFORMERS**

Input 230 volts. 50/60 cycles. Output 0-200 volts at 9 amps. Fully shrouded. For bench or panel mounting. A robust job of outstanding quality and performance. Brand new and guaranteed. £15. Carr. 7/6. Made in U.S.A.



**AUTO TRANSFORMERS.** Step up, step down. 110/115, 220/230 v. Full shrouded terminal block connectors. 150 w. 32/6; 300 w. 47/6; 500 w. 67/6; 750 w. 77/6; 1,000 w. 90/-; 1,750 w. 175/- Carriage 5/- on each type.

**RCA PLATE TRANSFORMERS** 190 to 250 v. primary 50-60 cycles. Secondary 1,500-0-1,500 v. or 2,000-0-2,000 v. at 500 milliamps. Brand new and boxed 26/10/-. Carriage extra.

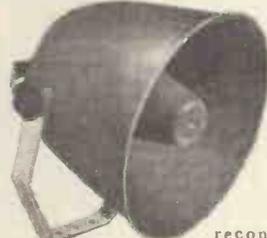
**L.T. TRANSFORMERS.** Tapped. Primary 200/250 v. 50 cycles. Secondary, 0-12-18-24-30-36 v. at 6/8 amps. 65/- Ditto 10/12 amps. 85/- Carr. 5/- each.

**"GEE'S" ACCESSORY KIT**  
 1 "B1B" Splicer, 1 Splicing Tape, 3 Leader Tapes (3 colours), 10 Retaining Clips, Packed in plastic container. PRICE 32/6. While stocks last. **SPARE SPOOLS.** 4in., 5in., 5½in., 2/- each, 7in. 2/6; 8½in. 5/-.

**THE "INSTANT" BULK TAPE ERASER**  
 A complete reel of magnetic tape can be effectively erased of all traces of recorded matter within a few seconds leaving tape as new. Operates on A.C. 200/250 v. Today's price 35/- FEW ONLY AT 30/- P. & P. 2/6.

(Orders over £3 post free.) Many other types available including "SCOTCH", "EMI", "BASF", "Synchronape," etc. Send S.A.E. for our huge money-saving literature on Tapes and Accessories.

**P.A. EQUIPMENT**



**RE-ENTRANT LOUD HAILERS (Ex-Govt.)**  
 Heavy duty 20 watts, all-metal, 15 ohms. Dia. 15in., length 15in., (approx.). Brand new and boxed. 29. Carr. 10/- Ditto reconditioned, 26/10/- Carr. 10/-.

**TELEPHONE CABLE.** One mile drums. Single Brand new, 23/10/- Carr. 10/- Ideal for P.A. 6 inch P.M. HEAVY DUTY SPEAKERS. Complete with line trans., in all steel blue-grey double grilled circular cabinet, 30/- P. & P. 3/-.

**W. B. Stentorian Dual Purpose Speaker System**

Incorporates 2 8" 3 ohm speakers and 100 volt line transformer. Handling capacity 10 watts. Mounted back to back in one cabinet they give excellent sound distribution. Ideal for dance halls, factories, and all P.A. systems. **LIMITED QUANTITY ONLY.**



**SNIP PRICE 24/15/6 Carr. 8/6.**

**TRUVOX TANNYOY LOUD HAILERS.** With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case, 30/- Carr. 5/- **W.B. STENTORIAN 12in.** heavy duty 15 ohm. Speaker. Handling capacity 15-20 w. Listed £10/5/- **OUR PRICE 55/15/- P. & P. 5/-.**

**GEE BROS. RADIO LTD.**

15 LITTLE NEWPORT STREET, LONDON, W.C.2 GER. 6794/1453

Open 9-6 Mon. to Fri. 1 p.m. Sat. Adjoining Leicester Square Tube.

**100,000 O.P.V. MULTI-TESTER**

MODEL 370-N

**£14.14.0**

Incorporates 9.5 µA. basic meter, scale size 4 x 2½in. Ranges D.C. volts, 8 ranges 100 mV. to 5 kv. D.C. amps., 7 ranges, 10 µA. to 10 A. A.C. volts, 6 ranges 2.5 v. to 1 kv. Ohms 5 ranges 0-50 megohms and 5 ranges 40 ohms to 400 K ohms. Overall size 7 x 5 x 2½in.



30,000 o.p.v. MULTI-TESTER MODEL 500. Ranges D.C. volts 0-1,000 v. A.C. volts 0-1,000 v. (15,000 o.p.v.). D.C. current 0-0.5-500 mA., 0-12 v. Resistance 0-60 meg. Decibel. +20 to -54 dB. Sizes 3½in. x 6½in. x 2½in. **ONLY £37/6.** Both above supplied complete with instruction manual, test leads and batteries

**COSSOR 1035 DOUBLE BEAM OSCILLOSCOPE**  
 A fine instrument in perfect condition and in good working order, £40. Carr. 30/-. Also 1049 at £45. Carr. 30/-.



**EVERSHED & VIGNOLES Series II. 500 v. Megger in good condition, £18/18/-.** **DITTO. NEW with leather case £25.**

meter). 2 ranges 0-3, 0-30 ohm. Complete with leather case and test leads. As new, 26/6/-. Ditto 0-500, 100-5,000 ohms, 26.

**EVERSHED & VIGNOLES MEGGER CIRCUIT TESTER** (low reading ohm meter). 2 ranges 0-3, 0-30 ohm. Complete with leather case and test leads. As new, 26/6/-. Ditto 0-500, 100-5,000 ohms, 26. **EVERSHED & VIGNOLES.** Wee Megger 500 w., with leather carrying case, good working order £15. Also 100 v., as above, 26/6/-.



**BRIDGE MEGGERS.** Evershed and Vignoles Series 2, 500 v. Accurate working order, perfect condition, fully tested. Complete with leather case, £40. **AVO MODEL 7.** 50 ranges of A.C. D.C. tests. Complete with leads and batteries. Ready for use. Perfect order. **ONLY 10 gns. Carr. 5/-.**

**FERRANTI SILICON DIODE. ZR21, 50 v. at 8 amps.** Brand new 15/-.

**WESTINGHOUSE 38EHT240 PENCIL RECTIFIER.** 12½in. long x ½in. dia. 6.7 KVA at 5 mA. 15/-.

**OUTSTANDING BUYS IN QUALITY MULTI-METERS**

Model Y.3. 2,000 ohms per volt. Sub-miniature in size and convenient in use. Ranges D.C. volts, 0, 30, 150, 500, A.C. volts, 6, 30, 150, 600. D.C. amps, 150 mA. Ohms, 0-100 K ohms Size 3½ x 2½ x 1½in. **PRICE 39/6. P. & P. 2/-.** Model YP.00. 3,300 ohms per volt. Pocket size suitable for general use. Ranges D.C. volts, 6, 12, 60, 300, 1,200. A.C. volts, 6, 12, 60, 300, 1,200. D.C. amps., 300µA, 3 mA., 300 mA. Ohms, 0-30 K ohms, 0-3 M ohms. DB, -20 to +18 dB, 0 to +24 dB. Size, 4½ x 3½ x 1½in. **PRICE 52/6. P. & P. 2/-.**

Model 100L. 4,000 ohms per volt. Miniature tester with high sensitivity of 150 µA. Ranges D.C. and A.C. volts, 10, 50, 250, 500, 1,000. D.C. amps., 250 µA, 50 mA., 500 mA. Ohms, 0-10 K ohms, 0-1 M ohms. DB -20 to +22dB, +20 to +36 dB. Capacity, 0.05 µF, 1 µF, 250µF, 0.2µF. **PRICE 59/6. P. & P. 2/-.** All complete with test leads, battery, instructions and fully guaranteed.

**G.P.O. STANDARD 19in. HEAVY DUTY EQUIPMENT RACKS**

5ft. 6in. Angle Uprights, 24/10/- Carr. 15/-.  
 6ft. Channel Upright, 26. Carr. 20/-.  
 7ft. Channel Upright, 27. Carr. 20/-.  
 All with Heavy Duty Base.

**TELEFUNKEN HI-FI STEREO AMPLIFIER MODEL S.82 WITH BALANCE CONTROL NOW ONLY £5/19/6.** Carr. 7/- 110/250 v. A.C. input 5 watt undistorted, output (10 w. nominal). Size 12 x 9 x 2in. Weight 9 lb. Complete with spec. and instrct.

**6 TRANSISTOR AND DIODE SUPERHET**

A first class 2 waveband transistor superhet. ● Printed circuit panel (size 8 1/2 x 2 1/2 in.). ● 3 pre-aligned I.F. transformers. ● High gain Ferrite rod aerial. ● First-grade transistors. ● Car-aerial winding. ● Push-pull output. All parts supplied with simple instructions. Set of parts if purchased at one time **ONLY £4/5/-**. P. & P. 2/6. All parts sold separately.



**35 OHM SPEAKERS**

*Suitable for use with above:*  
2in. Goodmans. Ideal replacement for many pocket portables, 8/6; 2 1/2in. 10/6; 3 1/2in. 12/6; 5in. 17/6; 7 x 4 2 1/2in. P. & P. 1/6 per Speaker **PORTABLE CABINET** Size approx. 9 1/2 x 6 1/2 x 3 1/2 in. Suitable for above using 3 1/2 in. speaker 25/- P. & P. 2/-

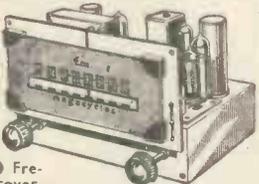


**COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET**

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling), 28/6 complete, post 1/-. 6 transistor printed circuit, board to match, 8/6, post 9d. Circuit diagram 1/6 extra.

**HARVERSON'S F.M. TUNER MARK I**

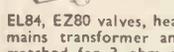
F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● OAB1 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5 1/2 in. ● All parts sold separately. Set of parts if purchased at one time, **£5/19/6** plus 8/6 P.P. and ins. Circuit diagram and illustrations 1/6 post free. **Mark II Version**, as above, but complete with magic eye, front panel and brackets. **£6/12/6**. P. & P. 8/6. **Mark III Version**, as Mark I but with output stage (ECL82) and tone control, **£7/7/-**. P. & P. 8/6.



**HANDSOME METAL CABINET IN CHOICE OF GREY, BLACK OR GREEN. TO FIT MARK I, 25/- P. & P. 2/6. TO FIT MARK II, 17/6 P. & P. 2/6.**

**3-VALVE AUDIO AMPLIFIER MODEL HA34**

Designed for Hi-Fi reproduction of records. A.C. mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2 in. w x 4 in. d x 4 1/2 in. h. Incorporates ECC83, EL84, EZ80 valves, heavy duty double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Peak output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for **ONLY £4/5/-**. P. & P. 4/-.



**TWO-VALVE AMPLIFIER**, similar to above but using ECL82 and EZ80, with Tone and Volume controls. Output 3 watts. **PRICE 75/-**. P. & P. 4/-.

**SPECIAL OFFER!**

**GORLER F.M. TUNER HEADS** 10.7 Mc/s. I.F., 15/-, plus 1/9 P. & P. (ECC85 valve 8/6 extra.)

**F.M. TUNER HEAD**



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) and drum and spindle. 18/6, plus 1/9 P. & P. Valve 8/6 extra. Drum and spindle 3/6 extra.

**SPECIAL PURCHASE!**

Brand new and unused **TURRET TUNERS**

By famous maker Complete with PCC84 and PCF80 valves. 34-38 Mc/s. I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied. 25/- each. P. & P. 2/6.

**FURTHER HUGE PURCHASE** enables us to offer the

**E.M.I. 4-speed Player and P.U.** FOR ONLY **67/6** P. & P. 4/6.



Heavy 8 1/2 in. metal turntable. Low flutter performance 200-250 v. shaded motor with tap at 45 v. for amplifier valve filament if required. Turn-over LP78 head.

**4-SPEED PLAYER UNIT BARGAINS**

Single Players. B.S.R. TU/12, £3/10/- Carr. 3/6. **Auto Changers.** B.S.R. UA14, £6/2/6. Latest B.S.R. UA16, £7/2/6. Carr. 5/- on each. Latest Garrard 'Auto-Slim', £6/17/6 Carr. 5/-.

**SPEAKER AND CABINET FABRICS**

Oatmeal, Red and Gold fabrics and various patterns in Vynair and Tygan for speaker and cabinet covering only. 35/- yard. Our Price (Min. order 1 yd.). Send S.A.E. for samples.

**HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1**

★ Peak output in excess of 1 1/2 watts. ★ All standard British components. ★ Built on printed circuit panel, size 6 x 3 in. ★ Generous size Driver and Output Transformers. ★ Output transformer tapped for 3 ohm and 15 ohm speakers. ★ Transistors (GET 114 or S1 Mullard OC81D and matched pair of OC81 o/p). ★ 9 volt operation. ★ Everything supplied, wire, battery clips, solder, etc. ★ Comprehensive easy to follow instructions and circuit diagram 1/6 (free with kit). **All parts sold separately.** Also ready built and tested 52/6. P. & P. 2/6. A pair of TA1's are ideal for stereo

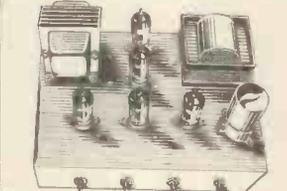


**SPECIAL PRICE 45/-** P. & P. 2/6.

**TRANSISTORS All brand new**

GET15 (Matched Pair) 15/-  
OC71 ..... 5/- PXA101 ... 6/6  
OC72 ..... 6/- XA103 ... 6/6  
OC76 ..... 6/- V15 10p ... 12/6  
Set of Mullard 6 transistors OC44, 2-OC45, OC81D, Mchd pr OC81, 25/- Ediswan Mazda R.F.1 Pack: 1-PXA102 Mixer, 2-PXA101 I.F. amps. (equiv. OC44 and OC45) 10/6; R.F.2 Pack: 2-PXA101 I.F.; 1-PXA102 Osc.; 1-PXA102 Mixer 12/6. (All post free.)

**10/14 W. HI-FI AMP. KIT**



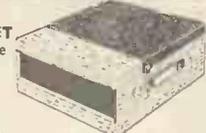
A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer (to match 3-15Ω speaker) 2 independent volume controls and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier, **ONLY £6/19/6**. P. & P. 6/6. All parts sold separately. Simple instruction book 1/6. (Free with parts.) Also available ready built and tested complete with input jack plugs, **£8/15/-**. P. & P. 6/6.

**AMPLIFIER CARRYING CASES**

Brand new. Strongly made wooden construction, tough vinyl covered, complete with carrying handle. Overall size 13 1/2 in. wide x 9 in. deep x 8 in. high with sloping front panel. Weight only 4 1/2 lb. Ideal for our 10/14 watt Amplifier and many others. **Bargain Price 28/6**. P. & P. 4/-.

**LARGE CABINET**

Suitable for B.S.R. Auto Unit and amps. Complete with 3 ohm speaker. **£3/9/6**. Carr. 5/-.  
**Superior Cabinet.** Similar to above to take 8 x 5 in. speaker, with motor board, will accommodate BSR UA14 or UA16. **£3/9/6**. Carr. 5/6. Speaker 15/- extra. P. & P. 1/6 extra.



**3 OHM LOUDSPEAKERS**

2 1/2 in. 12/6; 5 in. 12/6; 6 1/2 in. 15/-; 8 in. 21/-; 10 in. 25/-; 12 in. .... 27/6  
E.M.I. 2 1/2 in. tweeter ..... 10/6  
8 x 5 in. by famous maker ..... 10/6  
E.M.I. 1 3/4 in. x 8 1/2 in. high flux 32/6  
Rola Celestion approx. 9 in. x 6 in., middle register speaker ..... 10/6  
15 ohm 12 in. .... 30/-  
P. & P. up to 6 in. 1/6; over 6 in. 2/6 per speaker. **ALL BRAND NEW.**

**B.S.R. MONARDECK**

(Single speed) 3 1/2 in. per sec., simple control, uses 5 1/2 in. spools, **£6/15/6**. **COLLARO STUDIO DECK** £10/10/- plus 5/6 carr. and ins. on both (Tapes extra on both).

**RECORD PLAYER AMP.**

2 valve (EZ80, ECL82), A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7 in. w. x 2 1/2 in. d. x 5 1/2 in. h. 55/- P. & P. 3/-.

**AMPLIFIER ON PRINTED CIRCUIT BOARD**

Two valve. UY85, UL84 with O.P. trans. use with 80 volt tap off motor, 39/6. P.P. 2/6 on above. Dropper res. for filaments if required 2/6.

**STEREO AMPLIFIER**

89/6. P. & P. 5/- **Bargain Offer** ★ 4 watts per channel. ★ Full tone and volume controls. ★ Absolutely complete, incorporating 2-ECL82's and EZ80 valves and heavy duty double wound mains trans.

**SPECIAL BARGAINS!**

**MAINS TRANSFORMERS.** Drop thru' type. Tapped primary 110 v., 200 v., 220 v., 240 v., 320-0-320 v. v. at 80mA and 6.3 v. at 3 amps. Generous core. Stack size 3 1/2 x 2 1/2 x 1 1/2 in. Weight 4 lb. **ONLY 15/-**. P. & P. 3/6.

