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Wireless World

Electronics
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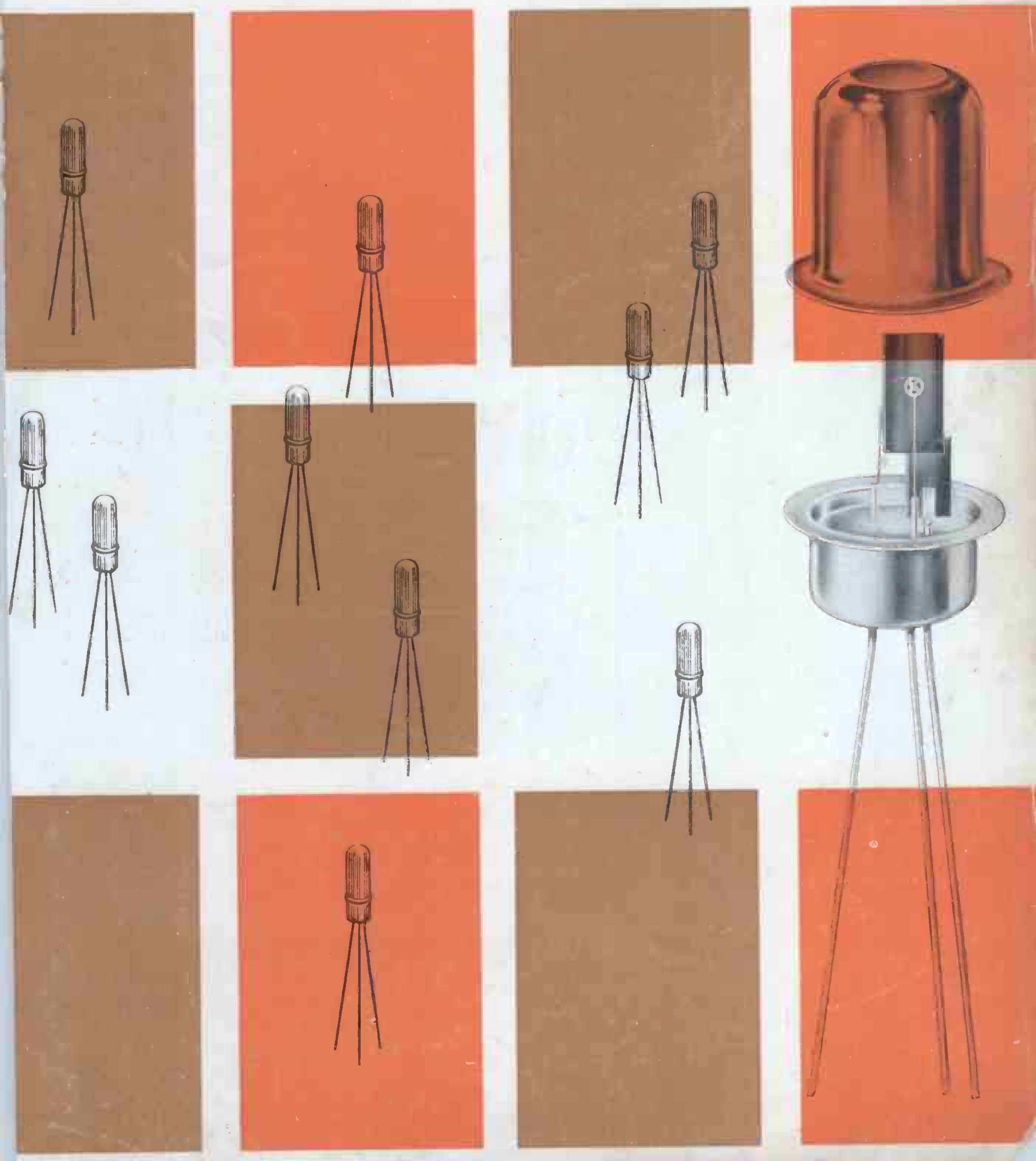
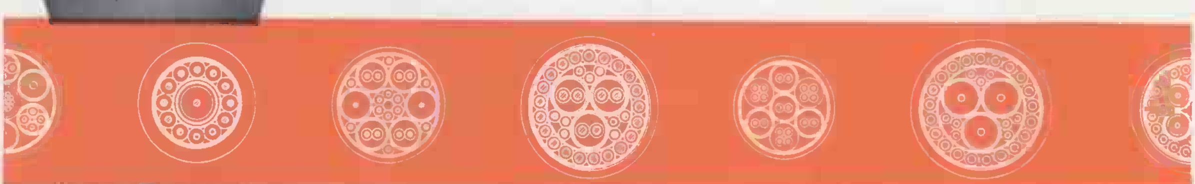


37-way moulded-on polypole coupler.



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JANUARY 1961

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Wireless World

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COLOUR BRINKMANSHIP

FOR a long time now colour television in this country has been in the doldrums. Those who want to get under way and who expected a wind from the Television Advisory Committee's Report were disappointed, but they have recently received what in nautical language might be termed a puff from an unexpected quarter.

The T.A.C. Report (May, 1960) said, amongst other things: "... we are of the opinion that present technical and economic limitations make it undesirable to introduce a colour television system in the near future," and that "any decision with regard to the introduction of colour must follow a decision on line standards."

The Director-General of the B.B.C. in a speech to the Radio and Television Retailers' Association in London (October 25th, 1960) said: "We in the B.B.C. are ready and very eager to proceed with a small compatible colour service within the framework of our existing programme in Band I on 405-lines, without waiting for a decision on whether there is to be a future move to 625-lines in Bands IV and V ... to wait for colour on 625-lines means that there will be no colour for a national audience for something like another ten years—and that, after the development work the B.B.C. has done during the past six years, would be most regrettable."

All very confusing and reminiscent of the ancient battle in which "those behind cried 'Forward,' and those before cried 'Back'." At least that is how it must appear to the layman who is confronted with such contradictory statements. But he should understand the feelings of the D.-G. His engineers have produced for him a beautiful toy. No one who has seen recent B.B.C. colour transmissions on a good colour receiver in any of the industry's research laboratories will deny that they are superb. Naturally he wishes to share his pleasure with others; the more the merrier, and the sooner the better. It may seem a small favour to ask of the P.M.G. that he should give permission to take the out-of-hours experimental transmissions which the B.B.C. has been putting out regularly for years, double their duration and include them in regular broadcasting hours: a start would have been made. A start of what? Not of colour television; that was made by the B.B.C. nearly six years ago. The start of a service, and we should be over the brink.

Once a service is started anything may happen. The public may cold-shoulder it on the score of cost, or a few Joneses may set the pace, and industry may be inundated with orders from their neighbours before it is in a position to meet the demand. If it decides to supply the die will have been cast and the pattern will be difficult to change.

Six years ago the Americans took the plunge and committed themselves to the N.T.S.C. system which, with the shadow-mask three-gun tube and with competent handling, is capable of giving superb results, but which failed to fulfil in the field the high promise of its sponsors. As a result of the American experience significant improvements have been made in receiver stability and reliability, but the three-gun shadow-mask picture tube, to the characteristics of which the N.T.S.C. system is tailored, is costly and likely to remain so. More important, the formulation of colour information in the signal has been compromised in its favour to produce an improved, though still not technically perfect, overall system performance. In so doing, difficulties have been placed in the way of the development of alternative and cheaper display tubes. These difficulties are not insuperable, as the article on a single-gun beam-indexing tube, which starts in this issue, will show, but a strong case can be made[1,2] for complete independence of brightness and colour information to give more freedom for possible future developments. In other respects the N.T.S.C. standards were a masterpiece of ingenuity and the basic concepts leading to compatibility with ordinary black-and-white television will no doubt be retained in any future standardization.

At the moment the shadow-mask three-gun tube undoubtedly leads the field, but it is being strongly challenged by single-gun tubes[3] of various types which are cheaper to produce, and if proved and adopted could help to remove the present obstacles of high first cost and maintenance. In the running are electro-luminescent and eidophor (oil film light gate) methods, and there may be as yet unknown outsiders working their way up towards the leaders.

On the present showing the B.B.C. has undoubtedly backed a winner in the shadow-mask tube, which even removes the lininess from the 405 standard! But it has also made sure of success by giving it the N.T.S.C. track to run on; other promising runners have at times found the going a little hard. The B.B.C.'s proper function is to provide and maintain the track, not the horses, and the choice of going will be the privilege and the duty of the Postmaster General after hearing the advice of the Pilkington Committee. They have called for evidence and it is now up to industry to bring out all those promising ideas on which they have been working for so long, so that their requirements may be taken into account in arriving at colour standards which are fair to all, and will endure.

[1] "N.T.S.C. Colour Information," by E. L. C. White. *Wireless World*, February, 1957.

[2] "An Alternative Colour TV System," by E. J. Gargini, *Wireless World*, August, 1957.

[3] "Single-Gun v. Three-gun Tubes: Their Influence on Colour Receiver Design," by R. N. Jackson, *Journal of the Television Society*, April-June, 1960.

Beam Indexing Tubes

1.—AN ALTERNATIVE TO THE SHADOW-MASK PRINCIPLE FOR COLOUR TELEVISION DISPLAYS

By IAN MACWHIRTER,* A.M.I.E.E.

The deficiencies of the shadow-mask colour display tube are outlined and proposals are made for the design of a tube which is completely free from these deficiencies. It is shown that the N.T.S.C. type of colour television signal is not suitable for direct application to the new tube and means are described for transforming the N.T.S.C. signal into a suitable form. The problems of synchronizing the colour signal with the instantaneous beam position are discussed and various solutions are suggested.

Comments are made on the advisability of modifying the formulation of the N.T.S.C. type of signal into a form better suited to the new display.

THE Television Advisory Committee has made no specific recommendations to the Postmaster General in connection with colour television standards.[1] Potential manufacturers of colour display tubes now have an opportunity for investigation of the usefulness of display tubes other than the shadow-mask tube. It is clear that had the early introduction of a public colour television service been recommended in the United Kingdom, the manufacturers of colour receivers would almost certainly have had to use a three-gun shadow-mask cathode ray tube. This tube, pioneered by R.C.A., has now been engineered to a standard with which all new developments in single unit colour display tubes will be compared. There are, however, operational shortcomings which are well known and can be briefly stated as follows:—

1. Only a small percentage of beam current reaches the phosphor because of shadow-mask trapping. Result: the maximum useful high-light brightness is limited to some 20ft. lamberts.

2. Because the phosphors have unequal efficiencies and because cathode ray tube guns have power-law characteristics, it is not easy to match the three guns in operating conditions. Result: the grey scale requires critical adjustment.

3(a). Each of the three beams must be individually aligned to excite the appropriate phosphor dots exclusively and completely. Result: incorrect purity adjustment will cause a colour shade in the picture both in brightness and in hue.

3(b). The three beams must converge on to one trio of phosphor dots. Failure of this requirement will cause colour fringing around the boundaries of picture components quite independently of the three differential driving voltages applied to the tube.

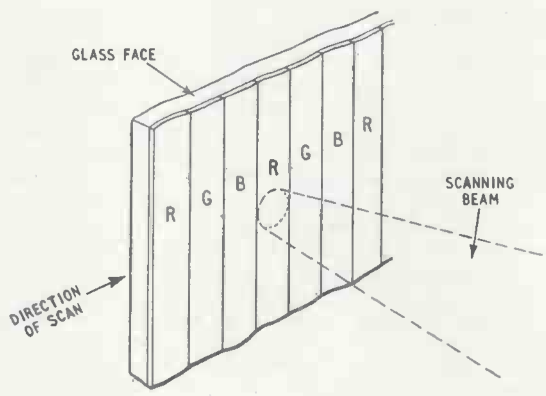


Fig. 1. Enlarged section of screen showing vertical phosphor strips.

4. Presently available tubes have a deflection angle limited to some 70°. Result: the tube is significantly more bulky than a 110° black and white tube of similar screen area.

A fundamental drawback is that the three-gun shadow-mask tube is difficult and expensive to make. Moreover, the tube must be used with a variety of magnets for convergence, beam-positioning and field purity, all of which help to increase receiver costs.

Proposed Solution. All four operational drawbacks may be obviated with the use of a single-gun tube whose beam can scan sequentially a series of tricolour phosphor strips; such strips may be arranged either horizontally or vertically, but this discussion relates primarily to tubes with vertical phosphor strips.[2,3] A steady beam current will

*Associated Electrical Industries, Ltd.

produce equal current excitation of the three phosphor strips during scanning and it is a fundamental requirement of this type of tube that the relative efficiencies of the phosphors should be balanced, so that white light is produced for a steady beam current. Small errors in the white point may conveniently be adjusted by means of external colour-correction filters.

The inevitable decrease in brightness caused by the balancing of the phosphor efficiencies, mainly in the green, can be alleviated if an elliptical spot is used whose minor axis is no greater than the width of a phosphor strip, and whose major axis is such that the scanning lines almost touch, i.e., satisfy the conditions for a "flat field." The brightness of a tube with such a gun can be as good as a modern black and white tube.

Fig. 1 is a drawing of a cutaway portion of the screen of such a tube, but the phosphor strips need not necessarily be contiguous as shown. It is of some importance that should the beam "spread" with increasing video drive, the intended excitation of, say, one primary should not be accompanied by unwanted partial excitation of the other two primaries.

Ideally, there should be a sufficient number of colour phosphor triplets such that the highest frequency component of the video luminance signal would be unable to excite less than one complete triplet of colour phosphors; it is axiomatic, then, that the average eye would be unable to resolve the individual colour strips at a normal viewing distance. In other words, a normal video signal applied to the tube would appear as a black and white picture, free from purity, convergence and electron-gun differential contrast characteristics. In practice, however, the use of a coarse strip structure appears to simplify some of the circuitry to be described later, and the number of triplets is chosen by a compromise.

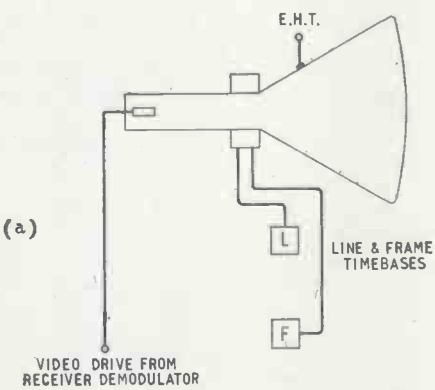
In order to show a colour picture, it is necessary that the beam current should be excited with voltages proportional to the colour signal when it is passing over the appropriate colour phosphor. This implies that an indicating or index mechanism is necessary to seek out the instantaneous horizontal position of the beam and to switch on, or "gate," the appropriate colour signal: red, green or blue.