**MAINS TRANSFORMERS.**

Tapped Primary, 1/2 wave or Bridge Rectifier. Secondary 250 v. at 75 ma. 6.3 volts at 2 amps. 10/6. P. & P. 3/-.

**MAINS TRANSFORMER.**

Impregnated and fully shrouded. Size 4 1/2 x 3 1/2 x 2 1/2 in. Weight 6 lb. Tapped primary 205, 225, 245 v. Electrostatic screen. Output 360-0-360 v. at 120 ma. D.C. plus 1050 v. half wave at 3 ma. D.C., 6.3 v. at 3.5 amps., centre tapped 5 v. at 2 1/2 amps. and 6.3 v. at 6 amps. **PRICE ONLY 21/-**. P. & P. 5/-.

**CARBON MIKE INSERTS.**

Brand new 2 1/2 in. dia. 3/6. P. & P. 9d.

**ELECTROSTATIC H.F. TWEETERS.**

Type L.S.H. 75. Size 3 x 3 in. 2/6 each, plus 9d. P. & P.

**ACOS CRYSTAL MIKES.**

High impedance for desk or hand use. High sensitivity, 18/6. P. & P. 1/6.

**TSL CRYSTAL STICK MIKES.**

(Listed at 45/-) Our Price 18/6. P. & P. 1/6.

**TRANSISTOR DRIVER AND O/P TRANSFORMERS.**

(Tapped 3 ohm and 15 ohm o/p) plus 4 suitable Transistors giving approx. 1 watt o/p. 30/- P. & P. 2/-.

**3 PUSH-BUTTON TRANSISTOR SWITCH D.P.**

— D.T. Each switch 5/6 plus 1/- P. & P.

**HARVERSON SURPLUS CO. LTD.**

170 HIGH ST., MERTON, S.W.19 CHERRYWOOD 3985/6  
Open all day Saturday Early closing Wed., 1 p.m.  
A few minutes from South Wimbledon Tube Station. (S.A.E. all enquiries.)  
Please Note: P. & P. charges quoted apply to U.K. only. P. & P. on overseas orders charged extra. (PLEASE WRITE CLEARLY.)

# TRANSISTORS, CRYSTALS, VALVES, COMPONENTS & EQUIPMENT

FOR THE AMATEUR AND PROFESSIONAL — TRADE SUPPLIED — QUOTATIONS BY RETURN  
NEW ITEMS ARRIVING EVERY DAY—SEE LATEST CATALOGUE AND LATEST SUPPLEMENT

## 10 WATT TRANSISTOR HI-FI AMPLIFIER AND PREAMPLIFIER

Sold as kits or Prebuilt units

For Mono or Stereo equipment.

● Power amplifier built on to 4 x 2½ in. panel with radiator for outputs. 6 transistors and rectifier: mains or battery.  
★ Complete Kit for 24 volt 3 ohm version

£5.15.6 P.P.2/6



Or built and tested **£5.19.6** P.P. 2/6.

Mains unit 69/6 extra.

★ Complete kit for 40 volt 15 ohm version £6. P.P. 2/6.

Or built and tested £6.5.0. P.P. 2/6.

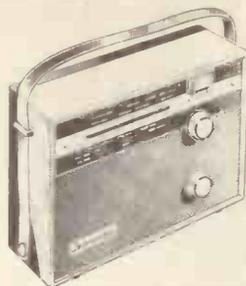
● Full function pre-amplifier and control unit on printed panel 9 x 2½ in. operates on any voltage 9 to 40 volts. 5 controls. Input selector, Treble, Bass, Filter. 1.5mV sensitivity.

Kit 99/6. P.P. 2/- . Built £5-10-0. P.P. 2/-.

The 24 volt 3 ohm power amplifier can be used on any D.C. mains or battery voltage from 4½ to 24 volts. Ideal for loudhailers, public address or equipment amplifiers.

A COMPLETE HI-FI SET UP—ALL TRANSISTOR

● LATEST BOOKLET—FREE ON REQUEST ●  
● CALL FOR DEMONSTRATION—ANY TIME



## "THE CONTESSA"

★ COMBINED PORTABLE AND CAR RADIO ★  
AMAZING SENSITIVITY AND SELECTIVITY ON MEDIUM AND LONG WAVEBANDS

★ The easiest Superhet Radio to build on the market. Features clearly-marked printed circuit and packaged components with full illustrated building instructions. Full tuning of medium and long wave bands with unbeatable sensitivity and selectivity. Excellent tone and volume with over 600 mW push-pull output.

★ Clearly marked horizontal station dial with slow motion tuning. Two colour Blue or Beige cabinets with Gold handles, grilles and fittings. Size 10½ x 7½ x 3½ in., includes car aerial socket, recording sockets.

★ 6 Mullard Transistors and 2 Diodes. Guaranteed the Best Obtainable

TOTAL COSTS OF ALL PARTS

**£9.19.6** P.P. 3/6.

Fully Detailed and Illustrated Leaflet on request

All parts sold separately.

● Attractive Appearance—Reliable Design—Unbeatable for Quality and Performance. ●

## NEW TRANSISTOR 4-CHANNEL MIXER

4-HIGH IMPEDANCE INPUTS FOR CRYSTAL P.U., MICS, TUNERS, RECORDERS, ETC. OUTPUT TO FEED VALVE OR TRANSISTOR AMPLIFIERS. BUILT INTO GOLD FINISH CASE **59/6** POST FREE

## FIELD STRENGTH METER

Five channels cover 1 Mc/s to 200 Mc/s. Fitted 200 microamp meter for CW or R.F. Indication and Earphone for A.F. monitoring. Designed for checking all types of transmitters. Size 4x2½x2½ in. Complete. Ready to Use, with instructions and telescopic aerial, 69/6. Post Free.



Multi-range test meters featuring easy to read scales and provided with full operating instructions, leads and batteries. Suitable for amateurs, designers, repair shops, all domestic uses. See catalogue for full details.

- ★ PT34 1 K ohm/volt..... £2 5 0
- ★ M1 2 " " " " £2 9 6
- ★ THL33 2 " " " " £3 15 0
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4-WAVEBAND COMMUNICATIONS RECEIVER RX60 OR SR40 550 kc/s.-30 mc/s.—BFO—AVC—S' meter —noise limiter—Bandspread—Telescopic aerial etc. Full handbook. Brand new.

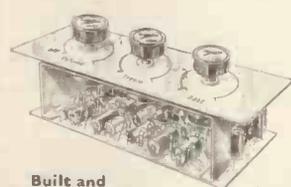
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Detailed leaflet on request.

★ Also de luxe version, 42 gns. P.P. 12/6.

We can supply from stock most of the components and items specified on circuits published in this and other magazines and radio books. Let us quote for your circuit.

## 7-TRANSISTOR RECORD/PLAYER/RADIOGRAM AMPLIFIER



Built and Ready to Use

**£5.19.6**

P.P. 2/- . (Complete with full descriptive Booklet)

Call for demonstration.

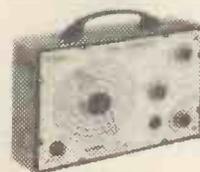
● TWO VERSIONS AVAILABLE

12/18 volt for 15 ohm speakers (mains unit 80/- extra)

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● Size only 6in. x 2½ in. x 2in. Ideal for mains or battery, portable or domestic record player, gram, etc.

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NEW a. TAPE JACK TUNER 29/- P.P. 1/6  
b. 10 watt HORN TWEETER 29/6 P.P. 1/6  
MICROPHONES—SPEAKERS—MAINS AND BATTERY DECKS—HEADPHONES—COMPLETE RANGE IN STOCK

## "CAPRI" POCKET RADIO 6-TRANSISTOR SUPERHET



Size only 4½ x 2½ x 1½" **REALLY POCKET SIZE!**

The most compact 6-transistor and diode radio with speaker available to

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TOTAL COSTS OF ALL PARTS **79/6** P.P. 2/-  
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Complete with full function pre-amplifiers and controls.

★ SA80 4+4 watts £9/10/-

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Each amplifier completely self contained and designed for Mono and Stereo output. Supplied complete with full manual. Leaflets on any type on request.

# HENRY'S RADIO LTD.

303 EDGWARE ROAD, PADDINGTON, LONDON, W.2.

OPEN ALL DAY SATURDAY. 100 yards from Edgware Road Tube Station.

PADDINGTON 1008/9. OPEN MON. TO SAT. 9-6. THURS. 1 o'clock.

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68-PAGE FULLY DETAILED AND ILLUSTRATED CATALOGUE (Plus 8-page Illustrated Supplement.)

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NEW ITEMS—PRICE REDUCTIONS 8-page Supplement for above Catalogue available separately 1/-.

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Sold as three pre-built units with less than 30 minutes inter-connection work. Originally sold at more than double the price. A superb record player, fully portable—the ideal gift for teenager or adult.

## "MINI-GRAM" TRANSISTOR PORTABLE RECORD PLAYER

- ★ Ready Built 4-transistor 1 watt amplifier with elliptical speaker and volume control, 35/-, P.P. 2/-.
- ★ 9 volt 45 r.p.m. turntable with Crystal pick-up, 39/6, P.P. 2/6.
- ★ Two-tone moulded case with handle, 5/-, P.P. 1/-.

OR TOTAL **79/6** P.P. 5/-  
COST 5/-

(Battery 3/9 extra)

### SUBSTITUTION BOXES

- Capacitor Box. Provides 9 standard values from 0.001 to 0.22 mfd at 600 volt working, 29/6.
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- Each box fully calibrated with insulated leads. Invaluable for service and design.

### 100 Kc/s QUARTZ CRYSTALS

- 2 Pin: OCTAL or 3 Pin 15/- ea.
- 500 Kc/s 2 Pin ..... 15/-
- 455 Kc/s (AR88) ..... 12/6
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- HC6U 18 mc/s to 46 mc/s... 7/6
- 80 frequencies 0.005% Acc.

# SCOOP! BOAC VHF POCKET RECEIVERS



- ★ Features 5-transistors (V6/BR = OC44) 2-OA91 diodes, V.H.F. detector, OA10 rectifier.
- ★ 1K ohm Stethoscope headset.
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- ★ Moulded case with aerial/strap.
- ★ Full circuit and details.
- Deac separately 12/6, P.P. 1/6.
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- Unit without above cell and phone 10/-, P.P. 1/6.

- Complete with circuit, 32/6, P.P. 2/-.

Ideal for experimental receivers—personnel locators, etc.

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- COLLARO STUDIO 2-TRACK DECK, £10.19.6., P.P. 5/-.
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- CABINET with SPEAKER for either of above, 5 gns., P.P. 2/-.
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Large range of Hi-Fi equipment in stock. See latest Catalogue.

### Cathodeon Miniature Crystal Oven

6 or 12 volt A.C./D.C. 80°C for HC6U crystals. Brand new, 22/6, P.P. 1/-.



## Henry's Radio Ltd.

303 EDGWARE ROAD, LONDON, W.2

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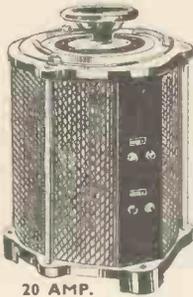
Open Monday to Sat. 9-6. Thurs. 10'clock.

2W W—166 FOR FURTHER DETAILS.

# VARIABLE VOLTAGE TRANSFORMERS

INPUT 230 v. AC 50/60~

**BRAND NEW.** Carriage Paid. Buy direct from the importer, keenest prices in the country. All spares available from stock.



20 AMP.

- Type 01 0-260 volts at 2.5 amps £5 17 6
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2.5 AMP.

These instruments are fully shrouded.

## STOP PRESS JUST ARRIVED!

**TYPE 001 0-260 volts at 1 amp. £4-10-0**  
Fully shrouded. Similar structure to 2.5 type.

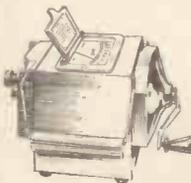
### PORTABLE

Input 230 v. A.C. Output variable 0-260v. A.C. at 2.5 a.



Fitted in beautifully finished steel case. Complete with volt meter, pilot lamp, fuse, switch, carrying handle, £9/17/6.

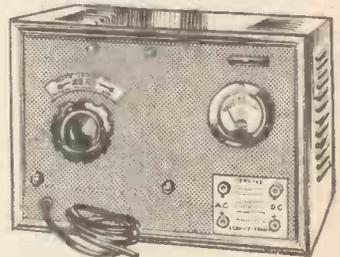
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Test to I.E.E. Spec. Rugged metal constructed, suitable for bench or field work, constant speed clutch. Size L. 8in., W. 4in., H. 6in. Weight 6lb. 500 volt, 500 megohms. Price £22, carriage paid. 1,000 volts, 1,000 megohms, £28, carriage paid.

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Input 230 v. A.C. Output continuously VARIABLE from 0 to 260 volts A.C. OR 0 to 230 volts D.C. at 7 amps. Robustly constructed in metal case, complete with safety fuse, neon indicator and voltmeter. Size 17in. x 12in. x 7in. Weight 36lb. Price £34/10/-. Carriage 20/-.



# SERVICE TRADING COMPANY



2W W—167 FOR FURTHER DETAILS.

### ULTRA VIOLET BULBS

Easy to use source of UV for dozens of practical and experimental uses.  
 12 volt 36 watt AC/DC 5B6 6/6. P. & P. 1/-.  
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 Transformer to suit the above: Input 200-240 A.C. 12 volt 36 watt, 16/6; P. & P. 2/6. Input 200-240 A.C. 12 volt 60 watt, 22/6. P. & P. 3/6  
**Set of 4 Colours FLUORESCENT PAINT.**  
 Red-yellow, green and blue. In 3/4oz. tins. Ideal for use with the above Ultra Violet Bulbs. 9/6, plus 1/6 P. & P.

**CARPENTER'S TYPE 5C9B POLARISED RELAYS.** 2 x 9,500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/-.



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**NSP2 CV2196 STROBOTRON FLASH TUBE** made by Ferranti, brand new I.O. base. Price 15/-. P. & P. 1/-.

**FOSTER CONSTANT VOLTAGE TRANSFORMER**  
 Automatic or hand operated. Input 250 volt + 5 - 15%. Output adjustable 200/250 volt. Max. 80 AMP. electro magnet control load unit as new £95 ex warehouse.

**G.E.C. SEALED RELAYS TYPE M1494.** 24 volt 670 ohms coil. 1 pole C.O. Brand new. Price 10/-. P. & P. 1/-.

**NEW P.O. RELAYS TYPE 3000**  
 2,000 ohms coil. 4 make 4 break. 12/6 each. 6,500 ohms, 1 changeover, 1 break. Price 12/6 10,000 ohms coil, 2 light c/o. 2 heavy duty c/o. Price 22/6. 16,000 ohms, 2 make 2 break. Price 15/-. P. & P. 1/- each item.

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**SUB-MINIATURE SEALED RELAYS** by Magnetic Devices Ltd., size 1 x 1/2 x 3/16 in. Wt. 1/2 oz. 500 ohm, 24 v. coil, double pole change-over. Price 39/6.

**EVERSHED & VIGNOLES BRIDGE MEGGER.** 500 v. Constant Pressure Series 2 with decade and varley loop facilities, perfect condition £40 including leather case and carriage.

**SIEMENS HIGH SPEED RELAY. SEALED TYPE H96D.** 500 Plus 500 ohm Ex. new equip., 12/6. Plus 1/- P. & P. Very latest type sealed H96E. 1,700 ohms plus 1,700 ohms. single C/O contacts. Price 16/6 each, plus 1/- P. & P.

**SLIDER RESISTANCES**  
 Geared drive, new. 1.2 ohm, 14 amp. 27/6  
 35 ohm 3 amp. 37/6  
 75 ohm, 2 amp. 37/6  
 200 ohm, 1.25 amp. 37/6  
 P. & P. 3/6

**W.W. RHEOSTAT.** New. 3.5K, 25 watts. Price 7/6. P. & P. 1/6. 22 ohm 1.5 amp., complete with knob, 8/6, plus 1/6 P. & P.

**EVERSHED & VIGNOLES MEGGER CIRCUIT TESTER.** (Low reading ohm meter.) 2 ranges, 0-3, 0-30 ohms. Complete with test leads, battery and leather carrying case. £6/6-. Post paid.

**ADJUSTABLE THERMOSTAT**  
 Mid-point setting 65°F, range 60 to 75°F, 15 amps. A.C. 230 volt. Price 8/6, plus P. & P. 1/6.

**UNISELECTOR** 8 bank 25 way 75 ohm coil full wiper, Ex. equipment. Individually tested. 45/-. plus 2/6 P. & P.

**HIGH SPEED BLOWER UNIT**  
 200/250 volt A.C. Powerful 2 speed motor, 11,000 and 13,000 R.P.M. 17/6, plus 2/6 P. & P.

**EX P.O. MAGNETIC COUNTER,** either 500 ohms for 24 volt operation or 3 ohms for 6 volt D.C. operation. 4 figures to 9,999. Price, either type 8/6. P. & P. 1/6.

**CROMPTON PARKINSON BRAND NEW 1/2 h.p. MOTORS.** 230/250 VOLT A.C. 1,400 R.P.M. Fitted with 2 1/2 x 3/16 in. SPINDLE. Price £3/15/-. Carriage 8/6.

**6-VOLT 40 A.H. ACCUMULATORS** in metal case with leather carrying handle. Brand New, 27/6. Carriage 8/-.

**AUTO TRANSFORMERS.** Step up, step down. 110-200-220-240 v. Fully shrouded New. 300 watt type £2/6/6 each. P. & P. 2/6. 500 watt type £3/7/6 each. P. & P. 3/9. 1,000 watt type £4/10/- each. P. & P. 6/6.

**MAGNETIC COUNTERS 40 IMPULSES PER SECOND**  
 Very latest High Speed type ex P.O., guaranteed perfect, type No. 100B, coil 2,300 ohms, for 48 volt D.C. operation (will work on 36 volt), overall size 4 x 1 x 1 in. Also available, type 101A which can be used as an interesting accessory with our Strobe unit. Either type price 15/-. P. & P. 1/6.  
 New Miniature Type 3 1/2 long x 1/2 square 300 ohm coil 12 volt D.C. operation. Skeleton type (less outer cover), 10/-. plus 1/6 P. & P.



**230 VOLT A.C. GEARED MOTORS**  
**Type B16G 80 r.p.m. .26lb. inch** £1/19/6. P. & P. 2/-.  
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**230 Volt A.C. 50 c/s 5-figure Veeder-root Counter** (not resettable). New. Boxed. 19/6, plus 2/6 P. & P.

**VEEDER MECHANICAL REV COUNTER** 6 figure fitted reduction drive. NEW. PRICE 10/6. P. & P. 1/6.

**MINIATURE UNISELECTOR SWITCH**  
 3 banks of 11 positions, plus homing bank. 40 ohm coil. 24-36 v. operation. Ex. equip. Individually tested. 22/6, plus 2/6 P. & P.

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 Kit of parts, including ORP.12 Cadmium Sulphide Photocell, Relay, Transistor and Circuit, price 25/-, plus 2/6 P. & P.  
 Additional ORP.12 8/6 each.  
 (Regret not supplied separately.)

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**BUILD AND EFFICIENT STROBE UNIT FOR ONLY "37/6"**  
 The ideal instrument for workshop, lab. or factory. This wonderful device enables you to "freeze" motion and examine moving parts as if stationary. We supply a simple circuit diagram and all electrical parts including the NSP2 Strobe tube which will enable you to easily and quickly, construct a unit for infinite variety of speeds, from 1 flash in several seconds to several thousands per minute. New modified circuits bring price down to 37/6, plus 3/- P. & P.

**14-DAY CLOCKWORK TIME SWITCHES** USED but guaranteed. 2 1/2 amp. 30/- P. & P. 2/6. 5 amp. type, 35/6. P. & P. 2/6.

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OC30 .....	10/- OC202 .....	21/-
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OC45 M/pair ...	9/- Get 105 .....	10/-
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OC72 .....	7/- Get 573 M/pair ..	25/-
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**ZENERS 5%**  
 All 1/2 watt 5% at 10/- each. 5.1 v. 5.6 v., 6.8 v., 8.2 v., 9.1 v., 12 v., 16 v., 22 v.

### INSULATED TERMINALS



available in black, red white, yellow, blue. New 15/- per doz. P. & P. 1/-.

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**Type 1.** Pri. 200-240 sec. tapped 30, 32, 34 36 volt at 2 amp., 57/6. P. & P. 4/-.  
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**Type 3.** Pri. 200-240 sec. tapped 10, 17 and 18 volt at 10 amp., 57/6. P. & P. 4/-.  
**Type 4.** Pri. 240 sec. tapped 6 and 12 volt at 20 amp., 72/6. P. & P. 5/-.

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 0-300 volt A.C. M.1 2 1/2 in. fl. rnd. New 22/6  
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 0-1 Milliamp Meter. 2 1/2 in. F.L. .... 25/-  
 0-350 M.A. T.C. 2 in. fl. rnd. .... 8/6  
 500 microamp., M.C. 2 1/2 in. rnd. F.L. scaled 15/600 volt. NEW ..... 16/6  
 500 MICROAMP SUB-MINIATURE M/C METER

1 1/2 in. diameter, flush mounting, single hole fixing. Scaled 0-1 MA. Supplied with Resistor for use as 1 MA if required. 29/6, plus 1/- P. & P.  
 Postage on all meters, 1/- each.

**SANGAMO WESTON DUAL RANGE VOLTMETER.** 5 and 100 volt D.C. 3 in. scale. F.S.D. 1 MA. Brand new in carrying case with Test prods and leads. Price 27/6. P. & P. 3/-.

### 4 DIAL DECADE RESISTANCE BOX

Range 0-11,110 ohm. XI Wire Wound, Max. current 300 MA. X10 Wire Wound, Max. current 150 MA.  


X100, X1,000. High Stability Resistors, rated 1 watt. Accuracy +/- 1%.  
 Switches make before break type fitted with low resistance silver plated contacts, polished wood case, new, price £10/10/- plus 6/6 P. & P.

### DESK TELEPHONES-TYPE I

Used but perfect. Complete with two-way calling system (buzzer). Internal battery. All ready for simple two-wire connection. Price £3/2/6 each or £6 the pair. P. & P. 3/6 each phone.

### DESK TELEPHONE SETS - TYPE II

Similar to G.P.O. extension telephones. Each complete with automatic dial, internal bell and long connection cord. Used but in perfect working order. Price £2/17/6 each. P. & P. 4/-.  
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Postage and Carriage shown above are inland only. For overseas please ask for quotation. We do not issue a catalogue or list.

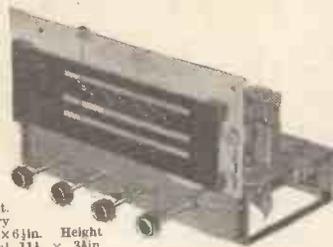
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# SERVICE TRADING Co.

### 7 VALVE AM/FM RADIOGRAM CHASSIS

Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.

Three Waveband and Switched Gram positions. Med 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Philips Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s. and 10.7 Mc/s. Dust core tuning all colls. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13 1/2 x 6 1/2 x 7 1/2 in. Edge illuminated glass dial 11 1/2 in. Vertical pointer Horizontal station names operation. Magic-eye tuning. Cct. diag. now available.



Gold on brown background. A.C. 200/250 v. Height 7 1/2 in. x 3 1/2 in. Gold on brown background. A.C. 200/250 v. now available.

Aligned and tested ready for use. **£13.10.0** Carr. & Ins. 5/.

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/8 extra. 3 ohm F.M. Speaker only required. Recommended Quality Speakers 10in. Blac H/D, 30"-, 13 1/2in. x 8in. E.M.I. Fidelity, 35/-. 12in. R.A. with conc Tweeter, 42/6. Carr. 2/6.

### ANOTHER TAPE RECORDER BARGAIN



Mfrs.' end of production Surplus Offer

A '24 gns. Tape Recorder offered at the bargain price of only 15 gns. plus 10/- Carr. Supplied in 3 Units already wired and tested. A modern Circuit for quality recording from Mike, Gram or Radio, using latest B.S.R. Twin Track Monardeck Type TD2. Valve line-up—EF86, ECL82, EM84, EZ80 and Silicon Diode. Send for detailed list—3d. stamp.

Complete Kit comprising items below.

<b>BARGAIN PRICE 15 Gns.</b> +10/- Carr.	
2-tone Cabinet and 6in. x 6in. Speaker. Size 14in. x 10 1/2in. x 7 1/2in.	£3 10 0 + 5/- Carr.
Wired Amplifier complete with 4 Valves, front Panel. Knobs, etc.	£5 12 6 + 3/6 Carr.
B.S.R. Monardeck Type TD2	£7 7 0 + 4/6 Carr.
Accessories: Mike, tape, empty reel, screened Lead and Plugs, Instructions, etc.	£1 0 0 + 2/- Carr.

We manufacture all types Radio Mains, Transf. chokes, Quality O/P Trans., etc. Enquiries invited for specials, prototypes for small production runs. Quotation by return.

TYGAN FRET (Contem. pat.) 12 x 12 1/2 in. 2/-, 12 x 15 in. 3/-, 12 x 24 in. 4/-, etc. BONDACUST Speaker Cabinet Acoustic Wadding, 1 1/2 in. wide, any length cut 1/6 ft. 4/- yd. EXPANDED ANODIZED METAL Attractive gilt finish 3/4 in. diamond mesh 3/8 sq. ft. Multiples of 6in. cut. Max. size 4ft. x 3ft. 4/76 plus carr.

**JASON F.M. TUNER UNITS**  
Designer-approved kits available  
FMT1, 5 gns., 4 valves 20/-  
FMT2, 27. 5 valves 35/-  
JTV Mercury, 10 gns. 3 valves 22/6.  
JTV2, 23/19/6. 4 valves 28/6.  
NEW JASON F.M. HANDBOOK, 2/6.  
48 hr. Alignment Services, 7/6 plus 9/6.

**CONDENSERS—Silver Mica.** All values 2 pf. to 1,000 pf. 6d. each. Ditto ceramic 8d. Tub. 450 v. T.C.C. etc., 001 mid., .01 and 1/850 v. 9d. .02-1/500 v. 1/- .25  
Hunis 1/6. 5 T.C.C. 1/9, etc. ca.  
CLOSE TOL. S/MICAS, 10% 5 pf.-500 pf. 8d. 600-5,000 pf. 1/-, 2% 2 pf.-100 pf. 9d. 100pf.-500 pf. 11d. 575 pf.-5,000 pf. 1/6.

**RESISTORS—Modern ratings fill range** 10 ohms to 10 megohms. 20% 1-1 w. 3d. ea., ditto 1 w. 6d. ea., 2 w. 9d. ea., 10% 2-1 w. 4d. ea. 5% Hi-stab. 2-1 w. 6d. ea. (below 100 ohms and over 1 meg. 9d. ea.), 1% Hi-stab. 2-1 w. 1/6 ea. (below 100 ohms 2-1 w.).  
**WIREWOUND.** 25 ohms to 10K. 5 w. 1/3, 10 w. 1/6, 15 w. 2/1.

**PRE-SET T.V. POTS.** W/V 26 ohms-50 K-Set. 50 K 2 Meg. (Carbon) 3/-.

**Electrolytics All Types New Stock TUBULAR CAN TYPES**  
25/25v. 50 12v. 1/8-4/8/450 v. 4/6  
50/50v. 100 25v. 2/- 32-32/275 v. 4/6  
8/450v. 4 350v. 2/3 50-50/350 v. 6/6  
16/80/450 v. 5/6 80-250/275v. 17/6  
32 32/450 v. 6/6 100-300/275v. 12/6  
Transistor Midge types—all values 1 mfd. to 50 mfd. 1/9 ea., 100 mfd. 2/-, 1/6.

**VOLUME CONTROLS—5K—2 Meg.** ohms, 3in. SPINDLES, MORGANITE MIDGET TYPE. 1 1/2 in. dia. Guar. 1 year. LOG or LIN. ratios, less 8w. 3/- D.P. Sw. 4/6. Twin Stereo less 8w. 6/6. Some values with DP sw. 8/6

### TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s 7 1/2 in. diam.	5/6
Osc. Coil M/W 2 1/2 in. dia.	5/3
Osc. Coil M. & L.W.	5/9
Midget Driver Trans. 3.5 : 1	6/9
Midget Output Trans. Push-Pull—3 ohms	6/9
Collec. Condens.—Midget Type 1 mfd.-50 mfd. ea. 1/9, 100 mfd. 2/-, 12 v. wkg.	
Condensers 150 v. working: .01 mfd., .02 mfd., .03 mfd., .04 mfd. 9d.; .05 mfd., .1 mfd., .175 mfd. 1/3; .5 mfd. 1/6, etc.	
Midget Tuning Condensers. J.B. "OO" 208 pf. and 176 pf. 8/6; ditto with trimmers 9/6. JB 220pf. and 105 pf. conc. slow motion 10/6. 365 pf. single 7/6. Sub Min. 3in. Dilemion 100 pf., 300 pf. 500 pf. 7/- each.	
<b>FERRITE AERIALS.</b> M. & L.W., car aerial coil 9/3.	
Midget V.U. Control with edge control knob, 5 K/ohms, with switch 4/9. Ditto less switch 3/9. Speakers: P.M.: 2in. Plessey 75 ohms 15/6. 2in. Continental 8 ohms 13/6. 7 x 4in. Plessey 35 ohms 23/6. 2 1/2in. Continental 8 ohms 13/6.	

### TRANSISTOR BARGAINS

Brand New—BVA 1st Grade			
OC44	8/6	OC70	5/6
OC45	8/6	OC71	6/-
OC81	7/6	GEX34	2/9
GET114	6/6	OA70	2/9
OC72	7/6	OA81	2/9
AF117	9/6	OA79	2/9

### BARGAINS 4-SPEED PLAYER UNITS

Single Players	carr. 3/6
Garrard-SRP10	£5 5 0
B.S.R. Latest Mod TUI2	£3 12 6
E.M.I. Junior "985"	£3 7 6
Auto-Changers	carr. 5/-
Garrard "Auto-Slim"	£6 15 0
Collaro C60	£6 19 6
B.S.R. (UA14)	£6 10 0

### RECORDING TAPE

Famous American Columbia (CBS) Premier quality tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new boxed and fully guaranteed. Fitted with leader and stop flaps.

Standard	Double Play
5in. 600ft. . . . . 13/6	1,200ft. . . . . 31/6
5 1/2in. 900ft. . . . . 16/-	1,800ft. . . . . 37/6
7in. 1,200ft. . . . . 21/-	2,400ft. . . . . 47/6
Long Play 400ft. Post & Pack	
5in. 900ft. . . . . 17/6	per reel, 1/6 plus
5 1/2in. 1,200ft. 19/6	6d. ea. for additional reels.
7in. 1,800ft. 28/6	
<b>SPECIAL OFFER.</b> 3in. Message tape, 150ft. 3/9; 3in. L.P. 225ft. 4/9; 3in. D.P. 300ft. 6/6. 2 & P. per reel 6d.	
<b>TAPE REELS.</b> Manfrs. surplus 7in. 2/3; 6 1/2in. 2/-; 5in. 2/-; 3in. 1/3; Plastic spool containers, 6in. 1/8; 5in. 2/-; 3in. 2/3.	

**SPEAKERS F.M.** 3 ohms. 2 1/2in. E.M.I. 15/6. 3in. Goodmans 16/6. 3in. Rola 15/6. 3in. Elac 16/6. 7in. x 4in. Goodmans 15/6. 8in. Rola 19/6. 10in. Elac 25/-, 10in. x 6in. Goodmans 22/6. 2 1/2in. E.M.I. Tweeter, 22/6. 13 1/2in. x 8in. E.M.I. 35/-.

**ENAMELLED COPPER WIRE—1 1/2lb. reels**  
14-20g. 2/6; 22-28g. 3/-; 30g-34g. 3/9; 36g-38g. 4/3; 39g-40g. 4/6. etc.

**TINNED COPPER WIRE 1 1/2-22g., 2/6 1/2 lb.**

**VALVE HOLDERS—Int. Oct. 6d. Nylon or Ceramic, B7G, B9A unskirted, 9d. B7G B9A skirted, 1/- each; B7G with Can 1/6; B9A with Can, 1/9 each.**

**KNOBES—Modern Continental types:** Brown or Ivory with Gold Ring. 1 1/2 in. dia. 9d. each, 1 1/2 in. 1/- each, Brown or Ivory with Gold Centre 1in. dia., 10d. each, 1 1/2 in. 1/3 each.  
**LARGE SELECTION AVAILABLE**

### RECORD PLAYER CABINETS

Attractive, contemporary two-tone. Size 15 1/2 x 14 1/2 x 8 1/2 in. Cabinet Price **59/6**  
fitted all accessories. Carr. & Ins. 5/-.

### 2-VALVE 2-WATT AMPLIFIER

EZ80 and Twin stage ECL82 with vol. and neg. feedback tone control. A.C. 200/250 v. with knobs, etc., ready wired to fit above cabinet, complete with 7in. x 4in. Quality Speaker and O/P Trans., **23/19/6.** Carr. 2/6. Complete Record Player Kit as illustrated, inc. BSR UA 14 Unit. New reduced price: **£11/10/-.** Carr. 7/6.



### COLLARO STUDIO TAPE RECORDER KIT

Regret all complete kits of this popular unit now sold out. Only a few cabinets and Collaro Tape Decks remain—NO AMPLIFIERS LEFT Plus 10/- carr.

**SPECIAL CLEARANCE OFFER £13.10.0** Plus 10/- carr. Cabinets 18 x 6 1/2 x 6 in. with cut-out mounting board and Collaro Tape Deck (3-speed).

Only a few items are listed from our comprehensive stock. Write now for full bargain lists, 3d.