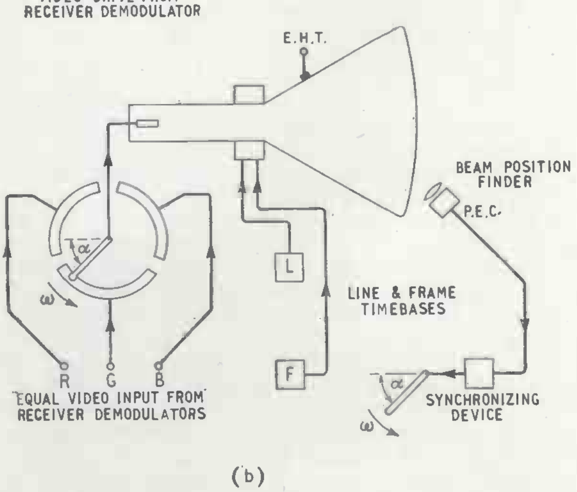
At this stage it is useful to make a comparison between the relative complexities of the following displays, a black and white, a single-gun strip phosphor and a three-gun shadow-mask. Fig. 2 illustrates this comparison. It should be appreciated that the fundamental difference between the three-gun shadow-mask display and the single-gun beam indexing display is that the former requires a three-stimuli, simultaneous-colour signal, whereas the latter requires a three-stimuli, dot-sequential signal.

The use of a beam position indexing mechanism in a colour receiver creates great problems and some time must now be spent in understanding them.

As an introduction to this, it would be as well to see how a typical band shared colour television signal is matched by the requirements of the three-gun shadow-mask display and by a "beam position indexing" display.

A typical colour signal, e.g., the N.T.S.C. signal, consists of two parts: (i) a wide-band black and white, or luminance, signal E_Y' and (ii) two bandwidth-limited components proportional to monochromatic colour minus luminance, $a(E_R^{1/\gamma} - E_Y')$, $b(E_B^{1/\gamma} - E_Y')$ which doubly modulate a carrier in balanced





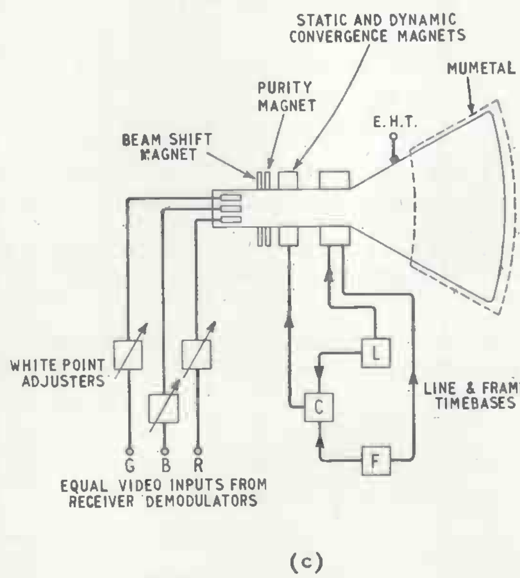


Fig. 2. Basic elements of (a) a black and white display, (b) a single-gun beam sensing display, (c) a shadow-mask display.

modulators, and these constitute the chrominance signal.[4] (The carrier of single frequency is divided into two orthogonal components, i.e., a quarter of a cycle apart, before the modulators). The composition of the luminance signal E_Y' is of some importance; starting with three suitable reproducing primaries, the amounts of red, green and blue are proportioned according to their relative contributions to luminance, which give rise to the visual sensation of brightness. This is because the colour difference channels are scaled so that they contribute nothing to brightness; this brightness reproduction is left entirely to the luminance signal. For N.T.S.C.

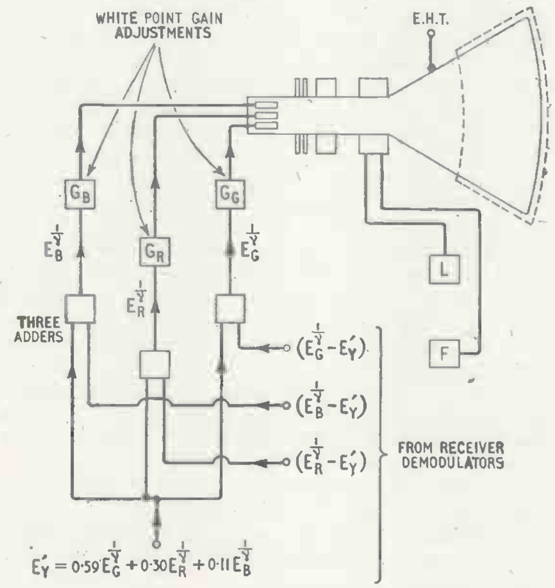


Fig. 3. In a typical display, $G_G = G_B = 0.7G_R$, but may vary with different phosphor conversion efficiencies.

primaries and for a normalizing white of 6,500°K, $E_Y' = 0.30\ E_R^{1/\gamma} + 0.59E_G^{1/\gamma} + 0.11E_B^{1/\gamma}$.

The colour difference signals $(E_R^{1/\gamma} - E_Y')$, $(E_B^{1/\gamma} - E_Y')$ and the derived $(E_G^{1/\gamma} - E_Y')$ when added to the luminance signal E_Y', produce colour signals for the display.[4]

Fig. 3 shows a three-gun shadow-mask display and the associated driving voltages derived from a colour signal proportioned to N.T.S.C. specifications.

If colour difference signals only are applied to the display, their relative contributions to luminance will be:

$$Y_R = 0.30\ (E_R^{1/\gamma} - E_Y')$$

$$Y_G = 0.59\ (E_G^{1/\gamma} - E_Y')$$

$$Y_B = 0.11\ (E_B^{1/\gamma} - E_Y')$$

$$\therefore Y_{total} = \sum Y_{RGB} = 0.30\ E_R^{1/\gamma} + 0.59\ E_G^{1/\gamma} + 0.11\ E_B^{1/\gamma} - 1.0\ E_Y' = 0$$

i.e., the colour difference signals themselves do not contribute to luminance changes (in a linear system). Therefore, the relative gains in the chrominance channels of the receiver may be proportioned so that an interfering signal present on all three colour difference signals will produce changes only in chromaticity of the display, i.e., constant luminance operation can be achieved. These necessary changes in relative gains are recognized in the formulation of the N.T.S.C. signal.

From the foregoing it will be appreciated that the three-gun shadow-mask tube is well matched to the N.T.S.C. colour signal.

Fig. 4 shows a single-gun beam indexing display and its associated driving voltages from which it will be seen that the N.T.S.C. simultaneous colour signal is transformed into a dot sequential signal by means of gate circuits. Again the display exhibits constant luminance but the three gate circuits must either be very linear in order to preserve the inherent perfect grey scale of the single gun tube or they must gate colour difference signals.[5,6]

The composition of the luminance signal which results in the smallest voltage swings in the colour difference gates, has equal weightings by red, green and blue.

Thus $E_L' = \frac{1}{3}E_R^{1/\gamma} + \frac{1}{3}E_G^{1/\gamma} + \frac{1}{3}E_B^{1/\gamma}$.

From this it is possible to predict the maximum excursion of the colour difference signals, and how these are matched to the permissible amplitude swing of the video signals in the gates for linear operation. If a saturated primary colour is transmitted, e.g., blue, then $E_L' = \frac{1}{3}$, since $E_R^{1/\gamma} = E_G^{1/\gamma} = 0$ and $E_B^{1/\gamma} = 1$, $\therefore\ (E_B^{1/\gamma} - E_L') = 1 - \frac{1}{3} = 0.67$. Now let the complementary colour yellow, be transmitted then

$$E_L' = \tfrac{2}{3},\ \text{since}\ E_R^{1/\gamma} = E_G^{1/\gamma} = 1\ \text{and}\ E_B^{1/\gamma} = 0$$

$$\therefore (E_B^{1/\gamma} - E_L') = 0 - \tfrac{2}{3} = -0.67.$$

Thus the peak excursion of the $(E_B^{1/\gamma} - E_L')$ signal is from $+\ 0.67$ to $-\ 0.67 = 1.33$. Because of the composition of the luminance signal, the peak excursion of all three colour difference signals is 33% greater than for single primary signals. This means that the gates must be designed to accept this increase in voltage swing. However, small differential contrast errors will not be objectionable since, for neutrals, the colour difference signals vanish.

A better use of the display tube would be one in which the chrominance signal is applied directly to the tube and so allows the sequential scanning of the colour phosphors to " gate " the chrominance signal at the appropriate time intervals.[7] Assuming that the line scanning is linear and that the phosphor strips are of equal width, the separation of vector components of the chrominance signal should be equi-angular rather than that of the N.T.S.C. signal formulations. A suitable chrominance vector signal is shown in Fig. 5, and superimposed is the N.T.S.C. chrominance signal which has been merely redrawn with three vector components.

Two points arise from this new chrominance vector.

1. The angular rotation, i.e., colour switching frequency, is decided by the number of phosphor strips on the screen. This frequency should be a little higher than the sub-carrier (if the visibility of the strip structure is not to be objectionable at a

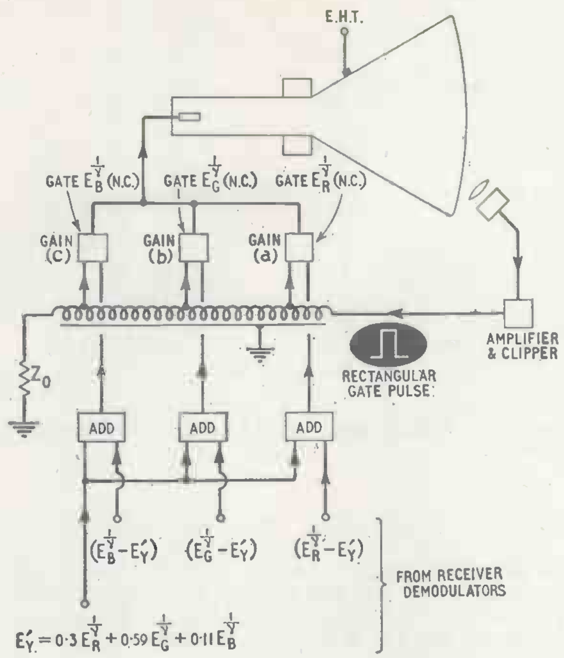


Fig. 4. Essential elements of a single-gun beam indexing display.

normal viewing distance), and it will vary if the line sweep is non-linear, or if the amplitude of the line sweep changes. Means must therefore be provided for synchronizing the new chrominance vector to the colour switching rate.

2. The vectors are shown as having equal amplitudes and the reason for this may not be immediately obvious. It will be recalled that in the design of a three-gun shadow-mask receiver, the gains in the colour channels (either in the three demodulators or in subsequent amplifiers) are such as to achieve constant luminance and the relative amplitudes of the transmitted colour vectors match the receiver requirements. Now the three "demodulators" of the single-gun display are made by the screen structure itself and although the relative "gains," or conversion efficiencies, of the three phosphors may be adjusted so that an interfering signal in the band shared channel will appear with minimum luminance disturbance, the colour of the screen will no longer be white. Because the screen must show white when an unmodulated beam scans it, it is not possible to change the "gains" of the single-gun "demodulator?." Therefore an equi-amplitude chrominance vector is necessary.

In order to complement this equi-angular, equi amplitude chrominance signal, a luminance component of the form $E_L' = \frac{1}{3}E_R^{1/\gamma} + \frac{1}{3}E_G^{1/\gamma} + \frac{1}{3}E_B^{1/\gamma}$ is required to provide the residual drive signals, $E_R^{1/\gamma}$, $E_G^{1/\gamma}$, $E_B^{1/\gamma}$. (This composition also happens to satisfy the requirement giving the smallest voltage swings in the colour-difference gate circuits.)

It should now be clear that, unlike the three-gun shadow-mask display, the single-gun beam indexing tube when screened with phosphors of balanced efficiency is not at all well matched for *direct* use with the N.T.S.C. formulated signals. Even if the widths and spacings of the three phosphor strips were made to match the non equi-angular spacings of the N.T.S.C. chrominance vectors, both constant luminance operation would remain unachievable and there would be incorrect colour rendering.

It is possible to transform the N.T.S.C. luminance and chrominance components into a form suitable for a single-gun display and also permit constant luminance operation to be achieved.[8] (In practice, however, certain simplifications which do not give an exact transformation may be justified on the grounds of economy, even though the resulting colour reproduction will not be exact.)

Now the N.T.S.C. luminance signal is weighted according to the relative luminosities of the specified primaries, i.e.,

$$E_Y' = 0.30E_R^{1/\gamma} + 0.59E_G^{1/\gamma} + 0.11E_B^{1/\gamma}$$

but for the single-gun beam indicating tube, the required luminance signal E_L' is given by

$$E_L' = \tfrac{1}{3}E_R^{1/\gamma} + \tfrac{1}{3}E_G^{1/\gamma} + \tfrac{1}{3}E_B^{1/\gamma}.$$

The difference $(E_L' - E_Y')$ vanishes for a neutral colour, i.e., $E_L' = E_Y'$

$$\therefore (E_L' - E_Y') = \tfrac{1}{3}(E_R^{1/\gamma} - E_Y') + \tfrac{1}{3}(E_F^{1/\gamma} - E_Y') + \tfrac{1}{3}(E_B^{1/\gamma} - E_Y')$$

From the N.T.S.C. colour signal formulation,

$$(E_G^{1/\gamma} - E_Y') = -\,0.51\,(E_R^{1/\gamma} - E_Y') - 0.19\,(E_B^{1/\gamma} - E_Y')$$

$$\therefore (E_L^1 - E_Y') = 0.33\,(E_R^{1/\gamma} - E_Y') + 0.33\,(E_B^{1/\gamma} - E_Y') - 0.51\,(E_R^{1/\gamma} - E_Y') - 0.19\,(E_B^{1/\gamma} - E_Y')$$

$$= 0.16\,(E_B^{1/\gamma} - E_Y') + 0.26\,(E_B^{1/\gamma} - E_Y^1)$$

$$\therefore E_L' = E_Y' + 0.16\,(E_R^{1/\gamma} - E_Y') + 0.26\,(E_B^{1/\gamma} - E_Y')$$

Rewriting this in terms of N.T.S.C. colour difference signal weightings,

$$E_L' = E_Y' + 0.18\,\frac{(E_R^{1/\gamma} - E_Y')}{1.14} + 0.58\,\frac{(E_B^{1/\gamma} - E_Y')}{2.03}$$

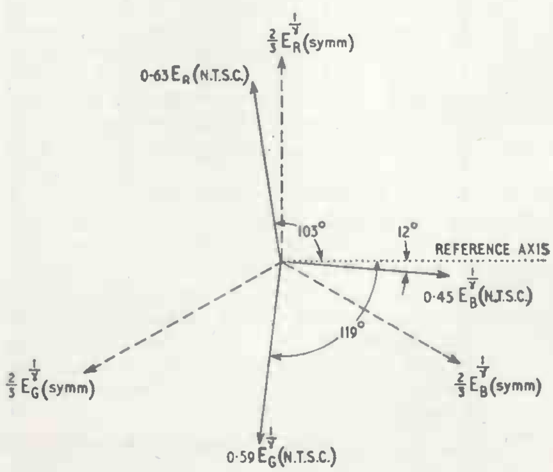


Fig. 5. Equi-angle and N.T.S.C. chrominance vectors.