**RADIO COMPONENT SPECIALISTS** Established 1946

70 BRIGSTOCK RD., THORNTON HEATH, SURREY  
Tel. THO 2188: Hours: 9 a.m.—6 p.m. 1 p.m. Wednesday

### BARGAIN CORNER

Brand New. Mfrs. surplus 1st grade 1 OC44 & 2 OC45, 15/6. 1 OC81D & 2OC81, 15/6. All above and OA81, 32/6 post free. 1/2 Meg. VOL Controls D.P. Sw. 3in. flatted spiggle. Famous Mfrs. 4 for 10/- post free.

### MULLARD "3-3" HI-FI AMPLIFIER. 3 VALVES 3 WATT



3 ohm and 15 ohm Output. A really first-class Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86, EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

**TECHNICAL SPECIFICATION—Freq. Response:** + or - 1db. 40 c/s-25 Kc/s. Tone control: Max. Treble Ctt 12 db. Output Power (at 400 c/s): 3 w. at 1% total harmonic distortion. Hum and Noise Level: At least 70 db. below 3 w.

**COMPLETE KIT** (incl. valves, all components wiring diagram and special quality sectional Output Trans.). **BGN. Price 26/19/6.** Carr. 4/6. Complete wired and tested, 8 gns. Wiring power O/P socket and additional smoothing for Tuner Unit. 10/6 extra.

Bronze Escutecheon Panel, Printed Vol. Treble, Bass, On-Off, supplied with each Kit.  
Recommended Speakers—WB, HF 1012 87/6. Goodmans AXIOM 10 28/5/-, 8" AXIETTE 25/5/-, or AUDIOM 31, 28/10/-.

# More BIG BARGAINS from R. & T.V!

## B.S.R. MONARCH

### UA 14 WITH FUL-FI HEAD

4-speed, plays 10 records, 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour, brown. Dimensions: 12½ x 10½in. Space required above baseboard 4½in., below baseboard 2½in. Fitted with Ful-Fi turnover crystal head, £5/19/6. P. & P. 6/6.  
 B.S.R. UA16, similar to the above, £6/12/6. P. & P. 6/6.  
 B.S.R. GU7, 4-speed, single-player, complete with pick-up on uni-plate with automatic switch. £3/19/6. P. & P. 5/6.

### 4-VALVE AMPLIFIER IDEAL FOR SMALL HALLS



High power—high quality 200/250 v. A.C. 2 inputs, mike and gram, bass and treble lifts. For use with Standard/L.P. records. Two would be suitable for stereophonic. Ideal P.A. system, £3/19/6. P. & P. 8/6.  
**CRYSTAL MIKE** to suit, 15/- P. & P. 2/- 8in. x 5in. P.M. **SPEAKER** to suit, 12/6. P. & P. 2/-.

**POCKET MULTI-METER.** Size 3½ x 2½ x 1½in. Meter size 2½ x 1½in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts 0-15 0-150, 0-1,000. D.C. current 0-150 mA. Resistance 0-100KΩ. Complete with test prods, battery and full instructions, 35/- Plus 1/6 P. & P.

### STAAR 45 9v. BATTERY RECORD PLAYER

**COMPLETE WITH PICK-UP AND DECK**  
 For a completely portable record player. Head is protected by a plastic dome with a brush which cleans the stylus as it rises into playing position. 45 r.p.m. Automatic on/off switch, governed 9 v. motor. Attractive 2-tone grey finish. £2/9/6. P. & P. 2/6.

**PRESS-BUTTON COIL PACK.** Medium and 2 shorts. Complete with twin-gang tuning condenser and ferrite rod aerial. 19/6, plus 2/6 P. & P. Circuit diagram 2/6. FREE with pack.

### SPECIAL OFFER! OBTAINABLE ONLY FROM R. & T.V.

## THE "Elegant Seven" COMBINED PORTABLE & CAR RADIO THE RADIO WITH THE "STAR" FEATURES

- ★ 7-transistor superhet. Output 350 mW.
- ★ Two-tone grey wooden cabinet, fitted handle with silver coloured fittings. Size 12½in. x 8½in. x 3½in.
- ★ Horizontal tuning scale, size 11½in. x 2½in., in silver with black lettering.
- ★ All stations clearly marked.
- ★ Ferrite-rod internal aerial.
- ★ IF 470 kc/s.
- ★ Operated from PP9 battery.
- ★ Fully comprehensive instructions and point-to-point wiring diagram.
- ★ Printed circuit board, back-printed with all component values.
- ★ Fully tunable over medium and long waveband.
- ★ Car-aerial socket.
- ★ Full after-sale service.

### RADIO AND T.V. COMPONENTS (ACTON) LTD.

21A, ACTON HIGH ST., LONDON, W.3. Goods not despatched outside U.K. All enquiries S.A.E. Terms C.W.O.

### SIGNAL GENERATOR



Covering 100 Kc/s-100 Mc/s. on fundamental and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. x 6½in. x 5½in., grey hammer finish. Incorporating three miniature valves and metal rectifier. A.C. mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£7/5/0 Or 30/- deposit and 6 monthly payments of 21/6. Post and Packing 6/6 extra.

### LINE E.H.T. TRANSFORMER

With built-in line and width control. 14 kv. Scan Coil. 90in. deflection, on ferrite yokes. Frame O.P. transformer 500 pf., 18 kv. smoothing condenser. Can be used for 14in., 17in., or 21in. tubes. Complete with circuit diagram, 29/6. Plus 5/- P. & P.

### MAINS TRANSFORMERS

ALL WITH TAPPED PRIMARIES 200/250 VOLTS.

250-0-250 v. 60 mA., 6.3 v. 1.5 amp., 6.3 v. 1 amp. ....	11/6
250-0-250 v. 80 mA., 6.3 v. 1.5 amp., 6.3 v. 1 amp. ....	15/-
250-0-250 v. 50 mA., 6.3 v. 2 amp. ....	9/6
250-0-250 v. 250 mA., 6.3 v. 5 amp. ....	19/6
Heater Transformer 6.3 v. ct. 3 amp. ....	7/6
Postage and packing on all the above transformers 4/-.	

**A.M./F.M. PERMEABILITY TUNER FOR ALL TRANSISTOR OPERATION.** Size 2½ x 2½in. approx. By famous manufacturer. A.M.-I.F. 470 kc/s., F.M.-I.F. 10.7 mc/s. A.M. coverage from 1,620 kc/s.-525 kc/s. F.M. coverage 108 Mc/s.-88 Mc/s. Circuit diagram 2/6, FREE with Tuner, 25/-, plus 1/- P. & P.

**INDOOR AERIAL** for I.T.V./B.B.C./F.M. Complete with standard co-axial plug. Heavy chrome extending dipoles—7ft. fully extended. Plugs straight into T.V. or V.H.F. Tuner. Fully directional, 10/6. P. & P. 1/6.

### TRANSISTORISED AMPLIFIER

CAN BE USED WITH THE STAAR 45

Output 1 watt. Can be used with the STAAR 45 record player. Size 4½ x 2½in., printed circuit. Tone and volume control. 4 transistors. Push/pull output. Complete with 3in., moving coil speaker. BUILT AND TESTED 49/6. P. & P. 2/-.



ONLY £5.9.6 PLUS 5/6 POSTAGE AND PACKING

### Tube

HIGHEST QUALITY—COMPARE OUR PRICES. GUARANTEED NEW TYPES

6 Months	12 Months	MW 31/74
£4-0-0		
12in.	£1.15 0	£3.10 0
14in.	£2. 0 0	£4. 0 0
15/17in.	£2.15 0	£4.15 0
21in.	£3.15 0	£5.15 0

Most Mullard, Eimicon, Eimicon, Brimar, Mazda, Cossor, Ferranti types

12in. NW 36/24  
14in. £5-0-0  
CRM 173 MW 43/84  
£6-0-0

### 100 RESISTORS

1-2W. 6/6

100 CONDENSERS 10/-  
Miniature Ceramic and Silver Mica.

### 3-VALVE AMPLIFIERS

Kit of new parts, consisting of chassis mains and output transformers, valves (P61, 69G, 6X5G) and all components. With full instructions for making high gain amplifier with separate base and treble control, negative feedback, etc. Truly unusual value at 25/-.

### TRANSISTORS

Top Quality  
Huge reductions. Red Spot standard R.F. type now only 1/6; White Spot R.F. 2/-; Mullard Matched Output Kits (OC81 and 2-OC81), 12/6. Receiver Kits, OC44, OC45, OC48, OC81D, OC81(2), six transistors, 24/-

AF102	15/-	OC26	12/6	OC81	5/6
AF114	8/-	OC32	14/-	OC81D	5/6
AF115	7/6	OC44	5/6	OC82	7/6
AF116	7/6	OC45	6/-	OC170	8/6
AF117	7/-	OC71	5/-	OC171	8/6
AF127	9/6	OC72	5/6	XB104	5/6

### P.M. SPEAKERS.

3 1/2 Top Makes.  
8in. 7/6 5in. 8/6  
7 x 4in. 8/6

### 250v. SILICON RECTS.

500 m/a standard TV replacement.  
Top quality 8/6 (3 for 24/-).

### 4 watt AMPLIFIERS

(AT 11-12 NORTH RD.)  
PLEASE NOTE THE ADDRESS AND CALL TO SEE OUR STOCKS OF TRANSISTORS, VALVES, RECTOR-CHANGERS, HI-FI EQUIPMENT, ETC. ETC. AT KEENEST PRICES.

Trade and Quantity quotations please telephone Brighton 690722.

### VALUE IN VALVES

—BY RETURN OF POST —GUARANTEED 3 MONTHS

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days.  
ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED.  
FREE TRANSIT INSURANCE. POSTAGE 1 vbc 6d., 2-11 1/-; FREE OVER 12.

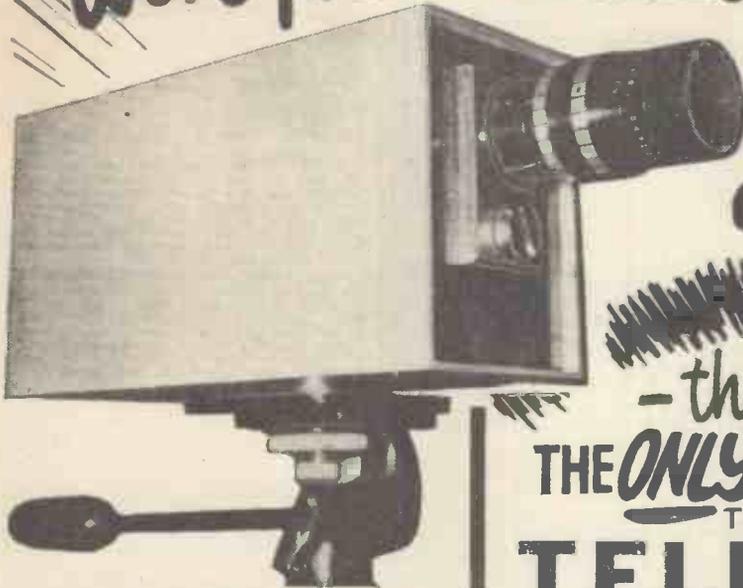
0Z4	4/6	6K8GT	8/3	14S7	14/6	EBC41	7/9	EZ80	5/9	SP61	2/-
7GT	9/6	6K25	8/6	19A05	7/9	EBC81	7/9	EZ81	5/9	SP62	2/-
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11HGT	8/9	6L6	7/6	20F2	9/6	EBF89	7/9	HV82	8/-	U18	7/6
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1S4	4/6	6L18	7/9	20P1	9/6	EEL31	19/6	KT36	14/-	U24	12/6
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3A5	8/6	6L25	5/6	20A6	8/6	EC63	4/6	KT61	8/6	U35	12/6
3DG	4/6	6P28	9/9	25LAGT	7/9	EC64	9/6	KT63	5/9	U50	4/6
3Q4	7/6	6Q7G	5/6	25ZAG	7/-	EC681	4/9	KT66	13/6	U107	12/6
3R4GY	9/6	6Q7GT	8/6	30F5	6/-	EC682	4/9	KT76	8/6	U191	11/6
3U4G	4/9	6A7	5/9	30FL1	9/6	EC683	6/-	KT88	17/6	U321	9/6
3T5G	4/6	6S07	4/9	30FL5	8/9	EC684	7/6	KT89	15/6	U322	15/6
3Y6GT	5/9	6S07	5/6	30P4	4/6	EC685	4/6	KTW63	8/6	U301	12/6
5Z4	9/6	6S17GT	5/9	30P12	7/6	ECF80	8/3	KTZ63	7/-	U328	9/6
5R4GY	7/6	6S17GT	4/6	30P13	9/6	ECF82	8/3	MU14	7/-	U801	18/6
5Z4GT	9/6	6S07	5/9	35C5	8/6	ECH21	11/6	N37	10/6	UAC80	7/9
630L2	9/6	6U4GT	9/6	35L0GT	8/6	ECH35	7/6	N78	13/6	UAF42	7/9
6A9G	7/6	6B9	7/9	35W4	8/6	ECH49	6/6	N109	12/6	UB21	8/6
6AK7	7/6	6V0GT	6/-	35ZAG	5/6	ECH81	7/9	PC88	11/6	UBC41	7/9
6A7S	5/6	6X4	4/6	50L0GT	8/6	EDH83	6/6	PC97	9/6	UBC81	7/9
6A05	6/-	6X5G	5/6	80	5/6	EEL80	6/6	PC84	6/6	UBF80	7/9
6A7S	5/6	6X5GT	5/6	185B7	19/6	ECL82	8/6	PC85	7/9	UBF89	7/9
6A06	7/6	7B5	9/9	185B7A	19/6	ECL83	10/6	PC88	11/6	UBL21	12/6
6A36	6/-	7B7	7/9	1918	19/6	ECL86	10/6	PC89	8/6	UC85	5/6
6BA8	5/6	7C5	7/3	807(A)	5/-	EP36	3/3	PC189	13/6	UCF80	13/6
6BE6	5/6	7C6	7/6	807E	4/9	EP39	4/6	PCF80	9/9	UCM21	9/6
6BGG15	15/-	7H7	7/3	813	4/9	EP40	11/6	PCF82	7/9	UCH42	7/9
6BH6	6/6	7E7	8/9	866A	12/6	EP41	8/6	PCF84	12/6	UCH81	7/9
6B16	5/6	7Y4	5/6	866B	12/6	EP42	3/3	PCF85	11/6	UCI82	9/6
6BR7	8/6	10C1	9/6	955	9/6	EP43	9/6	PCF89	7/9	UCI83	12/6
6BW6	6/9	10C2	14/6	956	2/6	EP85	6/6	PCI83	9/9	UF41	7/6
6BW7	5/6	10P1	4/9	9001	3/6	EP86	7/6	PCL84	7/3	UF42	5/6
6C4	2/3	10L1D1	14/6	9002	4/9	EP89	6/9	PCL85	10/6	UF80	7/6
6C5	5/6	10P13	8/6	9003	5/6	EP91	13/6	PCL86	10/6	UF85	7/6
6C6	5/9	10P14	9/6	AZP1	2/6	EP92	3/6	PCN25	3/9	UF89	7/6
6C9	11/6	12A7	9/6	AZP2	2/6	EP93	3/6	PCN85	8/6	UC85	5/6
6C0D6G	17/6	12A8H	9/9	B36	6/9	EP184	9/9	PCN46	4/6	UL44	14/6
6D6	3/6	12A7E	6/6	CL33	9/6	EL32	3/9	PL33	9/6	UL46	9/6
6F1	4/9	12A77	4/9	CY31	9/6	EL33	7/6	PL36	9/6	UL84	7/6
6F6G	4/8	12A06	9/9	DAF91	4/9	EL34	11/6	PL38	17/6	UR1C	7/6
6F13	4/8	12A07	4/9	DAF96	7/3	EL35	9/6	PL81	3/3	UM80	9/6
6F14	9/6	12A08	6/6	DAF91	3/6	EL36	12/6	PL82	6/6	UX6	12/6
6F15	9/6	12A07	6/6	DF92	3/6	EL41	8/6	PL83	6/6	UX8	12/6
6F23	6/6	12B46	7/9	DF96	2/3	EL42	7/9	PL84	7/6	UY21	8/6
6J5G	3/6	12B6A	6/6	DK91	5/6	EL84	6/6	PX31	3/3	UY41	6/6
6J5GT	4/3	12B67	3/9	DK92	2/9	EM34	8/6	PX32	10/6	UY85	6/6
6J6	3/6	12E1	17/6	DK96	7/9	EM80	7/9	PY80	6/6	VR105	5/6
6J7G	4/9	12VGT	6/6	DL92	5/6	EM81	8/6	PY81	6/6	VT150	5/6
6J7GT	7/6	12KGT	9/9	EM85	8/6	EM84	8/6	PY82	9/6	W81	12/6
6K0GT	6/-	12K8	9/9	DL96	7/3	EM85	9/6	PY83	6/9	X78	11/6
6K7	5/9	12K8GT	9/9	EACB30	6/6	EM51	7/6	PY88	9/9	X79	21/6
6K7G	2/6	12Q7GT	5/6	EAF42	3/3	EX86	7/3	PY80	9/9	X91	8/6
6K7GT	4/8	12S47	7/9	EB41	5/6	EX88	9/6	PZ30	9/6	X91M	8/6
6K9	8/6	12S47	6/6	EB91	3/3	EZ40	6/6	E91	9/6	Y63	3/6
6K9G	5/6	12S47	8/6	ECB33	4/9	EZ41	9/9	SP41	2/3	Z66	8/6