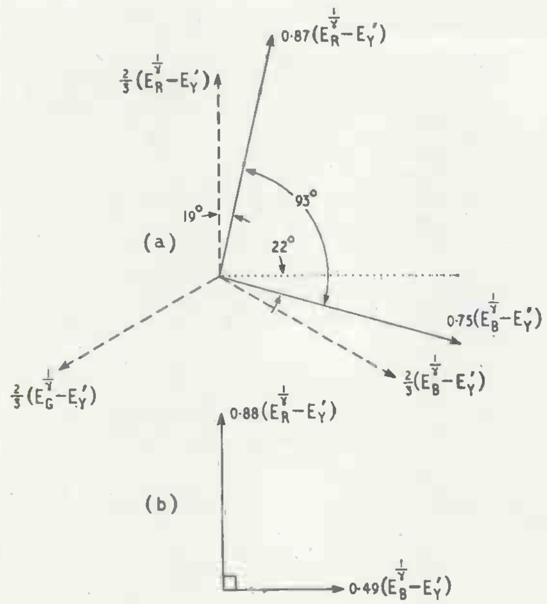


Fig. 6(a). Transformation of equi-angle vectors to two-colour difference vectors, (b) Orthogonal N.T.S.C. chrominance vectors.

i.e., the correcting signal $(E_L' - E_Y')$ which must be added to (E_Y') can be derived by demodulating the N.T.S.C. chrominance signal with a gain of $\sqrt{0.18^2 + 0.53^2} = 0.56$ and at an angle of $\tan^{-1}\dfrac{0.18}{0.53} \simeq 19°$ i.e., $0.56\angle 19°$.

It is of interest to note that the luminance correcting signal is derived directly from the two colour difference chrominance components which have been band limited. These components, i.e. $(E_L' - E_Y')$ in no way impair luminance detail since, during an achromatic transition in picture information, $(E_L' - E_Y') = 0$ and the transition is described by (E_Y') only.

The N.T.S.C. chrominance signal can be transformed into an equi-angle, equi-amplitude signal and Fig. 6 (a) shows the redrawing of the required symmetrical vectors into two colour difference vectors. In order to facilitate this transformation, a signal $(-\tfrac{2}{3}E_Y')$ has been added to each vector.

These should be compared with the available N.T.S.C. colour difference vectors in Fig. 7, from which it will be seen that whilst the $(E_B^{1/\gamma} - E_Y')$ vector is greatly increased in amplitude, the $(E_R^{1/\gamma} - E_Y')$ vector is slightly reduced. In addition, the new vectors are no longer orthogonal, but are separated by an angle of 93°.

This vector transformation is conveniently accomplished with an amplifier whose gain is varied with the second harmonic of sub-carrier frequency, (ω_c). Let the gain $G = a\cos(2\omega_c t + \theta)$ and the input signal be $E_c = b\cos(\omega_c t + \phi)$. Then output $= GE_c = ab\cos(2\omega_c t + \theta)\cos(\omega_c t + \phi)$.

$$= \frac{ab}{2}\left\{\cos(3\omega_c t + \theta + \phi) + \cos(\omega_c t + \theta - \phi)\right\}$$

Filtering out all components above (ω_c), output $= \dfrac{ab}{2}\cos(\omega_c t + \theta - \phi)$. Clearly, this includes the input signal with a reversed phase sequence $(-\phi)$, and this may be added in a suitable proportion to the unmodified N.T.S.C. chrominance signal, see Fig. 7. It is suggested that this proportion and the phase (θ) of the frequency-doubled sub-carrier be adjusted when observing the output signal on a calibrated vectorscope. A suitable test signal consists of colour bars containing primaries, complementaries and a neutral. In practice it has been found possible to set the vector angles to within 2 or 3 degrees of their correct value.

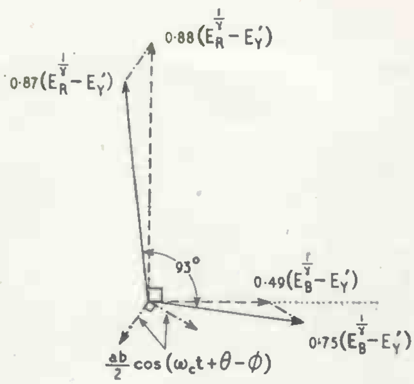


Fig. 7. Transformation of N.T.S.C. colour difference vectors.

It will be appreciated that a beam indexing display when used with a N.T.S.C. type of signal needs to have rather complex signal translation apparatus in order to give correct colour rendition. There is, however, a further colour error for which correction should be provided. Fig. 8(a) shows a diagrammatic section of a typical beam indexing tube screen and a chrominance signal corresponding to a saturated blue field (the luminance value of the blue field is not considered here). Clearly, there will be considerable excitation of the adjoining red and green phosphors, and this will cause desaturation of the intended pure blue light. Although this defect does not cause serious distortion of pastel colours, the loss of saturation on highly coloured objects is rather objectionable and correction for this can take one of three forms.

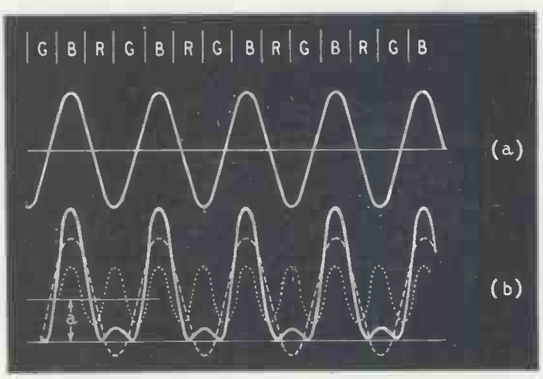


Fig. 8. (a) De-saturation of pure blue field. (b) Effect of adding 2nd harmonic term.

(i) The phosphor strips may be spaced with inert bands between adjacent colours, so that the conduction angle of the phosphors will be reduced.

(ii) The conduction angle can be reduced electrically by deducting from the luminance signal a signal proportional to chrominance carrier amplitude.[9] This idea is based on the fact that whilst the phase of the chrominance signal is proportional to saturation. An envelope detector will generate a signal proportional to saturation only, and this can be used to control the luminance amplitude. The inevitable decrease in brightness can be corrected by an increase in the gain of the chrominance channel.

(iii) The most satisfactory method for saturation correction requires the use of a second harmonic chrominance component which is added to the original chrominance signal[10]. In Fig. 8(b) is shown the effect of this where the added signal is of the form $a + b\cos(2\omega_R t + \phi)$ where (ω_R) is the colour switching rate.

(*To be concluded*)

REFERENCES

1 Report of the Television Advisory Committee 1960 (H.M.S.O.).

2 Bryan *et alia*, "A New Color T.V. Display—The Apple System," *I.R.E. Convention Record*, 1956, Part 3, p. 34 *et seq*. Also in *Proc. I.R.E.*, Vol. 44, p. 1108 *et seq* Sept. 1956.

3 Patents, e.g., British patent No. 713641, Marconi's W/T Co. and L. C. Jesty, 1951.

4 Report No. 7161R, March 1956, Hazeltine Research Corporation, p. 36, Appendix E. Also in Appendix B, "Principles of Color Television," by the Hazeltine Laboratories Staff, John Wiley & Sons Inc., 1956. Also see, C. J. Hirsch, *et alia*, "Principles of N.T.S.C. Compatible Color Television," *Electronics*, February, 1952, p. 90.

5 Report No. 7174, July, 1955, Hazeltine Research Corporation, p. 4 *et seq*. Also Chap. 13, p. 436 *et seq*., "Principles of Color Television," by the Hazeltine Laboratories Staff.

6 K. G. Freeman, "A Gating Circuit for Single-gun Colour Television Tubes," *Brit. I.R.E. Television Convention* 1959, pre-print page 5. Also in *Journal Brit. I.R.E.*, Nov. 1959, Vol. 19, No. 11, p. 667 *et seq*.

7 Report No. 7174, July 1955, Hazeltine Research Corporation p. 22 *et seq*. Also in Chap. 16 p. 471 *et seq*., "Principles of Color Television," by the Hazeltine Laboratories Staff.

8 B. D. Loughlin, "Processing of the N.T.S.C. Color Signal for One-Gun Sequential Color Display." *Proc. I.R.E.*, Jan. 1954, Vol. 42, No. 1, p. 299 *et seq*. Also, Chap. 16, p. 438 *et seq*. "Principles of Color Television," by the Hazeltine Laboratories Staff.

9 D. G. Fink, "Television Engineering Handbook" McGraw-Hill, 1957, Chap. 16, pp. 251-252.

10 G. S. Ley, "Color Purity in Ungated Sequential Displays," *I.R.E. Trans.*, Vol BTR—1, No. 1, p. 36, Jan. 1955.

Silicon Carbide Transistor

NEW HIGH-TEMPERATURE DEVICE

By MICHAEL LORANT

RESEARCH scientists of the Westinghouse Electric Corporation in the United States have recently developed a transistor capable of operating above 650 degrees Fahrenheit, a temperature higher than the melting point of lead. The new transistor is the first to be successfully made from silicon carbide, a hard crystalline material which, in impure form, is used as an abrasive in grinding wheels.

The high-temperature capabilities of the new transistor mark it as a significant advancement in the technology of these semiconductor devices. Present-day transistors, manufactured almost exclusively from germanium and silicon, can operate at temperatures no higher than about 200 degrees F (germanium) or 400 degrees F (silicon). Germanium and silicon transistors, however, cannot always meet the high-temperature requirements of today's existing and planned aircraft and space vehicles. Such applications, therefore, have furnished strong motivation for the development of higher-temperature transistors. Because of its great chemical stability and desirable electrical properties which it retains at elevated temperatures, silicon carbide is one of the most promising transistor materials for extremely high-temperature applications. Laboratory tests show that the new silicon carbide transistor still amplifies at 670 degrees F, and with further development, an upper operating temperature of more than 925 degrees F should be achievable.

The new device is actually a "unipolar" or "field-effect" transistor, which differs in operating principle from those usually made from germanium and silicon. Such conventional transistors regulate the flow of an electric current through them by the injection of electric charge carriers across a junction built into the semiconductor material. The unipolar transistor, on the other hand, acts more like a valve which opens and closes to regulate the electron flow.

The new transistors are made from exceptionally-pure crystals about two-thousandths of an inch thick. The necessary junction is built into the material by exposing it to vaporized aluminium at the white-hot temperature of 3,900 degrees F. The aluminium atoms diffuse into the silicon carbide crystal, changing its electrical behaviour from so-called n-type material to p-type. The junction is formed where the two types meet, and the process is controlled to an accuracy of a few millionths of an inch.

Then, to establish the input and output terminals of the transistor, the wafer is etched at two points in such a way that the silicon carbide is eaten away until the junction within the body of the crystal is reached. Electrical connections at these two points and to the body of the wafer complete the transistor.

A typical finished transistor is about 80-thousandths of an inch long and 40-thousandths of an inch wide, and the "working" area of the crystal surface is smaller than the head of a pin. Electrical measurements on the finished transistors show them to give a power gain of about 60 at room temperatures.

Electronic Telephone Exchanges

RECENT DEVELOPMENTS DISCUSSED AT THE I.E.E.

THE papers presented at the Institution of Electrical Engineers' Conference on Electronic Telephone Exchanges on November 22 and 23 were contributed by experts from Europe, Asia and America and covered a very wide field in considerable detail. They will be reprinted in full in 1961 in Part B of the Proceedings, and the following notes are intended only as an introduction for those who may wish to study the subject further.

Time Division

In Great Britain, feasibility studies of the design of a completely electronic exchange have been carried out. The studies, undertaken independently by the Post Office and five principal manufacturers of telephone equipment, and later by the Joint Electronic Research Committee, have resulted in the experimental exchange shortly to be installed at Highgate Wood, in London.

In order to provide consistency of service to subscribers during the experimental period, a complete electromechanical exchange will be installed. If, at any time, the electronic exchange is removed from service to allow modification, the mechanical system will function in its place, and in fact will remain permanently in service when the experiment reaches its conclusion.

The electronic system employs the time-division multiplex method of switching, each unidirectional "highway" carrying 100 channels. Each connection requires two antiphase channels, $\frac{1}{2}$ cycle (50μsec) apart, and is established by switching line and inter-highway diode gates by means of channel pulses, which are obtained from a channel store consisting of a circulating delay-line of the magnetostriction variety.

The central control equipment of the exchange is also, in the main, composed of magnetostriction delay-lines, which employ channel pulses to set up and supervise the progress of calls.

The speech-path channels are amplitude-modulated, the slight loss encountered during transmission through gates being made good by amplification in the demodulator.

Permanent control information, such as directory numbers, and transient information such as state of line, is stored on a magnetic drum. The drum is a magnetically coated cylinder with reading and writing heads. In the case of the permanent information, the writing head is normally isolated from its amplifier, to prevent accidental mutilation of the information. The type of permanent store employed lends itself to modification as a service expands.

When the design of the experimental exchange commenced, it was thought that transistors would restrict the transmission performance of the system and thermionic valves and semi-conductor diodes were chosen. It is reasonable to suppose that advances in semiconductor research have brought an exclusively solid-state exchange within the bounds of possibility.

Space Division

An American experimental exchange, the Morris Electronic Central Office, is described in a paper by Keister, Ketchledge and Lovell. This exchange, designed by Bell Telephone Laboratories, employs a space-division system using gas-filled diodes as switching elements. The diodes have a negative-impedance characteristic which offsets loss in transformers and other elements in the transmission path.

Permanent control information is stored in a flying-spot photographic store, while transient information is held on barrier-grid tubes.