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0B2	6/9	10D2	13/6	DH78	3/9	EM81	7/6	SP41	2/6	SILICON
0P4GT	4/6	10P1	10/6	DK92	6/9	ELL80	20/5	SU23	27/2	RECT
1A5	5/6	10P13	8/6	DK96	6/3	EM4	17/9	T41	9/6	FIERS
1A7GT	5/6	10P14	11/6	DK18	15/6	EM34	8/9	TD44	8/6	Mullard
1C5	6/9	11D5	17/6	DL96	5/9	EM71	13/6	TH41	13/6	BY100
1D6	9/9	12A6	2/3	D1A0	18/6	EM80	6/6	TH233	15/6	Output
1H5GT	8/6	12AD9	8/6	DM70	5/6	EM81	7/6	TP29	5/6	250 v. at
11A	2/6	12AD9	8/6	DM70	5/6	EM81	7/6	TP29	5/6	amp
11D5	4/3	12A6	8/6	E90F	24/6	EM85	9/6	TP2620	17/6	No larger
11N5	4/6	12A8H	9/9	E93F	24/6	EM87	15/2	TP2620	17/6	than a shirt
11NSGT	8/6	12A76	4/9	E98C0C	10/6	EN31	45/6	U12/14	11/8	button-
185	4/6	12A06	6/6	E180F	19/6	EV61	6/6	U16	10/6	8/- each
185	4/6	12A06	6/6	E180F	19/6	EV61	6/6	U16	10/6	TRAN-
185	3/9	12B46	8/6	E47	7/6	EY83	9/3	U19	45/6	SISTORS
174	2/6	12B66	5/6	EACB30	6/6	EY84	10/8	U22	6/6	AND
1U4	5/6	12B87	7/6	EACB31	6/6	EY86	5/9	U24	15/6	DIODES
1U5	5/3	12E1	17/6	EAF42	7/6	EY88	9/3	U25	8/6	AC107
2D21	5/6	12A77	7/6	EB34	1/6	EZ40	6/6	U26	7/9	AD140
2X2	3/6	12K5	10/6	EB41	4/9	EZ41	6/6	U31	7/6	AF102
3A4	4/6	12KGT	3/9	EB01	2/3	EZ42	6/6	U33	26/2	AF114
3A5	6/9	12K8GT	9/9	EB03	20/6	EZ41	4/3	U35	16/6	AF115
3B7	5/6	12QGT	3/9	ECB33	8/6	EZ30	7/6	U37	23/3	AF116
3D6	4/6	12B47	7/9	EB041	6/9	EZ32	7/6	U45	15/6	AF117
3Q4	5/6	12B67	4/9	EB081	6/6	EZ33	17/6	U60	4/6	AF117
3Q5	7/3	12K87	3/6	EBF80	6/6	EZ34	10/6	U62	4/3	AF118
3B4	4/6	12K8GT	9/9	EBF83	7/6	EZ37	16/6	U63	19/6	AF127
3V4	5/6	19A05	7/9	EBF89	6/9	HN309	25/6	U101	19/6	BYZ13
5R4GY	9/6	19H1	6/6	EL121	8/6	HN309	25/6	U107	17/6	GET111
5V4G	4/3	20D1	9/9	EC70	12/6	HV82A	9/9	U191	10/6	12/6
5V4G	7/6	20D9	21/6	EC81	27/6	KT330	4/9	U281	9/6	GET115
5Y8GT	4/3	20P2	12/6	EC82	7/6	KT36	29/1	U282	13/6	GET173
5Z6	5/6	21/6	12/6	EC32	4/6	KT41	7/6	U312	9/6	MAT100
5Z6	7/6	20P1	12/6	EC34	21/7	KT46	5/9	U325	9/6	MAT101
6A8	7/6	20P2	12/6	EC35	5/9	KT61	7/6	U339	10/6	MAT120
6A05	2/9	20P4	13/9	EC40	7/6	KT63	4/9			

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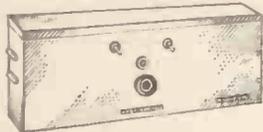
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5	10, 17, 18 v., 10 a.	£2 17 6	4/-
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7	20 volts, 30 amps.	£6 15 0	7/6
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11	17, 18, 20 v., 20 a.	£4 19 6	5/-
12	6, 12 v., 20 a.	£3 12 6	5/-
13	20 volts, 20 amps.	£4 15 0	7/6
14	30, 32, 34, 36 v., 5 a.	£2 17 6	4/-
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17	24 volts, 10 amps.	£3 5 0	4/-
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21	6.3 volts, 15 amps.	£1 17 6	3/6
22	6.3 v., 5 a. and 6.3 v., 1 a.	15 0	3/6
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25	6, 9, 15 v., 4 a.	£1 5 0	3/6
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240-110 volts 2 kVA. Completely enclosed in metal case with carrying handle. Fitted with 2 two-pin American sockets or terminal blocks. Size 10 x 8 x 6 in. Supplied brand new and guaranteed. £8/15/-. Carr. 7/6, 1,000 watts £4/15/-. Carr. 4/-, 500 watts £3/10/-. Carr. 4/-, 300 watts £2/7/6. Carr. 3/-.

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Pri. 240 v. Sec. tapped 4, 6, 11 volts 200 amps. £9/10/-. Carr. 10/-.

**A.M. HEAVY DUTY AUTO STEP-OR STEP-DOWN TRANSFORMERS.** Designed for the Air Ministry for mains boosting or operating 110 v. equipment. 10KVA. Tapped 250, 240, 230, 220, 120, 115, 110, 105 volts. Completely enclosed in metal case. Size 27 x 17 x 14 in. Weight approx. 3 cwt. £29/10/-. 5KVA. Tapped as above. Size 23 x 14 x 11 in. Weight approx. 2 cwt. £19/10/-. 2.5KVA. Tapped as above. Size 15 x 8 x 8 in. Weight approx. 75 lb. £10/19/6. All transformers supplied new and guaranteed and offered at a fraction of maker's price. Carr. extra.

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## THE SKYROVER

## THE SKYROVER De Luxe

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THE SKYROVER De Luxe

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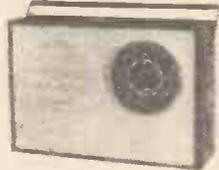


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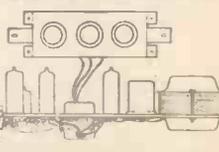
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Diameter in inches	Gauss in Lines	Impedance in Ohms	Price	Diameter in inches	Gauss in Lines	Impedance in Ohms	Price	Diameter in inches	Gauss in Lines	Impedance in Ohms	Price
2	7,000	80	9/-	4	7,000	25	11/6	5	8,500	3	9/8
2½	7,000	35	8/6	4	8,000	35	10/8	5	8,500	5	9/6
2½	7,000	50	8/6	4	7,000	35	11/-	5	9,500	3	10/8
2½	7,000	80	8/-	4	9,500	35	11/8	5	9,500	5	10/6
3½	8,500 (E.M.I.)	3	8/6	5	6,000	3	8/-	5	10,000	3	11/8
3½	7,000	35	8/6	5	6,000	5	8/6	5	9,500	25	11/6
3½	9,500	50	10/6	5	7,000	3	8/6	6½	7,000	3	11/-
4	8,000	3	8/-	5	7,000	5	8/6	6½	7,000	5	11/-
4	7,000	3	8/6	6	7,500	3	9/-	6½	8,500	3	11/6

Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price	Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price	Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price
3 x 3	6,000	3	7/6	6 x 4	8,500	3	9/6	8 x 2½	8,500	5	9/6
5 x 3	7,000	3	8/-	6 x 4	9,500	3	10/-	8 x 2½	9,500	3	10/-
5 x 3	9,000	3	8/6	7 x 3½	9,500	3	10/6	8 x 2½	9,500	4	10/-
5 x 3	9,000	5	8/6	7 x 4	7,000	3	10/-	8 x 2½	9,500	5	10/-
5 x 3	6,000	25	9/6	7 x 4	8,500	3	10/6	8 x 5	6,000	3	8/6
5 x 3	7,000	25	10/-	7 x 4	9,500	3	13/6	8 x 5	7,000	3	9/-
5 x 3	9,000	25	11/-			(with match. trans.)		8 x 5	8,500	3	9/6
5 x 3	9,000	35	11/-	8 x 2½	6,000	3	8/6	10 x 6	10,000	3	19/6
5 x 4	7,000	3	9/-	8 x 2½	7,000	5	9/-				

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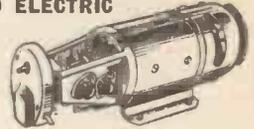
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AR4 . 3/6	E1148 2/6	EF78 . 5/-	HF300100/-	PEN320A .	U27 . 8/-	1T4 . 3/-	6A86 . 4/-	6R7 . . 6/-	12SH7 3/-	220TH 4/6	CV196
ARF12 2/6	E1232 9/-	EF74 . 4/-	HK54 22/6	PL36 . 3/-	U22 . 5/-	2A3 . 5/-	6AX4 . 3/-	6SCTGT 5/-	12SK7G 5/-	307A . 5/8	E4103/B4
ARF21 7/-	E1266 50/-	EF80 . 5/-	HLK4 22/6	PL38 . 16/-	U801 . 17/8	2A5 . 6/-	6B4G 8/-	6R87 5/-	3/-	350B . 8/-	28/-
ARF24 3/6	E1415 30/-	EF85 . 5/-	HL23 6/-	PL38 . 16/-	UAB080 5/-	2A6 . 7/-	6B7 . 5/-	6BFSGT 5/6	12SN7GT 5/6	357A . 70/-	E4604/B110
ARF34 4/-	E1524 12/6	EF98 . 6/-	HL23DD	PL81 . 7/-	UBC41 6/6	2C26 . 3/-	6B9G 2/6	6BH7 . 3/-	5/9	368A . 5/-	28/-
ARTP1 6/-	E2134 16/-	EP88 . 4/8		PL82 . 5/6	UBF80 6/6	2C26A 3/-	6BA6 4/9	6BJ7 . 6/-	12SR7 5/9	398A . 15/-	28/-
ATF4 . 2/3	E450 . 1/6	EP93 . 2/9	HL1 . 4/-	PL83 . 6/-	UC239 7/-	2C34 . 2/6	6B56 5/6	6BJ7G 5/6	12T4 . 9/-	468 . 6/-	VCR97 28/-
ATF7 . 5/6	E476 . 7/-	EP92 . 2/9	HR8 . 15/-	PL84 6/6	UBL21 11/-	2C43 . 42/6	6BR7 9/-	6BJY 6/6	14L7 6/-	703A . 30/-	VCR138
AU7 . 50/-	E4BC80 6/-	EP95 . 5/-	HR2 . 9/-	PL84 6/6	UC42 7/-	2C46 . 30/-	6BW6 9/-	6BRK . 4/6	15D2 6/-	703A . 15/-	30/-
B34 . . 10/-	EAC91 3/6	EP183 8/-	K3A . 10/-	PT15 . 10/-	UCL82 8/-	2C51 . 12/-	6C4 . . 2/6	6C5G . 4/-	19G3 10/0	715B . 60/-	VCR139A
B884 47/6	EAF42 5/-	EP184 8/-	K732 8/-	PT25M 7/6	UCL82 8/-	2C51 . 12/-	6C5G . 4/-	6C5G . 4/-	19G6 9/-	801 . 6/-	35/-
BT10 25/-	EBM4 1/8	EL32 . 3/9	KT33G 6/-	PK4 . 14/-	UCL83 10/-	2X3 . 3/-	6C5GT 6/-	6R97 . 6/-	19M1 6/-	803 . 22/8	3BF1 30/-
BT35 . 25/-	EB91 . 3/-	EL34 . 8/6	KT44 5/9	PK12 10/-	UL41 . 7/8	3A3 . 4/-	6C6 . 4/-	6R97 . 2/-	20A2 17/8	805 . 30/-	3PF7 45/-
BT35 . 15/-	EB93 6/-	EL35 . 5/-	KT63 4/6	PY33 10/-	UL84 6/6	3A/167M 3/-	6C6G 3/-	6U4GT 9/6	20P4 17/8	807BR 6/-	5CE1 . 25/-
BT83 . 35/-	EB94 6/9	EL38 17/8	KT66 12/9	PY80 5/6	UO9 . 8/6	3B7 . 5/-	6C6G . 3/-	6V6G 5/-	21B8 9/-	808 . 8/-	5PF7A 25/-
CC3L . 2/-	EB90 5/-	EL41 7/3	KT75 15/6	PY81 5/6	UY1 . 5/6	3B7 . 5/-	6C8 . 5/-	6V6GT 5/6	25L6GT 7/-	813 . 55/-	
C10 . . 6/-	EBF80 6/6	EL42 . 8/-	KT76 8/6	PY82 5/6	UY41 . 5/6	3B24 . 5/-	6D6 . 3/-	6V6M . 8/-	25Y5 . 6/-	829A . 30/-	
CL33 . 9/-	EBF83 7/6	EL50 . 8/-	KTW1 5/6	PY83 6/-	UY85 . 5/-	3B28 15/-	6E5 . 6/-	6X4 . 4/-	25Z4G 6/6	829B . 50/-	
CV71 . 3/-	EB98 6/8	EL4 . 6/8	KTZ1 6/6	PY86 8/6	VR99 8/-	3B29 50/-	6E5G 5/3	6X5 . 5/-	25Z5 7/6	830B . 4/-	
CV77 . 8/-	EC58 12/6	EL83 . 7/-	KTZ3 6/6	PZ1-35 10/-	V1924 18/-	384 . 5/6	6E6GT 3/9	6X5GT 8/6	25Z6GT 8/6	839 . 15/6	Photo Tubes
CV102 1/-	EC70 . 5/-	EL84 . 5/-	LP2 10/-	PZ1-75 12/-	V2023 13/6	384 . 5/-	6E6G . 4/-	6Y6G 6/-	30/-	837 . 9/-	
CV103 4/-	EC90 . 20/-	EL85 . 8/-	MS100 9/-	QP21 6/-	VMP4G12/-	3V4 . 5/9	6E7 . 6/-	6Z0L2 10/0	30C15 . 10/0	843 . 5/-	
CV4014 7/-	EC91 . 3/-	EL91 . 4/8	MS142 12/-	QP25 5/-	V2130 5/6	5A173G 5/6	6F8G 6/6	6Z4 . . 5/-	30F3 . 8/8	866A . 14/-	
CV4015 5/-	EC91 5/6	EL95 . 6/-	MS190 5/-	QR55 10/6	VP33 10/-	5A174G 5/-	6F19 4/6	7B7 . 7/6	30FL1 9/8	944 . 14/-	
CV4020 12/-	EC92 4/6	EM20 . 6/8	M14 5/-	QR1202 8/6	VR99 8/-	5B/257M 5/-	6F19 3/6	7C5 . 10/0	30P19 14/-	954 . 2/6	
CV4040 40/-	EC93 6/-	EMS1 . 7/6	M16 6/-	QV047 8/6	VX3256 4/-	6F32 4/-	6F32 4/-	7C8 . 7/-	30P11 10/8	955 . 2/6	
CY31 . 6/-	EC94 6/6	EM84 . 4/-	MN/PEN 6/-	R3 . . 8/-	X66 . 7/6	9/-	6F5G 3/-	7C7 . 5/6	80PL13 10/8	956 . 2/6	
D1 . . 1/6	EC95 6/6	EM85 . 8/-	NGT2 . 10/-	RP2 . 3/6	Y63 . 5/-	5Z4 8/6	6G6 . 3/6	12A6 2/6	38 . . . . 4/-	1629 . 4/6	837/10
D41 . . 3/3	EC91 4/-	EN31 10/-	OB3 . 7/-	RP41 . 2/-	Y66 . 8/-	5Z4G 7/-	6G6W 7/-	12A67 5/-	41MP 4/-	2051 . 5/6	723A/B 50/-
D41 . . 3/3	ECF80 7/8	EM208 6/-	OC3 . 5/8	SP61 . 2/-	Y68 . 8/-	6A87 4/-	6J7G 5/-	12A88 11/-	30L6GT 6/6	4043C . 13/8	725A . 30/-
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DA30 12/6	EH32 8/-	EY86 5/6	OZ4 4/-	8TV380/40	1A3 . 3/-	6AG5 2/6	6K7G . 2/-	12A7 5/-	68 . . . . 6/-	4063 8/-	
DAF96 6/6	EHC2 . 8/-	EY91 3/-	PAC80 7/-	1A5GT 6/6	1A5GT 6/6	6A07 6/6	6K7G . 2/-	12A7X 6/-	69 . . . . 6/-	4074 . 9/-	
DD41 4/-	ECH81 6/-	EZ40 . 5/6	PC84 5/6	SU2150A	1C5GT 7/-	6A86 10/-	6K9G . 4/-	12A7Y 10/-	75 . . . . 5/6	5726 . 6/6	Transistors
DE75 8/-	ECH83 7/8	EZ41 . 5/8	PC85 7/6	T41 . . . 6/8	1D8GT 6/6	6AJ5 . 8/6	6K9GT 8/3	12B46 6/-	76 . . . . 5/6	6064 . 7/6	OC26 . 25/-
DE720 2/-	ECL80 6/-	EZ80 . 5/6	PC88 9/6	TP28 . 5/-	1E6 . 3/-	6A77 3/-	6K8M 8/6	12B66 7/-	77 . . . . 6/6	6065 . 6/-	OC44 . 6/-
DF31 3/-	ECF82 7/8	EZ81 . 4/6	PCF80 7/-	TP29 . 5/-	1E6 . 3/-	6A85 5/-	6K25 12/-	12B7 . 7/8	80 . . . . 5/6	6193 . 9/-	OC45 . 6/-
DF92 . 3/-	ECL83 10/-	F6837 5/-	PCF82 6/6	TP95 15/-	1O6GT 6/6	6A85 6/-	6L5G 6/-	19C8 3/-	80 . . . . 6/6	6075 . 3/6	OC72 . 7/-
DF96 . 6/-	ECL86 10/-	F8061 5/-	PCF84 10/-	TT11 . 3/-	1L4 . . 2/6	6A87 . 6/-	6L6 . . 9/-	12E1 17/-	81 . . . . 9/-	8013A 25/-	OC81 . 7/-
DK92 . 3/-	EF36 . 3/6	F6063 4/-	PCL81 9/-	TT15 . 30/-	1LA6 6/-	6A75 . 4/-	6L6G . 8/-	12H6 2/-	82 . . . . 8/-	9001 3/6	OC82 . 10/-
DK96 . 8/6	EF39 . 4/-	PW4/206G 8/-	PCL82 9/-	TT30 6/6	1LC8 . 7/-	6AL5W 7/-	6L6A 7/6	12J5GT 2/6	84 . . . . 8/-	9002 4/6	
DL92 . 5/6	EF40 . 9/-	G112306 8/-	PCL83 3/3	TT33 3/3	1LH4 4/-	6A85 . 2/6	6L7G . 4/6	12K7GT 2/6	85A2 8/8	9003 6/6	

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves.