The more important sections of the equipment are duplicated, while fault detection and, in certain cases, correction are automatic.

Novel facilities provided by the exchange include the possibility of obtaining frequently called numbers by dialling two digits only, and of connecting extension telephones, via the exchange, in an intercommunication circuit.

Switching Elements used in modern space-division systems fall broadly into two classes, electronic and electromechanical. Representative of the electromechanical switch are the reed relay, and a development known as the "ferreed."* The reed relay consists of contacts mounted on two metallic strips or reeds, the whole being mounted in a sealed glass tube. Surrounding the tube is a solenoid carrying the control current, which magnetizes the reeds and brings them into contact. Long life is a feature of this type of switch. In the ferreed, the reeds form part of a magnetic circuit, in part of which is ferrite material. The remanence of the ferrite is capable of maintaining closure of the contacts in the absence of controlling current.

Electronic switches include the neon-filled diode and the p-n-p-n junction diode. Both of these devices have the slight negative slope to their characteristics referred to earlier. The junction diode requires a much lower operating voltage than the neon diode, heat-dissipation problems with both these devices being negligible.

Exchanges employing time-division and space-division multiplexing are under active development in many parts of the world, and it may reasonably be assumed that one or more systems, both economically and technically competitive with the electromagnetic exchange, will have proved themselves within a few years.

* The Ferreed—A New Switching Device. A. Feiner *et al.* B.S.T.J. Vol. XXXIX. No. 1.

PHYSICAL SOCIETY EXHIBITION

MANUFACTURERS AND RESEARCH ESTABLISHMENTS EXHIBITING

THE 45th show of scientific instruments and apparatus which has become known as the Physical Society Exhibition will open at the Royal Horticultural Society's Halls, Westminster, on January 16th for five days. This year, however, the exhibition assumes a new official title, the Annual Exhibition of the Institute of Physics and the Physical Society, because of the recent amalgamation of the two organizations.

On a very large proportion of the 150 stands there will be equipment of interest to radio and electronic engineers and, as in the past, the emphasis will be on new developments in instruments and research techniques as well as on standard instruments and equipment.

From 10.30 to 2.0 on the opening day admission is limited to members of the society and the Press. On succeeding days the exhibition will be open to ticket holders at 10 a.m. It will close at 7.0 on the 16th, 18th, and 19th, at 9.0 on the 17th and 1.0 on the last day. Tickets are obtainable from exhibitors or from 47 Belgrave Square, London, S.W.1.

Wireless World, together with our associate journal *Electronic Technology*, are among the publications which have taken space in the exhibition.

The following demonstration-lectures will be given at 5.45 on the middle three days: "Hydrodynamic Research" by F. S. Burt of the Admiralty Research Laboratory (17th); "The Physics of the Oceans" by Dr. G. E. R. Deacon of the National Institute of Oceanography (18th); and "Some Physical Problems in Travelling at Supersonic Speed" by Dr. F. P. Bowden of Cambridge University (19th). The Acoustics Group is holding a symposium on traffic noise at 2.0 on the 18th.

A.E.I.
Admiralty Research Estabs.
Advance Components
Airmec
Archæology and the History of Art, Research Lab.
Avo

Baird & Tatlock
Baker, C., Instruments
Baldwin Industrial Controls
Barr & Stroud
Beck, R. & J.
Bellingham & Stanley
Birmingham University
British Iron & Steel Research Assoc.

C.N.S. Instruments
Cambridge Instrument Co.
Casella, C. F., & Co.
Cawkell
Cooke, Troughton & Simms
Cossor Instruments

D.S.I.R.
Dawe Instruments
Decca Radar
Distillers Co.
Dobbie McInnes
Doran Instrument Co.
Dynatron Radio

E.M.I. Electronics
Edwards High Vacuum
Ekco Electronics
Electro Methods
Electronic Instruments
Electronic Tubes
Electrothermal Engineering
Elliott Brothers
English Electric Valve Co.
Ericsson Telephones
Evans Electroselenium

Ferranti
Flann Microwave Insts.
Fleming, J. & R.
Fleming Radio
Furzehill Laboratories

G.E.C.
Gallenkamp, A., & Co.
General Radiological
Griffin & George
Guy's Medical School

Hilger & Watts

International Computers & Tabulators
Isotope Developments

Joyce, Loebl & Co.

Kelvin & Hughes

Labgear
Lintronic
Locarte Co.
Lucas, Joseph

M-O Valve Co.
Marconi Instruments
Marconi's W/T Co.
Marshall of Cambridge
Megatron
Mervyn Instruments
Metals Research
Ministry of Aviation
Morgan Crucible Co.
Muirhead & Co.
Mullard

N.G.N. Electrical
N.P.L. & Post Office Engg.
Nagard
Nash and Thompson
National Res. Dev. Corp.
New Electronic Products
Newport Instruments
Northern Polytechnic
Nuclear Enterprises (G.B.)

Oertling, L.
Oliver & Boyd
Optica United Kingdom
Optical Works
Ottway, W., & Co.

Panax Equipment
Paton Hawksley Electronics
Perkin-Elmer
Planer, G. V.
Plessey Co.
Post Office Engineering Dept.
Prior, W. R., & Co.
Pullin, R. B., & Co.
Pye, W. G., & Co.

Racal Instruments
Rank Cintel
Reading University
Royal College of Surgeons
Royal Meteorological Society
Royston Instruments

S.T.C.
Sanders, W. H. (Electronics)
Sangamo Weston
Science Museum
Servomex Controls
Shackman, D., & Sons
Singer Instruments Co.
Solartron Electronic Group
Solus-Schall
Stanton Instruments
Stanley, W. F., & Co.
Sunbury Glass Works

Taylor, Taylor & Hobson
Techne (Cambridge)
Telcon Metals
Texas Instruments
Thermal Syndicate
Thompson, J. Langham
Thorn Electrical Industries
Tinsley, H., & Co.
Tintometer
Towers, J. W., & Co.
Townson & Mercer
20th Century Electronics

U.K.A.E.A.
Ultrasonoscope Co.
Unicam Instruments

Venner Electronics
Vinten, W.

Watson, W., & Sons
Wayne Kerr Laboratories
Wray (Optical Works)

Industrial Groups—IV

WITH the growing practice of diversification in industry new names are coming into the field of radio and electronics as companies or groups are merged with concerns in such industries as mining, steel and ship-building. A case in point is **Metal Industries, Ltd.** The M.I. group which now comprises 38 companies in the U.K. and overseas and employs over 12,000 came into our field with the acquisition in 1959 of Avo (formed in 1923) and its subsidiary Taylor Electrical Instruments (1938). The group had been on the fringe of our field since its acquisition of several electrical concerns including Brookhirst Switchgear and Igranic Electric, now known as Brookhirst Igranic.

The group recently doubled its size with the acquisition of Lancashire Dynamo Holdings. Among the Lancashire Dynamo companies is Lancashire Dynamo Electronic Products and also the International Rectifier Company (Great Britain) which was formed in May, 1959, jointly by L.D. and the International Rectifier Corporation of Los Angeles.

The Metal Industries group now includes:—

Avo
Brookhirst Igranic
Cable Jointers
Cox & Danks
Crypto
Crypton Equipment
Dynamo & Motor Repairs
Farmer Brothers (Shifnal)
Fawcett Preston & Company
Foster Electrical Supplies
Foster Transformers
Hughes Bolckow
J. G. Statter & Company
John Allan & Company (Glenpark)
Lancashire Dynamo & Crypto
Lancashire Dynamo Electronic Products
Lancashire Dynamo Nevelin
Malcolm & Allan (London)
Metal Industries (Salvage)
Minerva Mouldings
New Eagle Foundry Company
Shipbreaking Industries
Taylor Electrical Instruments
Towler Brothers (Patents)

Overseas Companies

Brookhirst Igranic S.A. (South Africa)
Fawcett Preston (Europe) S.A. (France)
Lancashire Dynamo Central Africa (Rhodesia)
Lancashire Dynamo South Africa
M.I. Australia
Metal Industries Europe S.A. (Belgium)
Olaer France S.A.

Associated Companies

Bepco Canada
International Rectifier Company (G.B.)
Soc. Representation d'Appareils Mecaniques (France)

Scientific Radio Conference

U.R.S.I. AND INTERNATIONAL RADIO MEASUREMENTS

By R. L. SMITH-ROSE, C.B.E., D.Sc., F.C.G.I., M.I.E.E.

DURING September, the International Scientific Radio Union held its XIIIth General Assembly at University College, London, when over six hundred scientists and engineers from twenty-four countries discussed various fields of scientific research ranging from precision laboratory measurements to the propagation of radio waves and communications in space. In his opening address, Dr. L. V. Berkner, the president since 1957, briefly reviewed the work of the Union over the past three years. It was during this period that the outstanding programme of the International Geophysical Year (1957/58) had been completed according to the carefully arranged plan, and this was followed by a year of International Geophysical Co-operation in 1959.

Since its formal organization in 1921 as an international scientific union, U.R.S.I. (the initials of its French title "Union Radio Scientific Internationale") has taken a keen interest in the characteristics of the atmosphere which determine the transmission of radio waves, and of the influence outside the atmosphere which determine these characteristics. It was thus perhaps a natural consequence that as the president remarked, U.R.S.I. was the first union to express its confidence in the scientific benefits that would result from artificial satellites in orbit around the earth. It is significant to note that the spectacular developments in the launching and use of such satellites and other vehicles in outer space have all taken place in the past three years. To deal with the scientific aspects of this work, an International Committee on Space Research (C.O.S.P.A.R.) was formed with U.R.S.I. as a charter member and having direct representation.

During the past triennium the allocation and protection of frequency channels for the use of radio astronomers has been actively discussed. With the coming of artificial earth satellites and their associated radio transmissions, this question has become of much greater importance. Although some frequency assignments were made for research purposes at the Geneva conference of the International Telecommunication Union at the end of 1959, it has been considered necessary to explore the future needs much more thoroughly; and at the recent U.R.S.I. General Assembly, representatives of U.R.S.I. and C.O.S.P.A.R., together with members of the International Astronomical Union, agreed to set up an inter-union committee for this purpose.

Scientific Programme of U.R.S.I.

The work of the International Scientific Radio Union is divided among seven commissions, dealing with individual portions of the field as indicated by their titles. These, together with the names of the chairmen appointed in September for the current three-year period (1960-63), are as follows:—

I	Radio measurements and standards	Dr. U. Adelsberger (Germany)
II	Radio and troposphere	P. Voge (France)
III	Ionospheric radio	J. A. Ratcliffe (U.K.)
IV	Radio noise of terrestrial origin	Prof. R. A. Helliwell (U.S.A.)
V	Radio astronomy	Prof. A. C. B. Lovell (U.K.)
VI	Radio waves and circuits	Dr. J. Loeb (France)
VII	Radio-electronics	Prof. W. G. Shepherd (U.S.A.)

At the General Assembly in London, the programme was arranged so that all these commissions met concurrently to discuss subjects which had been selected. A few joint sessions were also held to deal with subjects of common interest to two or more commissions. Outstanding among these was a morning session for the whole assembly allotted to the radio aspects of space research. Several papers described experiments made with rockets and satellites for studying the ionosphere and outer atmosphere as well as cosmic noise and solar ionizing radiations. Other papers stimulated a discussion on the scientific and technical aspects of communications by means of active and passive satellite relay systems. One of these papers outlined a proposal to discharge from a satellite large quantities of small metallic filaments into an orbital belt of microwave-resonant dipoles, which would reflect radio waves for long-distance communications purposes. This proposal was viewed with some misgivings by both optical and radio astronomers, since the existence of a permanent reflecting or scattering belt might seriously impair future scientific research in the astronomical field.

At the closing plenary session, the individual chairmen reported on the activities of their commissions and working parties; and put forward resolutions and recommendations for adoption by the Union. The individual papers presented at the meetings of all commissions, together with reports of the scientific discussions, will be published as a series of U.R.S.I. monographs in the near future. In the meantime, a brief review of some of the items discussed will be given in this and succeeding contributions.

It was at the closing session also, that the following officers were elected for the next triennium.

President:	Dr. R. L. Smith-Rose (U.K.)
Vice-Presidents:	B. Decaux (France)
	Professor I. Koga (Japan)
	A. Prochorov (U.S.S.R.)
	Professor G. A. Woonton (Canada)
Hon. Treasurer:	Professor Ch. Manneback (Belgium)

The Headquarters of the Union are at 7 Place Emile Danco, Brussels 18, Belgium, and the secretary-general is E. Herbays.

These, together with the commission chairmen listed above, will prepare for and organize the next General

Assembly to be held in Tokyo in 1963, when the Union will be celebrating its Jubilee. It grew out of the International Provisional Commission of Scientific Wireless Telegraphy formed in 1913.

From the earliest days of U.R.S.I., one of its most important activities has been to establish agreement throughout the world on the accuracy of measurement of such quantities as frequency, power and field-strength, which form the basis of all international research in the radio field.

As a result of intensive research and development over the past quarter of a century in several national laboratories, the frequency of an alternating current can now be measured to an accuracy which surpasses that of any other type of physical measurement. After passing through phases when a temperature-controlled tuning-fork and, later, a specially cut quartz crystal, formed the essential element in a standard frequency source, one of the resonant modes of a cæsium atom has now proved to be the most accurate and stable basis of reference.[1] The stability of radio-frequency oscillators controlled by a cæsium atomic standard has been shown to be of the order of one or two parts in 10^{10}.

Direct comparisons have been made in the same laboratory between the standard developed at the National Physical Laboratory in this country and the corresponding U.S.A. standard. The results[2] showed that the standards of the two countries agreed to within about 2 parts in 10^{10}, and that part of this discrepancy could be attributed to the different electronic arrangements used to drive the cæsium oscillators.

In order to state the actual frequency of such an oscillator, it is necessary to specify what standard of time is to be used. It is convenient for many purposes to adopt a uniform scale of time; but for precise scientific work, it is now internationally agreed that ephemeris time, which is based on the revolution of the earth round the sun, should be used. As a result of a joint programme of measurements carried out between the National Physical Laboratory in this country and the United States Naval Observatory, Washington,[3] the mean value of the frequency of the cæsium oscillator was found to be 9 192 631 770 cycles per second, with a probable error of ± 20 c/s (Ephemeris Time). At the recent U.R.S.I. General Assembly, it was recommended that the Bureau International de l'Heure should keep under review the appropriate astronomical observations and announce a nominal value of this frequency for use during the following year.

In order to make such a standard available to users in various laboratories, programmes of international standard frequency transmissions have been established in several countries on various frequencies between 2.5 and 25Mc/s. In this country, the transmissions are emitted by a G.P.O. station at Rugby under the call sign MSF; and they are now supplemented on an experimental basis with a much lower frequency (16kc/s) from Rugby (GBR). These signals are measured at the N.P.L. by reference to the cæsium standard, and the values of the deviations from the nominal frequency are published monthly in *Electronic Technology*.

At a meeting of Commission I of the General Assembly of U.R.S.I., a review of the present position of "Standard Frequencies and Time Signal Transmissions" was introduced by U. Adelsberger (Germany), who gave particular attention to the problem of modulating or interrupting the continuous wave emissions in order to produce accurate time signal ticks. The Commission recommended that the day-to-day phase stability of the very low-frequency transmissions should be measured in various countries in order to assess their usefulness for high precision time synchronization and frequency comparison purposes.

Another radio measurement of reasonably high accuracy is that of the velocity of electromagnetic waves in a vacuum. At the XIIth General Assembly at Boulder, U.S.A., in 1957, a value of 299,792.5 ± 0.4 km/s was adopted; and this has been found to give consistent results in the measurement of geodetic distances by electronic means. At the last Assembly it was recommended that agreed formulæ for the refractive index of the atmosphere should be adopted for both light and radio frequencies, so that the value of the velocity can be corrected for the appropriate ambient conditions, which prevail in practical use.

Considerable attention has been given by U.R.S.I. at previous meetings to the specification of field strength measuring techniques and their international comparison. As the frequencies in use have increased into the microwave region, it has become customary to specify a received signal in terms of power flux rather than field strength; and a recommendation was made in 1957 that the national laboratories should compare their standards of power measurement in the neighbourhood of 3,000 and 10,000Mc/s. On this occasion, a paper by J. A. Lane (U.K.), presented the results of measurements made at the Radio Research Station, Slough, at a frequency of 9.375 Gc/s (wavelength 3.2cm) on wire and film bolometers submitted by the National Bureau of Standards, Boulder, U.S.A., and by the University of Tokyo, Japan. The measurements were made in several ways, including one using a constant-flow water calorimeter in which the microwave power was dissipated.[4] The general conclusion from these comparisons was that the techniques used in the three participating countries agree within the limits of their estimated accuracy, about 1.5 or 2.0%.

In view of the general trend of radio research and application to increasingly higher frequencies, the U.R.S.I. General Assembly recommended that this work should be extended to 140 Gc/s; and that similar experimental comparisons should be made on other electrical parameters, such as voltage, attenuation, impedance and voltage standing-wave ratios in waveguides. Such measurements are clearly fundamental to the design of terminal radio equipment as well as to the study of radio wave propagation.

REFERENCES

[1] L. Essen and J. V. L. Parry. "The Cæsium Resonator as a Standard of Frequency and Time." *Phil. Trans. Roy. Soc.* 1957, Vol. 250, pp. 45-69.

[2] L. Essen and J. V. L. Parry; J. N. Holloway and W. A. Mairberger; F. N. Reder and G. M. R. Winkler. "Comparison of Cæsium Frequency Standards of Different Construction." *Nature*, 1958, Vol. 182, pp. 41-42.

[3] W. Markowitz and R. G. Hall; L. Essen and J. V. L. Parry. "Frequency of Cæsium in Terms of Ephemeris Time." *Phys. Rev.* Letters, 1958, Vol. 1, No. 3.

[4] (a) J. A. Lane. "The Measurement of Power at a Wavelength of 3cm by Thermistors and Bolometers." *Proc. I.E.E.*, 1955, Vol. 102, Part B, p. 819.

(b) J. A. Lane. "Transverse Film Bolometers for the Measurement of Power in Rectangular Waveguides." *Proc. I.E.E.*, 1958, Vol. 105, Part B, p. 77.

WORLD OF WIRELESS

Audio Festival

PLANS are well in hand for the International Audio Festival and Fair being organized by a committee of audio manufacturers for April 6th to 9th at the Russell Hotel, London, W.C.1. Over 50 British manufacturers are subscribers to this international show at which quality of reproduction will be the keynote.

The following have been elected to form the council:—H. J. Leak chairman, R. Merrick (Ferrograph) vice-chairman, R. Arbib (Multimusic), D. Chave (Lowther), Major J. F. E. Clarke (Clarke & Smith), H. Farquharson (Armstrong), H. S. Futter (Gramophone Co.), L. B. Livingstone (Tannoy), J. Maurice (Lustraphone), J. Rogers (Rogers Developments), L. Stone (E.A.R.), L. Smith (Wharfedale), J. Swift (Goodmans), P. Walker (Acoustical), and L. Young (Vitavox). G. A. Briggs (Wharfedale) and J. Maurice have been appointed Trustees.

In addition to the usual stands and individual demonstration rooms for the 60 or more exhibitors, plans are being made for special lecture sessions covering reproduction from disc, tape and radio. Admission to the exhibition will be by ticket obtainable free from exhibitors and audio dealers.

Further details are obtainable from C. Rex-Hassan, 42 Manchester Street, London, W.1.

Television Afloat

The new 42,500-ton P. & O. luxury liner Oriana, now on her maiden voyage, has a television installation which provides not only a closed-circuit service but also for the reception of 405-, 525- and 625-line transmissions. The incoming television signals are, where necessary, converted to 525 lines for display on Ekco receivers and, moreover, where alternative programmes are available the viewer can make his own choice. Initially 60 receivers have been installed in public rooms and first-class cabins but provision is made for nearly 400. The television system was installed by Marconi's who also provided the ship's communications equipment, navigational aids and sound reproducing equipment incorporating 1,600 loudspeakers.

Radio Research

MANY interesting aspects of the research programme initiated by the Radio Research Board and carried out by the Radio Research Station at Slough are given in "Radio Research 1959"* which contains the report of the Board and of the Director of Radio Research. As might be expected the advantages to research in radio propagation afforded by rockets and satellites is given more than a passing reference. O. W. Humphreys, chairman of the Board, stresses that in order to obtain the full effect from the opportunities offered, the Radio Research Station "should devise its own experiments for flying in rockets and satellites." The proportion of the station's effort devoted to the general field of space research is being increased to 50%.

The present members of the Board are:—Prof. H. E. M. Barlow (University College, London), Prof. W. J. G. Beynon (University College of Wales), Dr. R. L. F. Boyd (University College, London), Prof. E. C. Cherry (Imperial College, London), O. W. Humphreys (G. E. C. Research Labs.), Dr. F. E. Jones (Mullard), K. I. Jones (Ferguson), C. J. V. Lawson (Cable & Wireless), F. C. McLean (B.B.C.), A. W. Montgomery (S.T.C.), Capt. J. S. Raven (Admiralty) and Capt. F. J. Wylie (Radio Advisory Service).

The 22-page report of Dr. R. L. Smith-Rose is of particular interest as it is his last as Director of Radio Research; he is succeeded by J. A. Ratcliffe.

*H.M.S.O. 3s.

College of Aeronautics.—For the past year or so the College of Aeronautics, Cranfield, Bletchley, Bucks., has been pursuing a policy of diversification of teaching activities, and as a result a number of new advanced courses have been developed in subjects which although relevant to aeronautics are of equal interest to many other branches of engineering. It has therefore been decided to change the titles of some of the departments thereby giving a better indication of the scope of their activities. Under this re-arrangement the Department of Aircraft Electrical Engineering becomes the Department of Electrical and Control Engineering. Professor G. A. Whitfield has been head of the department since its formation in 1955. In addition to providing specialized courses for aeronautical engineers as part of the two-year diploma course the department is now offering advanced courses in industrial control engineering and flight control as well as courses in space technology and guided missiles.

Satellite Tracking.—Two of the chain of 18 stations to be used for tracking the first American manned space satellite—those at Kano (Nigeria) and Zanzibar—are to be staffed by Cable & Wireless men for maintaining point-to-point communications. The stations will be linked by radio to London whence information will be passed to the U.S.A. *via* the transatlantic cable. W. A. Coslett, who during the war was engineer-in-charge of one of the mobile telecommunication units known as Blue Trains and until his retirement in 1959 at the age of 55 was C. & W. manager in Jamaica, has been appointed engineer-in-charge at Kano. The assistant engineers are J. D. Munday and T. Shepherd. At Zanzibar, D. G. Hicks will be E.-in-C. with P. J. Harlow and D. J. Payne as assistants.

S.O.N.D.E.—The Society of Non-Destructive Examination is to hold the first Croxson Memorial Lecture (in memory of the late Charles Croxson the founder chairman) on February 17th at 6.15 in the Caxton Hall, Westminster. Dr. L. Mullins will speak on "The Evolution of Non-Destructive Testing". Free tickets—not more than two per applicant—are obtainable from the Hon. Secretary of the Society, D. T. Carter, E.S.A.B. Ltd., Gillingham, Kent.

Computer Consortium.—The reconstituted British Conference on Automation and Computation, of which Sir Walter Puckey is chairman, has set up three panels to cover the following aspects of its interests:—education and training (with Professor G. D. S. MacLellan, of Glasgow University, as chairman); research and development (J. F. Coales, Cambridge University); and public relations (W. C. F. Hessenberg, British Iron and Steel Research Association). The general title of the conference of the B.C.A.C. to be held in Harrogate from June 27th to 30th is "Automation—Men and Money".

Television Society.—Sir Harold Bishop, Director of Engineering, B.B.C., has accepted the invitation of the Television Society to become president in succession to the late Sir George Barnes. He took office on December 8th for two years. The Society, which was formed in 1927 "for the furtherance of research in television and allied problems" now has a membership of over 1,200.

R.S.G.B. Membership.—For the fourth successive year after a period of recession the membership of the Radio Society of Great Britain had again increased at the end of June, 1960, when it passed the 10,000 mark. The year's increase recorded in the Society's annual report was 496 bringing the total to 10,036. Of the U.K. total of 8,729 holders of amateur (sound) licences, 6,473 (60%) were members of the Society.

Annual Dinner of the Royal Flying Corps Wireless Operators Old Comrades Association will be held in London on March 18th. Details are obtainable from E. J. F. C. Hogg, 57 Hendham Road, London, S.W.17.

African Radio Union.—Broadcasting organizations in Morocco, Tunisia, the United Arab Republic, Ghana, Guinea and Libya have set up an international organization under the name of African Radio Union. Principal aim of the Union is for technical and administrative co-operation between the different national broadcasting organizations in Africa. Abdoulaye Toure, director of the state-owned broadcasting service of Guinea, is the first president.

V.H.F. Sound Broadcasting.—The sixth edition of the list of European v.h.f. sound broadcasting stations, giving the situation on January 1st, will be published by the European Broadcasting Union early in February. The cost, including five bi-monthly supplements, is 50 Belgian francs. The list can be obtained from the E.B.U. Technical Centre, 32 avenue Albert Lancaster, Brussels 18, Belgium.

Receiving Licences.—During October the number of combined television and sound licences current in the U.K. increased by 82,397 bringing the total to 10,962,867. Sound-only licences totalled 4,226,094 including 459,856 for sets fitted in cars.

Pulse Techniques.—An 11-week laboratory course on pulse techniques begins at the Borough Polytechnic, Borough Road, London, S.E.1, in January. It will be held on Monday afternoons commencing January 9th and will be repeated on Thursday evenings from January 12th. The course will also be repeated on Monday afternoons from April 10th. (Fee £1).

Educational Publications.—The latest pamphlets in the series "Demonstrations and Experiments in Electronics" issued by the Mullard Educational Service give details of an all-transistor one-watt amplifier (No. 13) and an "echo" method of determining the velocity of sound (No. 14). The pamphlets are available free to schools, technical colleges and training establishments from the Mullard Educational Service, Mullard House, Torrington Place, London, W.C.1.

Police Radio—Features of this latest motor-cycle f.m. transmitter-receiver, produced by G.E.C. to a Lancashire Police design, are a handlebar press-to-talk switch, loudspeaker unit on the petrol tank and microphone-earpiece in the helmet.

Television receiver production in Hungary for the next five years, has been planned to total 1M. More than half the receivers are scheduled for export.

Moscow TV.—A tower carrying the aerials for five transmitters is a feature of the new television centre being built in Moscow.

Can you Help?—An American reader is anxious to secure a copy of *Wireless World* for January, 1952, to complete a 15-year file. Offers should be addressed to the Editor.

CLUB NEWS

Bradford.—Dr. G. N. Patchett of the Bradford Technical College will speak on transistors at the January 10th meeting of the Bradford Amateur Radio Society. A fortnight later D. Millard (G3OGV) will deal with amateur receiver alignment. The club meets at 7.30 at Cambridge House, 66 Little Horton Lane.

Cleckheaton.—"'Scope Interpretation" is the title of the talk to be given by T. C. Isaac of Bradford Technical College at the January 4th meeting of the Spen Valley Amateur Radio Society. On the 18th a member of staff of Philips Electrical will discuss tape recording. Meetings are held at 7.30 at the Labour Rooms.

Mitcham.—Lifeboat radio equipment is the subject of the talk being given by W. D. Pye to the Mitcham and District Radio Society on January 13th at 8.0 at "The Canons," Madeira Road.

Personalities

G. A. Marriott, B.A., is retiring in March from the managing directorship of the M-O Valve Company, a wholly owned subsidiary of the G.E.C., and is to be succeeded by **J. Bell,** B.Sc., F.Inst.P., at present deputy director and manager of G.E.C. Research Laboratories, and a member of the M-O Valve board. Mr. Marriott, who is 68 and a graduate of Caius College, Cambridge, has been with the G.E.C. throughout his professional life. He served on the board of the British Radio Valve Manufacturers' Association (B.V.A.) for nearly 20 years, and is now chairman of V.A.S.C.A., the associated organization which was formed in 1959 to take over from the B.V.A. the responsibilities for semiconductors and industrial valves and tubes. He was president of the Brit.I.R.E. from 1956 to 1958. Mr. Bell, deputy director of the G.E.C. Research Laboratories, Wembley, where he was manager of the telecommunications division from 1953 to 1958, was appointed to the board of the M-O Valve Company a few months ago.

G. A. Marriott

J. Bell

Paul Adorian, M.I.E.E., M.Brit.I.R.E., F.C.G.I., managing director of Associated-Rediffusion Ltd., has been elected a Fellow of the Institute of Radio Engineers of America, "for the development of electronic distribution networks used in broadcasting and television." He is the only British recipient among the 76 elected for 1961. Mr. Adorian is on the board of a number of companies within the Rediffusion group and is chairman of Central Rediffusion Services Ltd., Redifon Ltd., and Rediweld Ltd.