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### MARCONI COMMUNICATION RECEIVERS

**C.R.150.** Frequency coverage 2-60 Mc/s in 5 bands. Two I.F.s., 1st 1,600 kc/s, 2nd 465 kc/s. Image signal protecting over 40 db up to 30 Mc/s. and 20-40 db from 30-60 Mc/s. Self-checking calibration (built-in calibrator). Stabilisation of supply and temperature compensation. Electrical and mechanical bandspread. Metering and visual tuning indicator. Bandpass from 100 c/s to 10 kc. in 5 stages. Acoustic filter associated with 100 c/s. Bandpass position for CW reception. Facilities for diversity reception. In as new guaranteed condition with original mains power supply unit £70 or without power supply unit £60. Carriage 30/-.

**C.R.150/2.** Frequency coverage 1.5-22 Mc/s in 4 bands, all other features as in C.R. 150. Price £35. Carriage 30/-.

**P.C. RADIOS** mains power supply unit for above, 90/-.

**CARBON INSET MICROPHONE, G.P.O.** types, 2/6. P. & P. 1/6.

**VARIOMETER** for No. 19 SET. 17/6 each. P. & P. 3/-.

**"CONNECT AND FORGET CANNOT OVERCHARGE"** "ESSTRON" MARK I AUTOMATIC BATTERY CHARGER. Initial charging rate 6-7 amps. The charging rate automatically adjusts itself to the charge in the battery. Automatic current and voltage control. Patented application of magnetic amplification to battery charging. Indicator lights show battery fully charged, receiving charge, incorrectly connected or faulty cells. Mains voltage 200/250 v. Built for 6 or 12 v. batteries. Measurements 7 x 5 x 5 1/2 in. Weight 8 1/2 lb. Price £7/19/6. P. & P. 3/6.

**RECEIVER TYPE R.206. MARK II.** Frequency 0.55 Mc/s. to 30 Mc/s. in 6 bands. 100-250 v. A.C. or 12 v. D.C. Loudspeaker in power supply unit. High performance super heterodyne, eleven valves including a separate local oscillator valve, beat oscillator valve and two valves (amplifier and detector) in the A.V.C. system. In very good condition, £25 including power pack. Or £20 without power pack. Carriage and packing 15/-.

### NEW CHR HIGH-RESISTANCE HEADPHONES.

14/- P. & P. 1/6.  
**NEW DLR LOW RESISTANCE BALANCED ARMATURE HEADPHONES** 10/- P. & P. 1/6.

### TELEPHONE HANDSET. Standard G.P.O. type, new, 12/- P. & P. 2/-.

**R.209 RECEPTION SET.** A 10-valve high-grade Super Heterodyne Receiver with facilities for Receiving R/T (A.M. or F.M.) and G.W. frequency 1 Mc/s-20 Mc/s. Hermetically sealed. Built-in miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Overall measurements: Length 12in., width 8in., depth 9in. Weight 23lb. In as new, tested and guaranteed condition. £23/10/- including special headphones and supply leads. Carriage £1.

**H.R.O. SENIOR. TABLE MODEL.** In excellent, fully checked, and tested condition (without coils and power pack), £15/10/-. As above but rack mounted model, £14/10/-. Individual frequency coils for above £1 each or set of 9, £8. Either model carriage £1/10/-.

**ORIGINAL MAINS POWER PACK FOR H.R.O.** 110/220 v. A.C. Brand new in original packing 45/- P. & P. 4/-.

**HIGH QUALITY COMMUNICATION RECEIVER TYPE JR101.** 540 kc/s.- 30 mc/s. in 4 bands with bandspreads for 3.5, 7, 14, 21 and 28 mc. bands. A built in "Q Multiplier" permits the selectivity to be raised to a very high value. Vertical "S" meter. Automatic interference suppressor. 220 v. A.C. Valves: 6BA6 (3); 6BE6 (2); 6AV6 (2); 6AQ5; 5Y3. Weight approx. 20lbs. Measures 15in. x 10in. x 7in. Price £45. Carriage free U.K.

### CONNECTORS FOR TCS RECEIVER TRANSMITTER AND REMOTE CONTROL

with original plugs on both ends. New, £1/17/6 each. P. & P. 2/6.

### PANEL METERS (round)

-20 microamps	2 1/2 in.	D.C.	79/-
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0-500 microamps	2 in.	D.C.	30/-
0-1mA*	2 1/2 in.	D.C.	19/6
0-25mA	2 1/2 in.	D.C.	19/6
0-30mA	2 1/2 in.	D.C.	12/-
0-100mA	2 1/2 in.	D.C.	10/-
0-200mA	2 1/2 in.	D.C.	10/-
0-250mA	2 1/2 in.	D.C.	10/-
0-300mA	2 1/2 in.	D.C.	10/-
0-500mA	2 1/2 in.	D.C.	10/-
150-0-150mA	3 in.	D.C.	29/-
0-4 amps	2 1/2 in.	Thermo	8/-
0-15v	2 1/2 in.	A.C.	17/6
0-50v	2 1/2 in.	D.C.	28/-
0-300v	2 1/2 in.	A.C.	24/-
0-500v (shunt)	2 1/2 in.	D.C.	22/-
0-600v	2 1/2 in.	D.C.	15/-
0-5kV	3 in.	D.C. electrostatic	85/-
0-10kV	2 1/2 in.	D.C.	63/-
Freq. 0-70 c/Sec.	3 1/2 in.		52/-
125v	3 1/2 in.		52/-

\*Western, as usually used instead in H.R.O. "S" meter.

### BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS.

**I.F. TRANSFORMERS.** 1st, 2nd, 3rd, 4th (for type D), 12/6 each, or complete set of 6, 60/-.

**I.F. Transformers.** Crystal Load, 12/6 each. Plates escutcheons (for D and LF), 10/- each. Dials (for type D), 10/- each. Logging dial (for D and LF), 10/- each. Antenna Trimmers (LF and D), 2/6 each. Filter Condenser 3 x 4uF, 15/-.

**Condensers** 3 x .25uF (D and LF), 2/6 each. RF Antenna Inductors (D and LF), 7/6 each. Small Mica Condensers, various values, 1/6 each.

**Small Trimming Tool**, 7/6. Instruction Manual for AR88D, £1.

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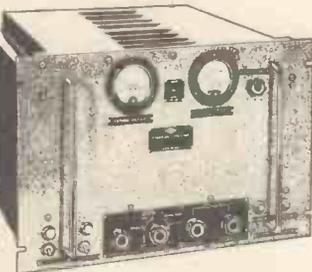
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Fully regulated and stabilized rack mounted (19in.) mains operated power unit providing the following facilities:

- Cathode volts—1.0 kV. to —2.4 kV.
- Grid volts 0 to —200 v.
- Reflector volts 0 to —500 v.
- Cathode current 18 mA. max.
- I.T. supplies 4.0 v. to 1.4 A.

INTERNAL GRID OR REFLECTOR MODULATION:  
Square wave: 2-4 kc/s., 70 v. peak-to-peak.  
Sawtooth 150-600 c/s.; 0 to 30 v. peak.  
PRICE, fully overhauled and guaranteed, £65.  
Packing and carriage 22.

## ELLIOTT FLUSH MOUNTED RECORDING MILLIAMMETERS TYPE 230



Range: 1 mA. direct-to-movement, D.C., and 1.1 mA. A.C. through internal rectifier. Curvilinear trace. 3/16 in. wide strip chart. Two-speed electric chart drive (230 v. A.C.) at 1 in. and 6 in. per hour. Two limit contacts provided for high and/or low current alarm.

PRICE, fully overhauled and guaranteed, complete with two charts... £37 10 0  
Packing and carriage 15/-

## 3-CENTIMETRE SIGNAL GENERATORS TS13/AP

Frequency range (723A/B oscillator) 9305-9445 mc/s. Output: CW pulsed, 50µV for 1 F.S.D. Pulsing: variable width from 4 to 2µsec. variable delay from 5 to 200µsec., variable repetition rate from 350 to 4,000 c/s. Self-contained cavity wavemeter and power monitor. Power supplies, 115 v. A.C. Price, fully overhauled and guaranteed... £70  
TS35/AP. Frequency range (723A/B oscillator), 8700-9,500 mc/s. Output: CW pulsed at 125 mc/s., 2µsec wide. Signal can also be synchronized with equipment under test. Peak power measurements range 0 to —68 ohm. Frequency measurement accuracy ±3 mc/s. Power supplies 115 v. A.C.  
PRICE, fully overhauled and guaranteed... £75

TS12/AP STANDING WAVE INDICATOR. Equipment is used for testing 3-centimetre circuit components and consists of: Detector amplifier unit having two parallel inputs for comparison purposes, with provision for using crystal or thermistor detectors, and case of accessories containing slotted waveguide assembly, connecting cables and the necessary items of 3-centimetre plumbing. The equipment should be used in conjunction with a suitable signal source such as TS13/AP or TS35/AP signal generators.  
PRICE, fully overhauled and guaranteed... £65

## MARCONI OSCILLOSCOPE TFI153

Single beam precision Oscilloscope employing 3 1/2 in. C.R. tube for accurate voltage and time measurements. Centre zero "Y" shift voltmeter. Calibrated "Y" D.C. and A.C. amplifier. Calibrated "X" shift. Voltage measurement range 1 v. to 300 v. F.S.D. Accuracy ±5%. Time measurement range 1µsec. to 50 msec. F.S.D. Built-in 5µsec. delay line. Frequency response 0-4 Mc/s. 230 v. A.C. operation.  
PRICE, in new condition... £110 0 0  
Packing and carriage £2/10/-

## MARCONI UNIVERSAL BRIDGE TF868B

Test frequency 1 kc/s. and 10 kc/s. ±2%. Ranges: 1Ω to 100Ω in 7 decades, ±1% at 1 kc/s., ±3% at 10 kc/s. 1 pF. to 100µF. in 7 decades; accuracy as above. Q—1 to 100; ±10% at 1 kc/s. Power factor, .001 to 1; 1.0 to 100 MΩ in 8 decades at D.C.; ±1%. Power supplies 200-250 v. A.C.  
PRICE, in new condition... £85 0 0

## MARCONI TF934 DEVIATION TEST SET



Fundamental frequency range 2.5-100 Mc/s. basic; range can be extended to 500 Mc/s. by using harmonics. Deviation range 0.5, 0-25 and 0-75 kc/s. in the modulation range of 50 c/s. to 15 kc/s. Sensitivity better than 55 mV. Power supplies 100-150 and 200-250 v. A.C. Price fully overhauled and guaranteed... £85 0 0

## MARCONI TF-801A SIGNAL GENERATORS

Frequency range 10-300 Mc/s. in four overlapping bands, calibration accuracy ±1%. Output 200 mV. max. into 75Ω. Calibrated step attenuator 0 to —100 dB in 1 dB steps. Internal sine-wave (up to 80%) and square wave (50-50) modulation at 400, 1,000 and 5,000 c/s. Provision for internal modulation. Power requirements 100-130 and 200-250 v. A.C. Fully overhauled and guaranteed.  
PRICE... £85 0 0

## METERS

50µA D.C. M.C. 2 1/2 in. rd. pl.	45/-
200µA D.C. M.C. 2 1/2 in. rd. Fl., Triplett	35/-
200µA D.C. M.C. 2 1/2 in. rd. Fl., calibrated 0-100, enclosed in a diecast case 1 1/2 x 3 1/2 in. A good and accurate portable meter.	45/-
300µA D.C. M.C. 2 1/2 in. rd. Fl. (Victoria)	15/-
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2 1/2 in. rd. P.M. Turnergog	30/-
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2 1/2 in. rd. P.M. (cal. 3/300 mA.)	25/-
2 1/2 in. rd. P.M. with loose square flange, Cal. 0-100	30/-
2 1/2 in. rd. Fl. Westinghouse, cal. —20 to +37 db.	35/-
2 1/2 in. rd. Fl. Clip mounted, metal clad.	30/-
4 x 4 in. sq. Fl.	65/-
5mA D.C. M.C. 2 1/2 in. rd. Fl.	30/-
3 1/2 in. rd. Fl.	50/-
10 mA D.C. M.C. 1 1/2 in. rd. P.M.	20/-
2 1/2 in. rd. Fl.	30/-
150/0/15 and 30/0/30 mA. D.C. M.C. Dual range 2 1/2 in. rd. Fl.	25/-
25 mA. D.C. M.C. 2 1/2 in. rd. Fl.	30/-
50 mA. D.C. M.C. 2 1/2 in. rd. Fl.	30/-
75 mA. D.C. M.C. 1 1/2 in. rd. P.M.	20/-
100 mA. D.C. M.C. 1 1/2 in. rd. P.M.	20/-
1 1/2 in. rd. Fl.	20/-
150 mA. D.C. M.C. 1 1/2 in. rd. Fl.	20/-
2 in. sq. Fl.	25/-
2 1/2 in. rd. Fl.	20/-
200 mA. D.C. M.C. 2 in. rd. Fl.	20/-
200 mA. H.F. thermocouple, 2 in. rd. plug-in	12/6
200 mA. D.C. M.C. 2 1/2 in. rd. Fl.	25/-
350 mA. H.F. thermocouple, 2 in. rd. plug-in	12/6
500 mA. D.C. M.C. 2 in. rd. Fl.	25/-
2 1/2 in. rd. Fl.	25/-
500 mA. H.F. thermocouple 2 in. rd. Fl.	25/-
1 a. D.C. M.C. 2 in. rd. Fl.	25/-
2 1/2 in. rd. Fl.	27/6
2 a. D.C. M.C. 2 in. rd. Fl.	25/-
2 1/2 in. rd. Fl.	27/-
2.5 a. A.C. M.I. 2 in. sq. El.	20/-
3 a. D.C. M.C. 2 1/2 in. rd. Fl.	27/6
4 a. H.F. thermocouple 2 in. rd. Fl.	20/-
5 a. D.C. M.C. 2 1/2 in. rd. Fl.	25/-
10 v. D.C. M.C. 2 1/2 in. rd. Fl.	25/-
15 v. A.C. M.I. 2 1/2 in. rd. Fl.	30/-
100 v. A.C. rectifier 2 1/2 in. rd. Fl.	35/-
150 v. A.C. M.I. 2 in. rd. Fl.	25/-
150 v. D.C. M.C. 2 in. rd. Fl.	25/-
300 v. A.C. rectifier 2 1/2 in. rd. P.M.	30/-

Notes: Fl., flange mounted. P.M., panel mounted, flush, with small flange, fixed by means of screwing or clip.

## VARIABLE AUTO-TRANSFORMERS Type B-2

Input 230 v. A.C., 50-60 c/s. Output adjustable from 0 to 260 v. at a maximum current of 9.5 amps. Scale graduated in volts. Dimensions: 3 1/2 in. dia. x 4 1/2 in. high. Fixing: Three 2 1/2 in. dia. holes on a pitch circle of 3 1/2 in. dia. PRICE, brand new... £5 10 6  
Packing and carriage 11/6.