E. S. Hall, M.I.E.E., this year's chairman of the Rugby Sub-Centre of the I.E.E., is a director of A.E.I. Sound Equipment, Ltd., and divisional assistant chief engineer of A.E.I. Electronic Apparatus Division, New Parks, Leicester. He joined B.T.H. as a student apprentice in 1924 and on completion of the course in 1929 went to the research laboratory on the development of sound film equipment. In 1946 he was appointed chief assistant to the manager of the B.T.H. Electronic Engineering Department. Mr. Hall has held his present position since the formation of the A.E.I. divisions in 1959.

R. H. Booth, at one time chief engineer of the industrial division of E.M.I. Electronics Ltd., which he joined in 1949, and now personal assistant to the company's technical director, has gone to North America for a two-year tour of duty. He will maintain liaison with E.M.I.'s representatives in the U.S.A. and undertake a survey of the American market.

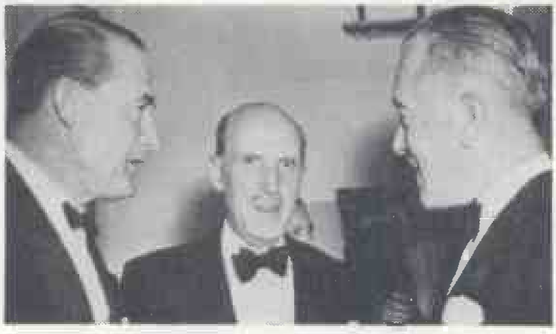
Professor F. C. Williams, O.B.E., D.Sc., D.Phil., F.R.S., of Manchester University, has received the American John Scott award in recognition of his work on the development of I.F.F. (Identification, Friend or Foe) during the war. Dr. Williams, who joined Watson-Watt's radar research team at Bawdsey in 1939, was employed throughout the war on radar circuitry. In 1947 he was appointed professor of electrotechnics at Manchester University, where he is now professor of electrical engineering and has been working on the development of digital computers. He is 49. The John Scott award is made by the City Trust of Philadelphia for "developing inventions for the benefit of mankind."

Professor A. C. B. Lovell, O.B.E., F.R.S., director of the Nuffield Radio Astronomy Laboratory of the University of Manchester at Jodrell Bank, has been awarded one of the two Royal Medals of the Royal Society for 1960, "for his distinguished contributions to radio astronomy."

Dr. D. Gabor, professor of applied electron physics at Imperial College, and **Dr. D. Jones** have been granted £2,000 by the Paul Instrument Fund Committee of the Royal Society for additional equipment for use in connection with the development of an electron interference microscope.

W. E. J. Farvis, B.Sc.(Eng.), M.I.E.E., senior lecturer in applied electricity and head of the post-graduate School of Electronics and Radio at Edinburgh University, has been appointed to the newly established chair of electrical engineering at the university. He has been in the Electrical Engineering Department for the past 12 years, prior to which he was for three years a lecturer at University College, Swansea. During part of the war he was engaged on the development of decimetric radar systems and later headed a radio counter-measures group.

P. L. Stride, formerly manager of Ekco's Malmesbury works, has become manager of the aviation division of Ekco Electronics Ltd., which is now centred at Southend. The division handles the design and technical liaison for ground and airborne equipment for the aviation industry. **P. J. Harvey,** formerly chief electronics engineer, becomes manager of the nucleonics and industrial division which is responsible for research and development covering nucleonic and physical instrumentation and control. **E. B. Thompson** continues handling the commercial activities of both divisions as sales manager.



S. R. Mullard, *M.B.E., recently celebrated his 40th anniversary as a director of the Mullard company. He is seen here with (left) Sir Arthur Vere Harvey, C.B.E., M.P., who has been with the company 25 years and (right) S. S. Eriks, O.B.E., managing director of the company.*

Sir Leslie Gamage has retired from the chairmanship of the General Electric Company and is succeeded by **Arnold Lindley**, who joined the company as an engineering apprentice in 1918. In 1958 he was made an assistant managing director in charge of the company's heavy engineering group, and for the past 18 months has been vice-chairman and a managing director.

E. Green, M.Sc., M.I.E.E., formerly head of the transmitter advanced development group of Marconi's, and for the past six years consultant engineer to the company, has retired. He has been with Marconi's since graduating at Manchester University in 1913. In his early days with the company Mr. Green was engaged in the installation of marine radio equipment and in 1915 he was seconded to the R.N.V.R. and was sent to Hong Kong to assist in the installation and operation of a 25-kW spark set and a Poulsen arc transmitter for the Royal Navy. In the years following World War I, he was assistant to C. S. Franklin during the whole of the development work on the short-wave beam system. His textbook "Amplitude-Frequency Characteristics of Ladder Networks" is a standard source of reference.

E. Green

L. C. Jesty

L. C. Jesty, B.Sc., M.I.E.E., has been appointed manager of Sylvania-Thorn Colour Television Laboratories in succession to **B. C. Fleming-Williams,** B.Sc., A.M.I.E.E., who has resigned. Mr. Jesty joined the Laboratories in 1957, and has been mainly responsible for the research and development programme on colour television and cathode-ray tubes. For seven years prior to joining the Laboratories he was with Marconi's, where he led the television research group and was closely associated with the development of the Anglicized version of the American N.T.S.C. colour system. From 1927 to 1946 he was at the G.E.C. Research Laboratories, and for three years at the Cinema-Television Laboratories. **J. K. Oxenham,** M.A., who has been in charge of the circuit work on colour and closed-circuit television at the Sylvania-Thorn Laboratories, has been appointed deputy manager.

T. E. Greenfield has been appointed sales development manager of the industrial process control division of Gresham Automation Ltd. After war service in the Merchant Navy he joined J. Langham Thompson Ltd. in 1946, and three years later went to the General Electric Co. at Stanmore, where he was concerned with flight instrumentation trials. In 1953 he returned to J. Langham Thompson, and since 1957 he has been with English Electric Aviation Ltd. He was appointed head of quality control for the production of guided weapons at their Stevenage works, and was also test project engineer for the Thunderbird II.

The ***Rietzke Award*** *being received from the donor Eugene Rietzke, founder and president of Capitol Radio and Engineering Institute, of Washington, by Sgt. J. H. O. Willacy "the airman showing the greatest promise in the field of electronics" at the R.A.F. Bomber Command Station at Cottesmore, near Oakham, Rutland. On the left is Air Commodore J. R. Morgan, Command Education Officer, and on the right Group Captain A. D. Mitchell, station commander. Some 70 airmen on the station took the electronics course of C.R.E.I.*

J. D. MacEwan, B.Sc., A.M.I.E.E., A.M.Brit.I.R.E., has been appointed by the B.B.C. engineer-in-charge, television, Birmingham, in succession to **H. G. Whiting,** who recently became Regional Engineer, Midland Region. Mr. MacEwan joined the Operations and Maintenance Department of the B.B.C. in 1947. Since 1956 he has been senior lecturer (technical operations) at the Corporation's Engineering Training Department.

G. W. Short, the first part of whose article on the bootstrap follower is on page 21, was for two years on the editorial staff of our sister journal *Electronic Technology* until 1958, when he joined the B.B.C. He served in Royal Signals from 1944 to 1947. He then went to Oxford University, where he graduated in 1951 and the following year received his M.A. From 1953 to 1956 he was assistant press officer at Mullard's.

Horace Freeman, who, as already announced, retired recently from active business life after spending nearly 40 years in radio and electrical advertising, has been elected an honorary vice-president of the Radio Society of Great Britain. It was appropriate that the certificate was presented to him at the opening of the Radio Hobbies Exhibition in the Royal Horticultural Society's Old Hall, for it was there that he organized the first all-British wireless exhibition in 1922.

B. M. Lee, son of E. M. Lee, director and general manager of Belling & Lee, Ltd., has been appointed manager of the company's industrial group and to the board of executive directors.

OBITUARY

Dr. W. R. G. Baker, vice-president of the General Electric Company of America when he retired in 1958, has died at the age of 67. He joined the company in 1917. Since his retirement he had been vice-president of Syracuse University. Dr. Baker's best-known contribution to the American radio industry is probably the direction of its two National Television System Committees, the first to establish standards for the American monochrome service and the second, appointed in 1950, to set up standards for what is now known as the N.T.S.C. colour system.

News from Industry

Telemeter "Pay-TV."—A new company, British Telemeter Home Viewing, has acquired from International Telemeter Co. the British rights of the "Pay-TV" system developed by its associates, Paramount Pictures Corp. The system, which is being used in a pilot scheme in Toronto, provides for the reception of a television programme specially transmitted by wire or over the air which is un-scrambled by a coin-in-the-slot unit fitted to a standard receiver. The subscribers to the new company include British Lion Films and the Granada Group.

Decca.—E. R. Lewis, the chairman of the Decca Record Company, announced at the extraordinary general meeting on November 10th that the year's results for the group were "by far the best in the company's history." The balance from the trading account was £3,714,547—an increase of some £400,000 on the previous year. The net balance carried forward was £1,821,984, a 28% increase on the previous year.

Plessey's consolidated profit and loss account for the year ended last June shows a trading profit of over £4M. After allowing for taxation and making various deductions the balance carried forward into the current year was £2,240,044 compared with £1,536,042 the previous year.

M.S.S. Recording Company have arranged with E.M.I. to manufacture and distribute the discs and disc cutting apparatus previously undertaken by M.S.S. who are concentrating on the production of their Mastertape and Data Tape.

Non-destructive Testing.—Solus-Schall, Ltd., of County Building, Honeypot Lane, Stanmore, Middx., have produced an information booklet reviewing the site methods of non-destructive testing provided by the company. Copies of the booklet are available free of charge.

The Gramophone Company are developing a combined four-track tape recorder and 45/33 r.p.m. record reproducer in which the tape and record are driven (simultaneously if required) by means of the same motor.

Aero Electronics Ltd., of Gatwick Airport, have been appointed the exclusive export agents and sole distributors to U.K. aircraft manufacturers of the products of Communications (Air) Ltd., of Bagshot, Surrey. Their products include a V.O.R./I.L.S. simulator and airborne V.O.R./I.L.S. equipment.

Beme Telecommunications Ltd., of 24, Upper Brook Street, London, W.1, a member of the Derritron Group of companies, has announced two new marine radio products—a depth indicator and a f.m./a.m. receiver. The transistor depth indicator "Diver 60" has a range of 0 to 360 feet.

Southern Instruments Ltd., who in association with the Drayton Regulator and Instrument Company of West Drayton, some months ago formed Drayton-Southern Ltd. (specializing in instrumentation and control systems), have more recently formed Storno-Southern Ltd. in association with the Danish Storno Radio Co. Storno-Southern is to manufacture in this country under licence v.h.f. communications equipment designed by the Copenhagen company. Another company, Southern Analytical Ltd., has been formed to take over the analytical instrument work of the parent company.

Ocean Weather Ships.—Four transmitters, eight receivers and two direction-finders are being supplied by Marconi's for each of two frigates *Amberley Castle* and *Pevensey Castle* which are being converted for use as ocean weather ships. The company is also modernizing Admiralty ranging and height-finding radar in the vessels. *H.M.S. Amberley Castle* has been renamed *O.W.S. Weather Adviser*.

Raytheon Co., of Waltham, Mass., have supplied two air traffic control radar systems for Switzerland's major air routes. The radars will be connected by microwave links to the Geneva-Cointrin and Zurich-Kloten airports which they will serve. The Geneva installation will be located on the 5,500-foot La Dole, 16 miles away, and the Zurich equipment on a mountain some seven miles away.

Central Electronics Inc., the recently formed wholly-owned French subsidiary of Zenith Radio Corporation, are building a factory in Paris for the production of components and receivers.

J. W. Maunder, U.K. agent for Shure audio components, now has an office at 22 Orchard Street, London, W.1 (Tel.: Hunter 4116).

NEW FACTORIES

Associated Transistors, Ltd., which is jointly operated by A.T.E., English Electric and Ericsson Telephones, has acquired an 18-acre site at Basingstoke, Hants, on which a transistor factory covering about 120,000 sq ft is to be built.

G.E.C.—A mill at Reddish, near Manchester, has been acquired by the G.E.C. Semiconductor Division. It will be known as Broadstone Works and has a working space of 600,000 sq ft. Manufacture of semiconductors is expected to start in the early part of this year.

Nottingham Electronic Valve Co., Ltd., manufacturers of Nev cathode-ray tube pumping equipment, have moved their offices and works from Netherfield to Main Street, East Bridgford, Notts. (Tel.: East Bridgford 276).

Elremco.—An extension to their factory at Bush Fair, Harlow, Essex, has increased the production area of the Electrical Remote Control Co. to 14,000 sq ft.

Marconi's Aeronautical Division is being regrouped in new premises at Basildon, Essex, where the bulk of the company's aeronautical equipment is manufactured.

L. E. Simmonds Ltd., relay manufacturers of 5 Byron Road, Harrow, Middx., have opened a new factory at Thetford, Norfolk. The factory gives an additional 6,000 sq ft to the company's present manufacturing capacity at Harrow, which will remain the headquarters.

Alma Components Ltd., manufacturers of precision wire-wound resistors, have recently opened a new factory in Diss, Norfolk (Tel.: Diss 2288). The London works have been closed but an office is being maintained at the old address: 551 Holloway Road, London, N.19 (Tel.: Archway 0014).

Sifam.—A new factory with a total floor area of 21,000 sq ft and accommodation for 260 employees has been opened in Torquay by Sifam Electrical Instrument Co.

TRANSISTOR INVERTER

By F. BUTLER,
O.B.E., B.Sc., M.I.E.E., M.Brit.I.R.E.

FREQUENCY STABILIZED CIRCUIT SUITABLE FOR RUNNING A TAPE RECORDER

HIGH-POWER transistor inverters commonly use two or a multiple of two transistors in a special type of push-pull oscillator circuit which is designed to give a square-wave output. High-efficiency operation is secured because the transistors alternate between two conditions in each of which the internal energy dissipation is very low. In one condition the transistor is cut off and there is no energy loss. In the other state the transistor is bottomed and although it then carries a large current the voltage drop across it is quite small and the energy loss is again very low.

If a sinusoidal output waveform is required the maximum efficiency is lower and cannot possibly exceed 78.5 per cent. In a practical case the efficiency would be nearer 60 per cent compared with about 85 per cent for the square-wave case.

Frequency Stability of Self-excited Inverters.—Push-pull square-wave oscillators are of two distinct types. In one of these the rectangular waveform results from magnetic saturation effects in the core of the oscillator transformer. High-efficiency

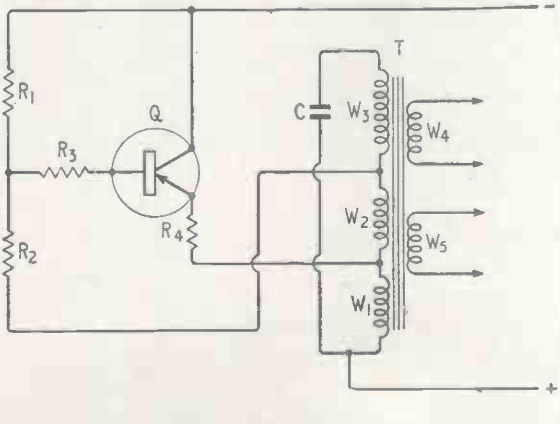


Fig. 1. Driver oscillator circuit for frequency-stabilized inverter.

operation therefore calls for the use of low-loss core materials. Suitable magnetic alloys are expensive but economy in the core size can be achieved by operation at a relatively high frequency, usually between 400 and 1,200 c/s. Within this range of frequencies the sum of all the losses (eddy current, hysteresis, dielectric and copper winding resistance) reaches an acceptable minimum value.

The second type of self-excited square-wave generator also employs a ferro-magnetic core but operates at flux densities which are always below the saturation level. Losses are thus reduced and it becomes possible to make use of conventional core materials. Amplitude limiting of the square-wave output is in this case caused by cut-off or saturation (bottoming) in the transistors. These must be accurately matched if it is important to generate a square-wave output with a mark-to-space ratio of unity.

Oscillators which make use of core-saturation effects generate a frequency which is proportional to the battery supply voltage. A constant output frequency thus calls for a regulated power supply. The output frequency is not markedly dependent on the connected load. A valuable feature is that the circuit is self protecting against overloads.

By contrast, inverters which operate with unsaturated transformers deliver an output frequency which is dependent on the supply voltage and on the connected load. A heavy overload will normally result in the destruction of the transistors.

Constant-frequency Inverters.—When used for d.c. to d.c. conversion there is no particular need to specify precisely the frequency of the oscillator. It is convenient to make this fairly high in order to simplify the output filtering arrangements, and a value in the region of 1000 c/s is entirely suitable.

There are cases in practice where there is no such latitude regarding the choice of output frequency. This is certainly true if the equipment to be operated contains squirrel-cage or synchronous motors which are required to be run at a fixed speed. A tape-recorder capstan drive motor comes into this category and for use in vehicles, in aircraft, or on board ship it must be supplied from a battery-operated constant-frequency a.c. source.

To operate mobile equipment a 28-V d.c. supply is normally available. Experience shows that it is possible to design an inverter for operation from such a supply which will give a continuous output of 100 W at any fixed frequency between 40 and 60 c/s.

In principle, a constant output frequency could be derived by amplifying the output of a low-power oscillator of stable frequency. If a sinusoidal voltage waveform is required with a substantial power output, a practical scheme would be to drive a Class-B amplifier from the oscillator, using intermediate amplifiers as necessary. Such an assembly would be expensive and inefficient. At best, the output stage would have an efficiency of under 70 per cent. The amplifier would have a high output impedance so that the voltage regulation would be extremely poor. This could be corrected by the use of negative feedback which in turn would call for higher gain in the amplifier, requiring at least one extra stage. At the expense of further circuit complication it might be possible to devise some form of automatic gain control to give a constant output voltage.

The situation is much more favourable if a square-wave output is acceptable. It is not considered very good practice to run large a.c. motors under these conditions. Heating is increased by the harmonic currents and the motor may tend to " cog " round at a small fraction of its fundamental synchronous speed. Nevertheless, many low-power motors appear to perform satisfactorily with a square-wave input.

In respect of its output impedance, the square-wave inverter is effectively an electronic switch, periodically reversing the supply battery connections to the primary of the inverter transformer. The output impedance at the transformer secondary terminals includes the secondary winding resistance plus the total primary circuit resistance referred to the secondary side, i.e. multiplied by the square of the transformer turns ratio. It also contains a term sufficient to account for all the other circuit losses. The voltage regulation of an inverter is normally about 20 per cent between no load and full load. During the conduction phase there is also a voltage drop across each transistor of about 0.75 V. Assuming that a 28-V battery supply is used, this is responsible for a further reduction in efficiency of 2.7 per cent.

As regards the design of a constant-frequency oscillator to drive the square-wave amplifier there are two possibilities to be considered, remembering that the output stage calls for a substantial drive power. One is to use a high-power tuned-circuit oscillator and the other is to use a low-power version, say of the Wien bridge type, followed by an intermediate power amplifier. The requirements for high oscillator stability and high output power are incompatible, but the amplifier drive power requirements can be reduced by making this stage regenerative. Sufficient positive feedback may be applied from the output stage to cause incipient self-oscillation and if the regeneration control is adjustable it may be set at such a level that only moderate power demands are made on the stable-frequency driving source. This technique is used in the actual equipment to be described later.

A circuit diagram of the 50 c/s oscillator is shown in Fig. 1. It is of a conventional feedback type, the arrangement being such that the transistor collector terminal may be connected directly to the negative supply lead which is at earth potential. The chassis can thus be employed as a convenient heat sink. The iron-cored transformer T carries five windings. Of these, W_4 and W_5 are the output secondaries used to couple the oscillator stage to the output amplifier. The primary windings W_1, W_2 and W_3 are connected series aiding, the total inductance being such as to resonate with C at a frequency of 50 c/s. A convenient value of C is about 0.5 μF which calls for a very large number of turns on W_3. The windings W_1 and W_2 are calculated to provide the requisite feedback voltage for reliable oscillation and to match the input and output impedance of the power transistor Q. The resistances R_1, R_2 and R_4 set the base bias of Q, while R_3 is sufficiently large to ensure a constant-current drive to the transistor base circuit. The transformer employs a C-core of grain-orientated silicon steel and has a small airgap to avoid magnetic saturation due to the d.c. component of the collector current.

Practical Inverter Circuit.—Fig. 2 shows the complete circuit diagram of a 100-W inverter. A power transistor Q1 associated with the transformer T1 constitutes the master oscillator, operating at 50 c/s. Apart from the specification of the transformer, to be given later, this stage calls for no further comment.

The output transistors Q2 and Q3 feed power to a centre-tapped winding on the transformer T2, each half-primary having N_1 turns. Two additional windings, each with N_2 turns, serve to provide positive feedback to the bases of Q2 and Q3, in phase with the oscillator drive from the secondaries W_4 and W_5 of the transformer T1. The magnitude of the feedback is controllable by the slider settings on the two variable resistors R_5 and R_6. If excessive regeneration is employed the master oscillator may lose control and the output stage will run as a self-

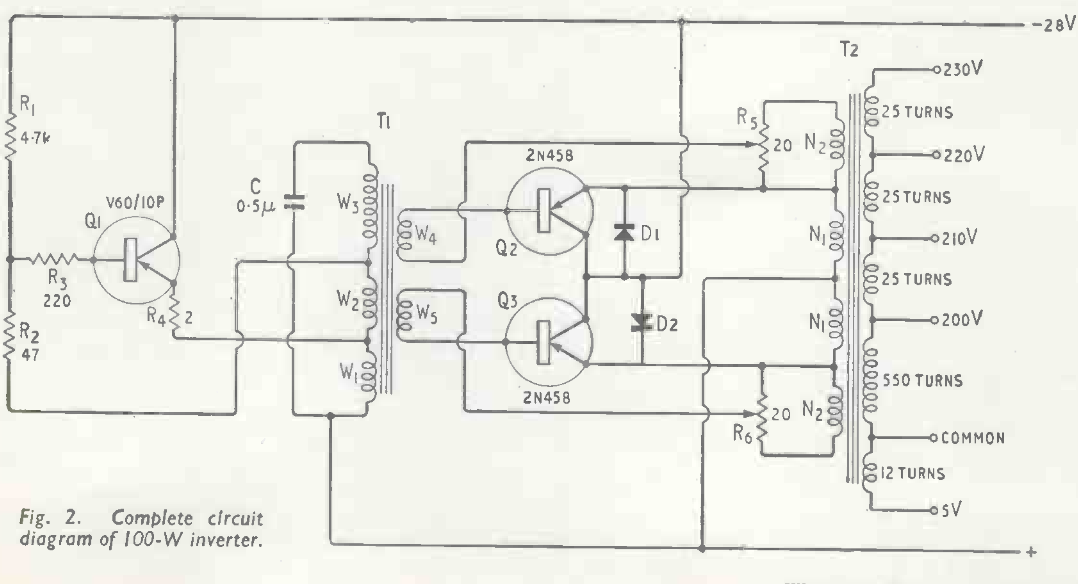


Fig. 2. Complete circuit diagram of 100-W inverter.

excited inverter. This condition must be avoided but a moderate amount of feedback makes the amplifier stage easier to drive. The two resistances also serve another useful purpose in that they can be used to equalize the drive to the output transistors if these have widely-differing characteristics. Heavy-duty wire-wound potentiometers should be chosen for this purpose. Except for R_4 the remaining resistors can be of 1-W rating and 5 per cent tolerance; R_4 should be a 5-W wire-wound component.

The diodes D1 and D2 call for comment. They must be in circuit if the inverter is used to supply a highly inductive load. Under these circumstances the output transistor load line degenerates into a distorted ellipse and there is a reverse flow of current which is in fact carried by the diodes. They are unnecessary if the load is resistive or if power-factor correction is applied. They can be of the germanium or silicon junction type, rated to carry a maximum current of 5 A and with an inverse voltage rating of 100 V.

The transformer specifications are as follows:—

OSCILLATOR TRANSFORMER T_1

Core: Double-C pattern, centre limb 1in × 1in (1 sq in cross-sectional area)
Airgap: 0.031in (1/32-in paxolin spacer)
Windings (all enamel and rayon covered):—

W_1: 160 turns, 22 s.w.g.
W_2: 70 „ 24 „
W_3: 4330 „ 34 „
W_4: 15 „ } 18 „ Bifilar wound
W_5: 15 „ }

OUTPUT TRANSFORMER, T2

Core: Double-C pattern, centre limb 1½in × 1½in (2.25 sq in cross-sectional area)
Airgap: None (butt joint)
Windings (all enamel covered):—

N_1: 56+56 turns, 14 s.w.g. } Bifilar wound
N_2: 8+ 8 „ 16 „ }

Secondary windings as shown in Fig. 2, 22 s.w.g. In both cases the heavy gauge wire is wound on first (nearest to the core).

The two transformers are bolted to a rectangular sole plate of ¼-in thick aluminium which constitutes the heat sink for all three transistors. These are in direct contact with the plate which is connected to the negative terminal of the supply battery. It may be earthed if required. The circuit wiring is straightforward and the layout of components is in no way critical.

Alternative types of transistors suitable for use in the circuit are readily available. They include the following:—

MANUFACTURER	Q1	Q2 and Q3
Ediswan-Mazda	XC142	XC155
	XC155	XC156
G.E.C.	GET 9	GET573
Mullard	OC28	OC28
	OC29	OC29
Newmarket	V60/10P	—
	V60/20P	—
	V60/30P	—
Texas Instruments	2N457	2N457
	2N458	2N458

Operation with Inductive Loads.—The dynamic characteristic of a power amplifier is almost a straight line for a purely resistive load. As previously mentioned it becomes a distorted ellipse if the load is reactive. The normal square-wave output from the inverter can under some circumstances be transformed to that shown in Fig. 3. This waveform was actually observed when the capstan drive motor of a high-grade tape recorder formed the inverter load. The motor called for a nominal input of 70 VA at 230 V and although its operation appeared to be entirely normal an attempt was made to correct the waveform by adjustment of the load power factor. It was found that a shunt capacitance of 1μF removed the effect but introduced some ringing on the leading edge of the square wave. This in turn was eliminated by connecting a resistance of 400Ω in series with the capacitor.

Power Output and Efficiency.—The inverter shown in Fig. 2 is easily capable of delivering 100 W into a resistive load. It can be switched on in the battery circuit with a 100 W lamp as the connected load and will quickly bring the lamp up to full brilliance in spite of the very low initial resistance of the cold filament. At full load the transistors remain cool and are clearly being run well below their rated maximum dissipation.

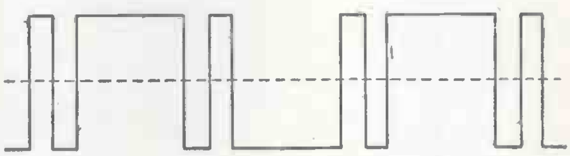


Fig. 3. Inverter output waveform with inductive load.

Measurements show that the unit draws 4.8 A from a 28 V battery when delivering 220 V, 0.46 A. An output of 101 W is thus obtained when the input is 134 W, corresponding to an efficiency of almost exactly 75 per cent. Some caution must be used when making measurements with rectifier-type a.c. meters. These in fact measure mean values but are calibrated to indicate the r.m.s. value of a sinusoidal voltage or current. They read about 10 per cent high when used to measure square waveforms.

The no-load current is 0.4 A at 28 V and the voltage regulation is about 10 per cent between one quarter load and full load output. Load changes have a negligible effect on the generated frequency, while halving the battery supply voltage changes the frequency by about 1 c/s. Finally the unit forms a suitable driver stage for a very-high-power amplifier. Using four Texas Instruments Type 2N 514B transistors in parallel push-pull an output in excess of 1 kW could easily be obtained.

Tape-Recorder Wow and Flutter.—There is no obvious reason why the performance of a recorder in respect of wow and flutter should be worse when the capstan drive motor is supplied from an inverter than when it is run from the mains. Elastic couplings, eccentric capstans and stretched tape are the usual causes of these types of distortion and are common to both cases.

Careful observations have shown that there is still another source of irregularity. This is due to a periodic fluctuation of motor torque which appears to be a function of the number of stator slots or rotor bars. It is sufficient to cause a slight frequency modulation of any recorded tone unless the torque variations are smoothed out by a mechanical low-pass filter.