## BRAND NEW POST OFFICE RELAYS TYPE 3000

500Ω, 2M+3C.O.	12/6
2,000Ω, 2B	10/6
2,000Ω, 4C.O.	12/6
6,000Ω, 2M+2B	13/-
6,500Ω, 1M	10/6
8,800Ω, 2M+1B	12/6

## POST OFFICE RELAYS, TYPE 3000

Reclaimed from equipment.	
100+100+300Ω, 1M+1C.O.	7/-
200Ω, 1C.O. + 1M before B.	6/8
200Ω + 400Ω (N1), 1M+1B	6/6
1,000Ω, 2M+4M before B.	7/-
2,000Ω, 1B	6/6
5,000Ω, 1M	6/-

## OPEN TYPE MINIATURE RELAYS

*8.T.C. 250Ω, 1M, heavy duty.	6/-
*8.T.C. 700Ω 2 C.O.	6/-
*Calbed Control A192817, 75Ω, 1M, 12 v.	1/6
R.B.M. 55251 270Ω, 1M, 12 v.	1/6
R.B.M. 55282, 130Ω, 6M, 24 v.	6/6
R.B.M. 55530, 130Ω, 3M + 1C.O., 24 v.	6/6

\*Reclaimed from equipment. The remaining relays are brand new.

## BRAND NEW SEALED RELAYS

8.T.C. 4134GE, 2,500Ω 2 C.O., 48 v.	13/-
Advance 68755-1Y, 65-5,000Ω, 1M, 15 v.	12/6
Advance FR849-1Y, 2,10,000Ω, 3B, 24 v.	15/-
Advance C894-1, 250Ω, 3B, 12.5 v.	12/6
R.P.M. 22240-4, 200Ω, 6M, 12 v.	10/6
Elect. Spec. T-162P1, 10,000Ω, 1C.O., 48 v.	12/6
Advance E8904-1, 300Ω 2 C.O. 12 v.	12/6
Potter Brumfield MH1769, 360Ω, 2 C.O., 24 v.	7/6

## MINIATURE VALVE BASES AND SCREENING CANS

B7G, PTFE, flange fixing, skirted.	1/6
B7G, PTFE, 3-flng fixing, skirted.	1/3
B8A, skirted, flange, fixing.	1/6
B9A, skirted, flange fixing.	1/-

SCREENING CANS  
B7G, short, 4d. B7A, long, 5d. B7G, long, 5d.  
SPECIAL OFFER: 12 bases of any type with 12 screening cans, 15/- Post Paid.

## MINIATURE VOLTMETERS—BATTERY INDICATORS

Reading from 4.5 to 8 v. D.C. (suppressed zero). 1 1/2 in. dia. scale, flange mounted... 15/-  
Packing and carriage 1/6-

## H.T. SELENIUM TUBULAR RECTIFIERS

T16HT56, 840 v. input, 8 mA. D.C.	5/-
T36EHT30, 1,620 v. input, 2 mA. D.C.	6/6
T36EHT30, 810 v. input, 2 mA. D.C.	4/-
T36EHT40, 1,080 v. input, 2 mA. D.C.	6/-
T36EHT90, 2,430 v. input, 2 mA. D.C.	7/-

Postage and packing 1/6 per rectifier.

## DOUGLAS TRANSFORMERS

Battery charging. Input 200-250 v.  
MT3/AT, output 12-15-20-24-30 v. at 2 a... 25/6  
MT19/AT, output 24 v. at 5 a... 38/6  
MT21/AT, output 12-18-20-24-30 v. at 4 a... 38/-  
Stepdown Transformers, MT4/AT 115/220 v., 150 watts... 25/6  
Packing and carriage 3/-

## EX P.O. MAGNETIC COUNTERS

500Ω Coil, energised by 24 v. D.C. four digit electro-magnetic fast acting counters (non-cancelling type) counting up to 9999. Perfect condition, 8/6. P.P. 1/6.

## 130 v. A.C. MOTORS

Approx. 8 watts 5 minute rating. Integral with 4-stage reduction gearbox giving an output shaft speed of approx. 14.5 r.p.m. with a torque of 11-1b. Shaft diameter 1/4 in. Overall dimensions 2 1/2 x 3 1/2 x 3 in. Will operate continuously at 180 v.  
PRICE... 12/6  
P.P. 2/6.



## POWER UNITS TYPE W8356A

This is a Navy version of Type 3 Power Unit. 19 in. rack mounting. Input 230 v. Fully smoothed H.T. output can be adjusted from 150 to 270 v. at 80 mA. by means of primary taps. L.T. output 6.3 v. A.C. at 4 amps. A.C. voltmeter monitors A.C. mains input and, with key switch depressed H.T. output. PRICE, second-hand, in good condition, £3/10/- P.P. 15/-.

TRANSISTORS

Table of transistor models and prices including Mullard, R.C.A., and Micro-Alloy series.

R.C.A. 2N410 (equiv. OC45) 4/3; 2N412 (equiv. OC44) 4/3.

MICRO-ALLOY MAT101 (up to 60 Mc/s) 8/6; MAT121 (up to 120 Mc/s) 8/6.

NEWMARKET V30/20 10/-; V30/30P 12/-

28002 20/-; 28004 40/-; 28006 40/-

SURPLUS TRANSISTORS

Standard: OC44 2/9; OC45 2/9

Spot transistors: WHITE 2/8 RED 2/8 YELLOW 1/10 GREEN 1/6

2.25 Watts ZENNER DIODES

Voltage tolerance ±5%

5.73V. (VR75B); 6.25V. (VR6.25); 7.0V. (VR7B); 9.0V. (VR9B); all at 6/6. Postage 6d. per diode.

SEMICONDUCTOR RECTIFIERS

GERMANIUM JUNCTION, STUD MOUNTED: GJ5M, 300 p.i.v. 500 mA. 3/6

GJ7M, 80 p.i.v. 500 mA. 3/6

The rating can be increased to 1A by mounting the rectifier on a heat sink.

SILICON JUNCTION, WIRE ENDED: BV100, 700 p.i.v. 450 mA D.C. 8/-

LUCAS DD05B. Miniature (5 mm. dia) diffuser junction device. Mains input 250V r.m.s. D.C. Output 290V. (half wave) at 500mA. Direct radio and T.V. replacement. Type. Exceptionally resistant to surges 12/6

KLYSTRONS

Table of klystron models and prices including 2K25, 2K28, 2K33, etc.

SELENIUM CONTACT COOLED RECTIFIERS

Input 230V. A.C.; Output 300mA. D.C. Type ZS001, Working range 220 to 275V; trigger voltage not less than 50V.; maintaining voltage 110V. Type ZR01U, Working range 150 to 170V., Maintaining voltage 105V. PRICE..... 15/- each

SPECIAL OFFER OF TRIGGER TUBES

Cold Cathode Inert gas filled trigger tubes with priming discharge. Miniature Glass Type with B9A bases. Max. Cathode current 2.5 mA. average and 10mA. peak. Max. operating speed 400 c/s. Type ZS001, Working range 220 to 275V; trigger voltage not less than 50V.; maintaining voltage 110V. Type ZR01U, Working range 150 to 170V., Maintaining voltage 105V. PRICE..... 15/- each

SUB-MINIATURE PRE-SET POTENTIOMETERS Carbon Track, Linear

100K, 11/16in. dia. x 1/4in. deep..... 1/3 100K, 5/16in. dia. x 1/4in. deep..... 1/6 2,500Ω, 1/4in. dia. x 1/4in. deep..... 1/6

"ELECTRON" OUTDOOR ROD AERIAL

3 long tubular light alloy sections 3ft. long each on an insulated aerial base fitted with wind mounting bracket. Complete with down lead. PRICE, brand new, P.P. 6/- 15/-

NUVISTORS

6CW4, for T.V. and F.M. Tuner applications... 14/6 6D84, similar to 6CW4 but with remote cut-off for use in weak signal areas... 15/- Bases for the above, 2/9.

OUR NEW PRICE LIST OF VALVES AND TUBES IS NOW READY. PLEASE SEND 6d. STAMP.

CATHODE RAY TUBES

Table of cathode ray tube models and prices including 2AP1, 3AP1, 3FP7, etc.

lin. Screen R.C.A. Tube Type 913, Integral with metal screen. Octal Base. 500V, E.H.T. 6.3V. htrs..... 50/- Bases: 2AP1 3/6; 3AP1 1/6; 3FP7, 7BP7, 913 (Octal) 1/-; 3BP1, 3FP7, 3FP7, 5CP1, 5SP7 3/6; ACRI0, OOD, OSJ 2/6; 5UP7 3/-; VCR97, VCR193, VCR517 3/6.

MAGNETRONS

Table of magnetron models and prices including 2J27, 2J28, 2J50, etc.

CRYSTAL DIODES.

Table of crystal diode models and prices including OA81, OA220, IN23, etc.

FULLY GUARANTEED FIRST QUALITY UNUSED VALVES

Large table listing various vacuum tube valves and their prices, including 0A2, 0A3, 0A4, 0A5, etc.

When ordering by mail, please add 2/6 in £ to cover handling and postage. MINIMUM CHARGE 1/6.

WE WISH TO BUY VALVES, KLYSTRONS, MAGNETRONS, etc. Please offer us your surplus stock.

Z. & I. AERO SERVICES LTD.

RETAIL BRANCH: 85 TOTTENHAM COURT ROAD, W.2. Tel.: LANgham 8403

Please send all correspondence and Mail Orders to our

Head Office: 14, SOUTH WHARF ROAD, LONDON, W.2. Tel: AMB 0151/2.

2 W W - 188 FOR FURTHER DETAILS.

**ERSIN**

*Multicore*



**SOLDER**

**IN THE NEW  
SAVBIT DISPENSER**



Easy to find in the tool box—simple to use. The new Multicore dispenser will stand up or lay on the bench without rolling off. The solder is in a continuous coil which can be used direct from the handy dispenser—in fact, it is virtually a third hand for those tricky soldering jobs. Containing 15 feet 5-core 18 s.w.g. Ersin Multicore Savbit alloy—the world-famous copper-loaded alloy that saves the soldering iron bit.

2/6 each (Subject)

**Bib Wire Stripper and Cutter**



This efficient tool strips insulation, cuts wires cleanly and splits plastic twin flex. It is adjustable to most wire thicknesses.

3/6 each (Subject)

*See also MULTICORE advertisement on back cover*

*If you have difficulty in obtaining any of these items, they will be sent post free.*

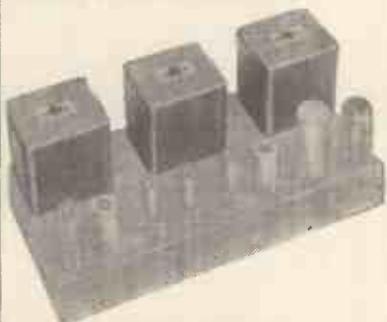
**MULTICORE SOLDERS LIMITED  
HEMEL HEMPSTEAD, HERTS  
CMMS. 6  
2W W—189 FOR FURTHER DETAILS.**

# NEWS

from  
*Partridge*

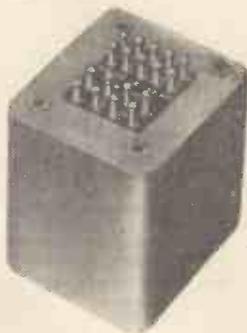
**MATCHING  
AND  
MATCHLESS**

The matchless quality of Partridge Transformers ensure their ready acceptance by designers—professional and amateur alike—for inclusion in equipment where the highest standards of performance and reliability are required. The illustration below shows a matching set of P.4200 Output Transformers and one P.4212 Mains Transformer used in a Mullard 10+10W. Stereo Amplifier.



**P4200**

the  
best  
we've  
ever  
made!



Write for the newest issues of Partridge literature on the P4200 & P4212.

**To Partridge Transformers Ltd.,  
ROEBUCK ROAD, CHESSINGTON, SURREY  
2W W—190 FOR FURTHER DETAILS.**

**CABINETS AT SENSIBLE  
PRICES FROM  
£5 . 7 . 6d!**

You can be sure of meeting the exact cabinet you require when you examine the most extensive range in the country at Lewis Radio, here are just two examples:



**THE BRAHMS**  
Price 26 gns.

This new elegant Brahms cabinet is available in medium walnut and medium mahogany or teak with 9in. legs and will take any tape deck, turntable, tuner and pre-amplifier, the largest stereo amplifier plus record and tape storage.



**THE LOWBOY**  
Price 24 gns.

This rigidly constructed Hi-Fi cabinet will accommodate even the largest Hi-Fi units—available in teak, walnut or striped sapele mahogany—size 53in. long by 20½in. deep by 26in. high including 12in. legs.

**TWO NEW LEWIS CATALOGUES**  
Designed to assist your choice of cabinet and equipment.

**THE new Lewis Radio Cabinet Catalogue—the most comprehensive ever prepared. ALSO the unique 60-page equipment catalogue. ONLY 3/6.**

Please send your two new catalogues. Enclosed is P.O. for 3/6 which will be credited against any purchase I make.

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CAPITALS PLEASE

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2W W—191 FOR FURTHER DETAILS.

# CLASSIFIED ADVERTISEMENTS

Rate 9/- for 2 lines or less and 4/6 for every additional one or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day December 1963 issue, Wednesday, November 13th. No responsibility accepted for errors.

## SITUATIONS VACANT

### D.S.I.R.

**HYDRAULICS** Research Station, WALLINGFORD, Berks. **EXPERIMENTAL** officer (instrument engineer) to work on design and development of instruments for research into water balance of catchment areas. Qualifications: degree, dip-techn., H.N.C., or equivalent; some experience of transistor and relay circuits desirable. Salary (minimum age 26) £1,164-£1,431.—Application forms and further details from Director at above address, quoting E/A/012. Closing date 11th November, 1963. [2583]

### WAR Department.

**VACANCIES** exist for telecommunication mechanics, radar mechanics, fitters and electricians for employment with R.E.M.F. at the T.S.D., Old Dalby, Melton Mowbray; starting grade of pay £11/4 to £12/6—progression beyond this according to service and qualification; suitable electronics type tradesmen may also be considered for direct entry or promotion to a higher grade on pay range of £13/15 or £15/—five-day 42-hour working week; assisted travel scheme in operation; pensionable established status may be offered on completion of requisite service.—Apply C.E.P.O., T.S.D., Old Dalby, Melton Mowbray, Leics. [2584]

### AN overseas career.

**WITH INTERNATIONAL Aeradio, Limited.** To meet the requirements of constant growth and expansion we invite applications from technicians and engineers for an overseas career in North, West and East Africa, the Mediterranean area, the Caribbean, the Arabian Gulf and the Far East. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F. or Radio Electrical Artificer in the Royal Navy or have other experience in the maintenance of HP and VHF communications, RTT and navigational aids, we should be interested to hear from you. Successful candidates would normally spend six weeks at our Radio Training School, Southall, Middlesex, before proceeding overseas, but in some cases staff with suitable qualifications and experience may be offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation, bachelor or married, is provided free; other benefits include generous U.K. leave and membership of an excellent pension and life assurance scheme.

WRITTEN applications, please, to Personnel Officer, 40, Park St., W.I. [0084]

### KENT COUNTY COUNCIL.

**KENT Education Committee.** **MEDWAY** College of Technology. **DEPARTMENT** of Electrical Engineering. **JUNIOR** Technician is required from 1st January, 1964, to work on the development of electronic circuits for teaching and research, to carry out routine maintenance and repair of equipment and to distribute apparatus for experimental work. **PREVIOUS** experience is not essential. Salary £335 at 16 years of age to £605 at 25 and over. Arrangements can be made for further study at the College. **APPLICATIONS** should be addressed to the Principal, Medway College of Technology, Horsted, Maidstone Rd., Chatham, Kent, and should include details of education and industrial experience (if any). [2555]

### INSTRUCTOR for Training Centre.

**UNDER 35**, to lecture and demonstrate electrical and telecoms principles and practice to all grades of apprentices.

**PRACTICAL** experience of electromagnetic and electronic equipment more important than teaching experience.

**SALARY** commensurate with experience and qualifications.

**APPLY** in writing to:—**THE** Personnel Manager, S. Smith & Sons (England), Ltd., Aviation Division, Bishops Cleeve, Nr. Cheltenham, Glos. [2594]

**ELECTRO-MEDICAL** equipment manufacture require male assembly wiremen for small batch production of hospital equipment, previous electronic wiring experience preferred.—Apply, stating age and experience etc., E.M.S., 65, Caleshot St., N.I. Attn. Mr. D. E. Oliver, Langham 5433. [2589]

## UNITED KINGDOM ATOMIC ENERGY AUTHORITY WINDSCALE AND CALDER WORKS

# INSTRUMENT MECHANICS

Windscale and Calder Works require experienced men with knowledge of electronic equipment and/or industrial instrumentation for fault diagnosis, repair and calibration of a wide range of instruments used in nuclear reactors, radiation laboratories and chemical plant. This work involves the maintenance of instruments using pulse techniques, wide band low noise amplifiers, pulse amplitude analysers, counting circuits, television and industrial instruments used for the measurement of pressure, temperature and flow.

Men with at least five years' Services, Industrial or Commercial background of radar, radio, television, industrial or aircraft instruments are invited to write for further information. Training Courses in Specialised Techniques are provided for successful applicants having suitable Instrumentation background.

Married men living beyond daily travelling distance will be eligible for housing. A lodging allowance is payable whilst waiting for housing.

Write for details, quoting reference BP 195 to:—**Works Labour Manager, U.K.A.E.A., Windscale and Calder Works, Sellafield, Seascale, Cumberland.**



## ELECTRONIC STAFF

Applications are invited for the following interesting posts in the Calibration and Inspection Divisions of E.M.I. Electronics Ltd. at Hayes and Feltham, Middlesex.

**CALIBRATION ENGINEER.** To be concerned with the calibration and maintenance of a range of electronic test equipment. Applicants should be of at least City and Guilds Intermediate certificate standard, and should have had experience in this type of work. **LOCATION FELTHAM** Ref. WW/A/5/5a.

**TEST ENGINEERS** and Assistant Test Engineers to be engaged on a wide range of Ministry equipment developed and manufactured by the Company **LOCATION FELTHAM & HAYES.** Ref. WW/E/9/HF.

Applicants should have a sound basic knowledge of electronics preferably to City & Guilds standard. Consideration will, however, be given to technicians who have worked on Radio and T.V. servicing or in the technical branches of H.M. Forces, who wish to broaden their experience. A Contributory Superannuation Fund with Life Assurance cover is in operation.

Applicants should apply in writing, quoting ref. no. to **THE GROUP PERSONNEL MANAGER (04213/F)**  
**E.M.I. LIMITED, HAYES, MIDDLESEX.**



## COLOUR TELEVISION

### SENIOR ENGINEER

With a degree or HNC and experience in television receiver design is required to work with a small team of engineers engaged on colour television development work.

### INTERMEDIATE & JUNIOR ENGINEERS

With HNC and two or three years' experience to undertake development work on colour television receivers and associated test equipment. These posts, which are based at Sunbury-on-Thames, carry attractive salaries. Contributory pension scheme and free life assurance.

Apply in confidence to: Personnel Manager,

### RCA GREAT BRITAIN LIMITED

Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex



## SERVICE ENGINEERS

(ELECTRONIC SYSTEMS)

These positions should attract men who have a good general engineering background and sound modern electronic experience. Ex-Service technical N.C.O.s should find these posts stimulating and varied.

Excellent working conditions and a non-contributory Pension and Life Assurance Scheme operate.

Please apply to: S. H. Fothergill, Personnel Officer,  
The Solartron Electronic Group Ltd.,  
Victoria Road, Farnborough, Hants.

**Plessey UK**

## Calibration Engineers

are required to carry out the checking and calibrating of a wide range of electronic test equipment used within the Company. A very high standard of accuracy is called for and previous experience of checking electronic measuring instruments to performance specifications would be an asset. Some academic training in the appropriate field is desirable though not essential. Progressive salaries. Pension and Life Assurance Scheme, 38½ hour week. Applications, quoting Ref. 7571, should be addressed to:



The Employment Manager,  
The Plessey Company (UK) Limited,  
Vicarage Lane, Ilford, Essex.

### TECHNICAL sales manager.

MAJOR British manufacturing organisation, marketing large quantities of high class electrical consumer goods, requires a technical sales manager.

HE will be responsible for maintaining contacts with manufacturers and government departments, dealing with technical queries and working in liaison with the company's research and development departments. He will be responsible to the general sales manager and will have a staff of several technical salesmen, a car will be provided. Non-contributory pension scheme. Attractive salary will be offered. APPLICANTS should be aged 28-40, must have a qualification in electronics of at least H.N.C. standard and preferably have some experience in technical representation and/or sales administration.

SEND brief details only of age, qualification, experience and present salary to Box 5255, all applications will be acknowledged. [2569]

### RADIO & Television Testers.

FOR City Factory; good rates up to 7/6 per hour; five-day week.

APPLY to Personnel Manager:→ ALBA (Radio & Television), Ltd., Tabernacle St., London, E.C.2. [0012]

### SINGAPORE TELEPHONE BOARD.

APPLICATIONS are invited from suitably qualified nationals of Singapore and Malaya for employment as Telecommunications Engineers with the Board. COMMENCING salary will be awarded according to experience in scales ranging from \$700 to \$1,456 a month which includes a Cost of Living Allowance of 25% of basic salary. Provident Fund is operated. Free passages.

CANDIDATES should be Graduates of the Institution of Electrical Engineers and preferably have had some experience of telephone communication engineering.

CANDIDATES lacking practical experience but possessing Grad. I.E.E. membership or qualifications granting exemption from the Institution's examinations are still encouraged to apply as consideration will be given to arranging courses in the U.K. for those selected.

APPLY to Crown Agents, 4, Millbank, London, S.W.1, for further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2/51946/WF. [2549]

### GRAMPIAN TELEVISION, LTD.

Queen's Cross, Aberdeen. A vacancy exists in the studio centre at Aberdeen for a Maintenance Engineer at £1,468 per annum for duties covering all station equipment. Sound basic knowledge of television required with adequate qualifications.

APPLICATIONS to Chief Engineer within ten days stating age, experience and qualifications. [2570]

### NEWCASTLE UPON TYNE HOSPITAL MANAGEMENT COMMITTEE.

NEWCASTLE GENERAL HOSPITAL. SENIOR Electronics Technician and Electronics Technician required in the Regional Neurological Centre at this Hospital. DUTIES will be concerned with the manufacture and maintenance of electronics and electrical apparatus used in various aspects of medical electronics. Candidates will be expected to be able to work on their own initiative although the projects will be supervised by the Chief Electronics Technician. Salary will be in the range £630-£1000 depending on qualifications and experience.

APPLICATIONS stating age, experience and the names and addresses of two referees, to be sent to the Secretary, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne, 4. [2574]

OPPORTUNITY arises for progressive person to start off and take charge of a new department for the manufacture of TV aerials, experience in this field essential; employment-partnership with or without capital would be considered; Slough area.—Box 5258. [2576]

### HAWKER SIDDELEY DYNAMICS LIMITED

now leads Europe in the field of

### AUTOMATIC TEST EQUIPMENT

Due to the expanding interest in the activities of the company in this highly advanced field there is a vacancy for an:—

### ELECTRONIC ENGINEER

with experience in circuit development of D.C. amplifiers, pulse techniques or semiconductor circuit design.

Candidates should hold a degree in electrical engineering or physics, or H.N.C. (elect.).

Please apply, giving full particulars of qualifications and experience to:—

The Personnel Manager (Ref. 18),  
Hawker Siddeley Dynamics Ltd.,  
Hatfield,  
Herts.

**G.E.C.**

**COVENTRY**

G.E.C. (Telecommunications) Ltd. are manufacturers of transmission systems in the VHF and micro-wave bands, and electronic and electro-mechanical telephone exchanges. We are going through a stage of considerable expansion and will be requiring the following staff from time to time over the next 12 months:—

**TEST DEPARTMENT**

For the junior vacancies we would like to see evidence of progress in ONC or in City and Guilds telecommunications subjects. Men who have been working on electronic or telecommunications equipment in the Services are particularly welcome. For the senior vacancies some years' experience on electronic or electro-mechanical equipment preferably combined with formal qualifications are desirable. Starting salaries are in the bracket £13/6/- to £18 a week.

*Apply, with full details of age, education and experience to:—*

**THE STAFF OFFICER  
THE GENERAL ELECTRIC CO., LTD.**

Telephone Works, Copeswood, Coventry

**CONTRACT ENGINEERS**

Would be particularly attractive to men who have had wide experience of the installation and commissioning of complex telecommunications systems and who are not seeking more static employment. Starting salary not less than £1,000 a year.

**INSTALLATION**

Testers and installers for the installation and commissioning of transmission equipment both in the U.K. and overseas.

**ELECTRONIC DESIGN ENGINEERS**

The production of prototype manufacturing instructions from laboratory schematic sketches. A formal qualification together with a mechanical as well as an electronic bent and draughting experience are required. Starting salaries are in the bracket £15-£17 a week.

**R**ADIO, Radar, Computers, Data Handling, SONAR and Inertial Navigation Systems for the Royal Navy.

EXPERIMENTAL Officers and Assistant Experimental Officers in the Royal Naval Scientific Service.

VACANCIES in Portsmouth, Weymouth and West London areas.

**QUALIFICATIONS:** Pass degree or H.N.C. or equivalent in Physics, Electronic, Electrical or Mechanical Engineering. Previous experience and interest in one or more of the subjects listed are essential. Work may involve trials at sea in surface ships and submarines. Candidates and both parents should be British subjects by birth.

**SALARY** (National rate): E.O. £1,164-£1,431; A.E.O. £490-£1,053.

APPLY to Superintendent of Scientific Personnel, Admiralty, Empress State Building, London, S.W.6. (5) [0216]

**MINISTRY OF AVIATION**, Air Technical Publications, Chessington.

**TECHNICAL** writers are required for work involving detailed study of aircraft and weapon systems that are under development for the Services, and writing under guidance, the descriptive maintenance manuals required by Services technicians; the equipments covered are:—AIRCRAFT instruments, electrical components and systems, guided weapons and radars.

**QUALS.** Recognised engineering apprenticeship, or an equiv. training in an appropriate trade; O.N.C., C. & G. Final Cert. or equiv. qualn. is required. Sound, up-to-date knowledge of at least one of the above classes of equipment is essential. Writing, editing, and Services' experience are all advantageous, but on-the-job training in writing is afforded. Salary: £1,104-£1,253 p.a.

**GOOD** prospects for promotion and pension. Technical College courses sponsored for suitable candidates.

**APPLICATION** forms from Manager (PE.3795), Ministry of Labour, Professional & Executive Register, Atlantic House, Farringdon St., London, E.C.4. [2547]

**AUDIO** enthusiasts to assist with service, varied light assembly and stock control.

**EXCELLENT** opportunity.—Please write Mr. N. Reeder, Reeder Sound Installations, Ltd., Gernon Works, Gernon Rd., Bow, E.5. [2578]

**RESEARCH AND DEVELOPMENT**

Vacancies exist for the following staff in an establishment in North Buckinghamshire.

**EXPERIMENTAL OFFICERS**

Salary scale: £1,164—£1,431 per annum.

**ASSISTANT EXPERIMENTAL OFFICERS**

Salary scale: £490 (age 18) £858 (age 28)—£1,053 per annum.

**Qualifications:** Pass degree, Higher National Certificate, or equivalent qualification.

**Experience:** Candidates should have experience of research into or the development of H.F., V.H.F., or U.H.F. communications or general electronic equipment.

Grading and salary according to age and ability. Candidates and both their parents must have been British subjects at all times since birth.

Applications giving age, qualifications and experience to Box. No. 5283 c/o "WIRELESS WORLD."

**A TECHNICAL OFFICER**

is required in a team investigating the Mechanisms Regulating Breathing. The team is supported by a grant from the Medical Research Council and is located at the National Physical Laboratory.

The work involves the recording of physiological data and their analysis on digital and analogue computers. Experience in design and construction of electronic apparatus is essential. Salary according to age and qualifications.

Apply to:—

**Dr. I. P. PRIBAN,**  
c/o Superintendent, Autonomics Division,  
National Physical Laboratory,  
TEDDINGTON, Middlesex.

**WAR DEPARTMENT**, 33, Central Workshop REME, Newark, Notts.

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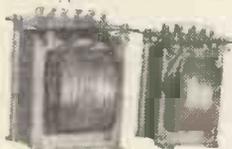
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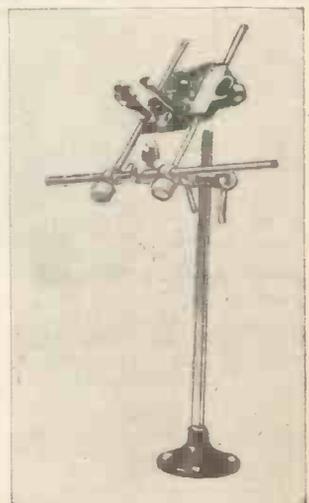
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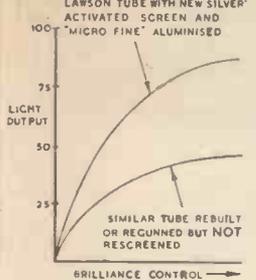
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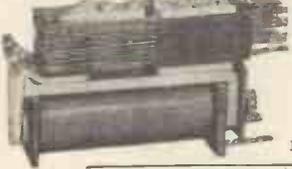
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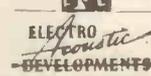
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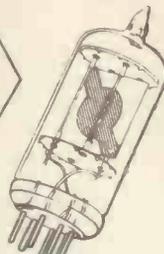
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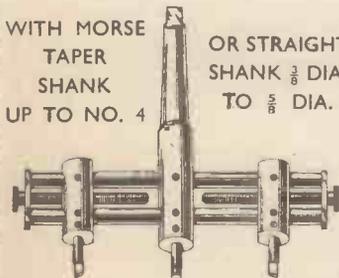
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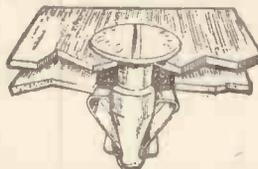
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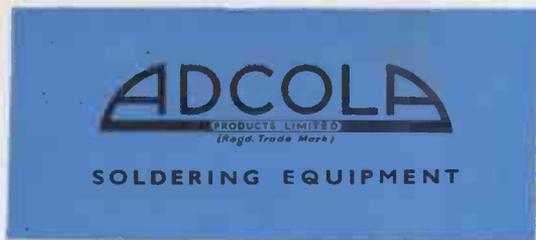
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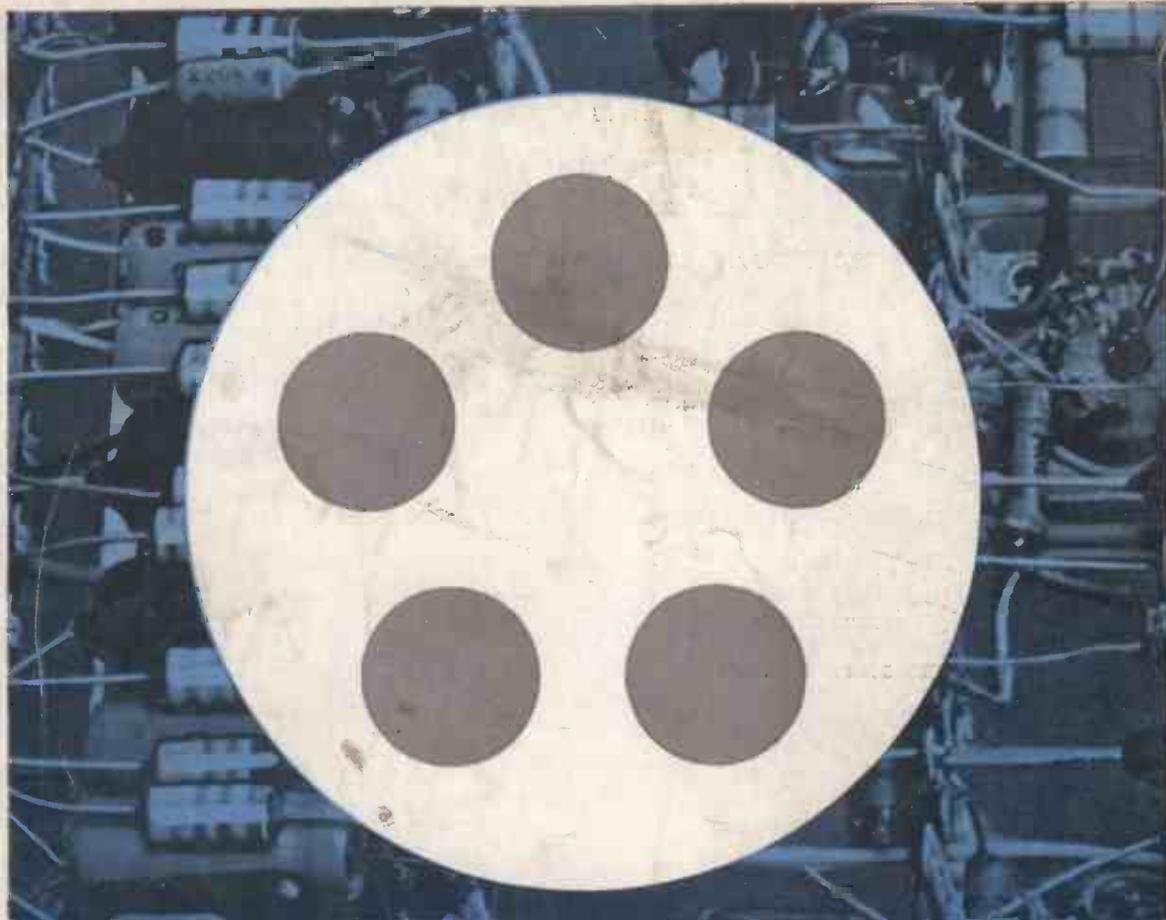
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