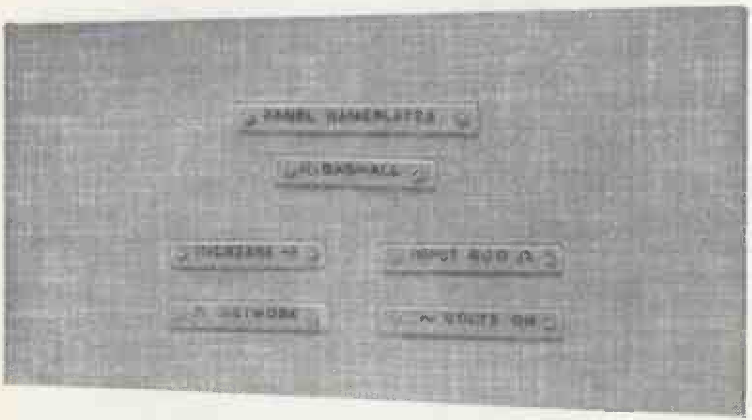
Actual measurements on a particular recorder (E.M.I. Type TR 52) give a total figure of 0.2 per cent wow and flutter from all causes when the machine is operating from the mains. The figure is exactly the same when running from the inverter provided that the battery gives a full 28 V output. When the voltage is reduced to 24 the figure rises to 0.3 per cent.

REFERENCES

1. Pye, T. R. High-Power Transistor D.C. Converters, *Electronic & Radio Engineer*, Vol. 36, March 1959, p. 96.

2. Butler, F. Transistor Inverters and Rectifier-Filter Units, *Electronic Engineering*, Vol. 31, July 1959, p. 412.

3. Wetzel, Klaus. Constant Frequency Inverter, *Radio Mentor*, Vol. 25, December 1959, p. 958 (in German).



Typical nameplates as they appear on plastic-faced hardboard.

A "DO-IT-YOURSELF" METHOD

PANEL NAMEPLATES

By H. DAGNALL, M.A.

THE use of transfers does much to improve the appearance of home-built equipment and helps to give it a professional finish. But, excellent as they are for many purposes, ready-made transfers do not entirely solve the problem of panel lettering for the amateur constructor. He is soon likely to discover that the exact wording required does not exist on any of the sheets available, and he is then forced either to abandon his chosen name for that switch or socket or to make up the word from single letters. If he attempts the latter alternative, the difficulty he has in aligning them will remain for ever distressingly visible—at least in the writer's case it does. Another difficulty likely to be encountered is that transfers cannot be applied to a crackle surface, nor can they easily be curved, compressed or expanded to fit a particular requirement.

The object of this note is to describe a method by which neat panel nameplates can be made in any desired size and wording. Lettering is done with the aid of a "Uno" stencil in black Indian ink on the reverse side of a strip of Perspex. Since the letters are on the back of the strip when it is affixed to the panel they are fully protected from damage and, being in optical contact with the Perspex, they appear intensely black.

Perspex having a thickness of 1/24 in is the most suitable kind to use. It should be cut into strips $\frac{1}{4}$ in wide and about 12 in long.

A jig to hold the Perspex and stencil in alignment while lettering is essential for neat work, but it need be nothing more elaborate than a board about 12 in × 4 in on which are nailed two pieces of hardboard of the same thickness as the Perspex. These should be $\frac{1}{4}$ in apart so that the Perspex strip is a push fit in the gap; if the edges of the hardboard are purposely left rather rough, the strip will be gripped quite securely between them. A rail, parallel to the strip, against which the top edge of the stencil moves, completes the jig and ensures that the letters are aligned along the centre of the strip.

"Uno" stencil UC.$1\frac{1}{2}$ (UF.$1\frac{1}{2}$ for figures) and pen No. O are suitable for the smallest ($\frac{1}{4}$-in) nameplates, but of course other sizes of strip and stencil can be used as required.

Writing on the Perspex is not difficult providing that it has been cleaned with carbon tetrachloride or other degreasing agent and the pen is kept clean to ensure free flow of ink. As the lettering is done on the rear surface of the Perspex the stencil must be reversed and writing done from right to left. To obviate the need for accurate centring of words on the strip, several legends are written on one strip and separated later.

The nameplates are fixed to the panel by means of countersunk 10 BA or 12 BA bolts. The heads of the bolts can afterwards be enamelled to match the panel.

On a light-coloured panel the words show up clearly but on a dark surface they should be backed with a light-coloured paper or paint; this also permits the use of colour coding for distinguishing different channels. Since the nameplates are transparent they are particularly suitable for mounting on light-coloured wood veneers or plastic-faced hardboard.

A circular dial plate can be lettered in a similar manner using a simple jig; circular plates can also be attached with 12 BA bolts to the brass bush of a knob to form a skirt.

Do not be put off because a required symbol does not appear on the stencil, for with a little ingenuity two or more characters or parts of characters can be combined to form the wanted symbol, for example parts of "O" and "L" to produce a neat capital omega symbol.

The Bootstrap Follower

ITS USE IN AUDIO AMPLIFIERS

By G. W. SHORT

THE title of this article might well have been "When Is A Cathode-Follower Not A Cathode-Follower?" However, I have a feeling that the Editor would have found that a wee bit too long. Moreover, using this as an opening gambit enables me to have the best of both worlds, since readers will have guessed that the answer to the question is "When it's a bootstrap follower," whatever that may be.

The object of the exercise is to investigate the behaviour at audio frequencies of the "cathode-follower" circuit of Fig. 1(a). This circuit is arrived at when it is desired to operate a cathode-follower with a cathode resistance much larger than is required for obtaining "cathode bias." A logical way out of the difficulty is then to use a normal-sized cathode-bias resistance in series with the desired high resistance, and to return the grid to the appropriate point, as in Fig. 1(a), so that only the voltage drop across the smaller resistance R_{k1} is operative as grid bias. In many practical circuits C_k is omitted, and the output is taken directly from the cathode.

The difference between this type of circuit and a true cathode-follower (Fig. 5(a)) is apparently trivial. It is merely a question of convenience in biasing, or so I thought for a long time. My first misgivings came when I encountered Jeffery's phase-splitter.[1] In this circuit use is made of the fact that, in the Fig. 1(a) type of circuit, the signal source "sees" not r_g, but a resistance many times greater. Thus the source delivers an increased voltage to the valve, since less is dropped across its internal resistance r_s. If r_s is large, the increase may be substantial. (In Jeffery's circuit, r_s is the anode resistance r_a of a pentode valve, and runs to several megohms.) This "impedance multiplication" effect is one which does not make itself very obvious in a true cathode-follower, where all it does is to reduce the input capacitance a little, without altering the input resistance.

It came as something of a surprise to have it pointed out years later, by "Cathode Ray,"[2] that the Fig. 1(a) circuit differs from a true cathode-follower in another important respect; it has less negative feedback. This is because the proportion of the output voltage which is fed back negatively to the grid is reduced by the source resistance r_s, because r_s and R_g act as a potential divider. The amount actually fed back; i.e., the amount developed between grid and cathode, is therefore $R_g/(R_g+r_s)$ times the actual output voltage. Thus the fraction fed back approaches unity as r_s approaches zero,

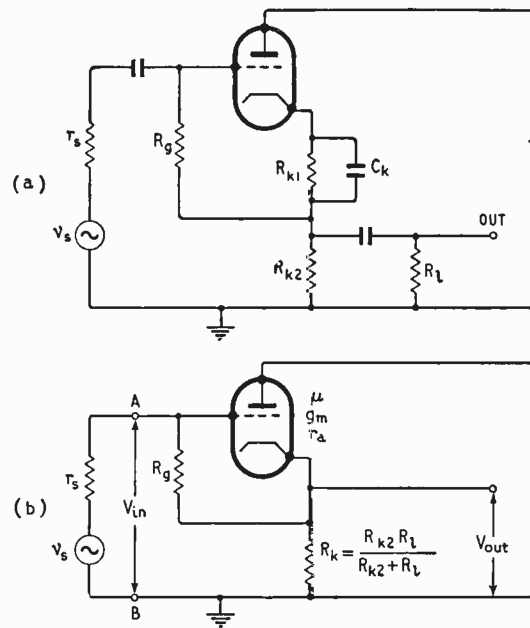


Fig. 1 (a) "Cathode-follower" circuit. (b) An a.c. equivalent circuit.

and it approaches zero as the signal-source resistance becomes infinite.

One thing which puzzled me at the time was this: if the feedback fraction is reduced, then the *gain* of the triode ought to be increased. Yet nobody seemed to have got out more voltage than he put in. Odd. But there are so many more interesting things to do than get out pen and paper and analyse circuits. Easier things, too, as far as I'm concerned. It wasn't until the circuit appeared again recently in *Wireless World*[3] that I finally got around to it, and discovered that, unlike the true cathode-follower which it so closely resembles, this circuit has an input impedance which depends on the load impedance, and an output impedance which depends on the signal-source impedance. The gain, oddly enough, is the same as that of a cathode-follower proper, though this depends on how it is defined.

For the purposes of analysis, Fig. 1(a) can be simplified to Fig. 1(b) which shows only those parts which are relevant to an a.c. signal. R_k is now the effective value of R_{k2} and the external load R_l in parallel.

Input Resistance.—This is the resistance "seen"

[1] "Push-Pull Phase-Splitter," by E. Jeffery, *Wireless World*, August 1947, p. 274.

[2] "Cathode Followers, With Particular Reference to Grid Bias Arrangements," by "Cathode Ray," *Wireless World*, June 1955, p. 292.

[3] "Economical High-Gain A.F. Amplification," by A. R. Bailey, *Wireless World*, January 1960, p. 25.

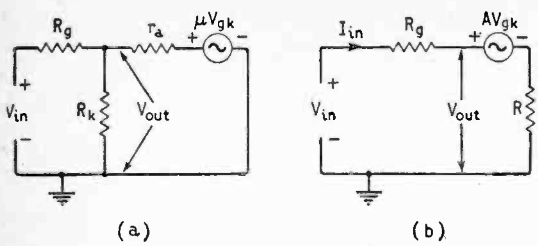


Fig. 2. Equivalent circuits of Fig. (1); (a) with normal equivalent valve circuit, (b) with valve and load combined.

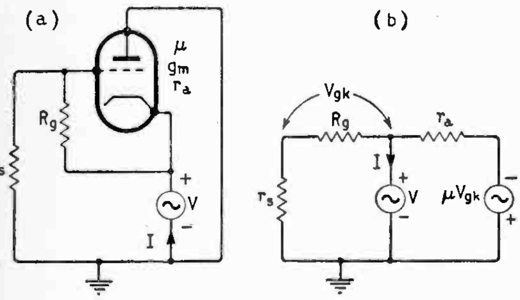


Fig. 3 (a) Circuit for calculating output impedance. (b) Equivalent circuit.

by the signal source. It is the resistance measured between points A and B with the source disconnected. If a voltage V_{in} is applied between A and B, a current will flow in R_g. The voltage drop across R_g is the true input to the valve; i.e., the voltage between grid and cathode (V_{gk}). The voltage across R_k is the output, and is AV_{gk}, where $A = \mu R_k/(r_a + R_k)$. The situation is shown in the equivalent circuit of Fig. 2(a). It is simpler, instead of analysing this circuit as it stands, to convert it into the straightforward series circuit of Fig. 2(b) by using the Thévenin equivalent for the valve and its load. This is a generator with an open-circuit output AV_{gk} and an internal resistance $R = R_k . r_a/(R_k + r_a)$. The current supplied by V_{in} is

$$I_{in} = (V_{in} - AV_{gk})/(R_g + R)$$

where $V_{gk} = I_{in}R_g$. These expressions yield $V_{in}/I_{in} = R_{in} = R + R_g(A + 1)$. The term $(A + 1)$ represents the impedance multiplication effect. The grid-cathode resistance appears to the source to be much larger than the actual physical value.

Gain.—It is clear from Fig. 1(b) that the voltage across R_k cannot exceed V_{in}. If it did, current would flow into the source instead of out of it. Thus V_{out} can approach V_{in}, but not exceed it, and the maximum possible value for the gain is 1, as in a normal cathode-follower. Here V_{in} is regarded as the input voltage. If v_s is considered to be the input voltage, then the gain is smaller and falls to zero as r_s becomes infinite.

From Fig 2(b),

$$\begin{aligned} V_{out} &= AV_{gk} \\ &= AI_{in}R_g \\ &= AV_{in}R_g/[R + R_g(1 + A)] \\ V_{out}/V_{in} &= AR_g/[R + R_g(1 + A)] = A' \end{aligned}$$

In most practical circuits, R is 100kΩ or less, and $R_g(1 + A)$ is 10MΩ or more, so that $A' \approx A/(1 + A)$, which is the same as the "gain" of a cathode-follower.

Output Resistance.—This is the resistance seen by the load R_k in Fig. 1(b). To compute it we replace R_k by a generator of e.m.f. V, and let V_s be zero. The situation is then as shown in Fig. 3. Only that part of V which is developed across R_g acts as an input voltage (V_{gk}) to the valve.

We have,

$$I = (V + \mu V_{gk})/r_a + V/(R_g + r_s)$$
$$\text{and } (V_{gk} = VR_g/(R_g + r_s)$$

The second term in the first equation merely represents a current through R_g and r_s which would flow even if the valve were not there. If we ignore it, we obtain,

$$r_{out} = \frac{V}{I} = \frac{r_a}{1 + \dfrac{\mu R_g}{R_g + r_s}}$$

When r is zero; i.e., when the amplifier is driven from a constant-voltage source, the expression for r_{out} reduces to $r_a/(1 + \mu)$, which is exactly what one would expect from a cathode-follower. But

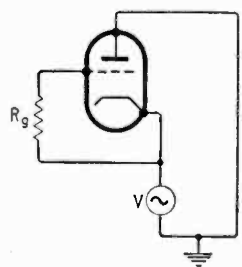


Fig. 4. When r_s is infinite, it can be removed without altering the output impedance.

when r_s is infinite; i.e., when the amplifier is driven from a constant-current source, $r_{out} = r_a$, which is what would be seen by the load if the circuit were a straightforward amplifier with no feedback. This is what it is, under these conditions, as far as output resistance is concerned. We have made r infinite, which means that it can be removed without altering the output resistance. The circuit then becomes that of Fig. 4. Here, V is applied directly between anode and cathode, and there is no input between grid and cathode, so that the resistance seen by V is r_a.

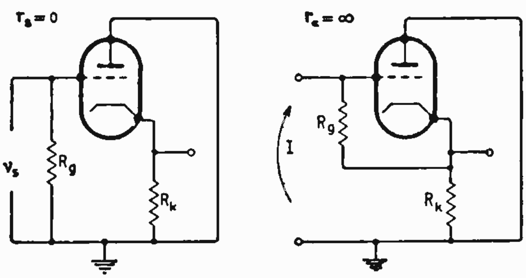
At this point it is instructive to see what sort of values one gets in practice. Using a valve such as the ECC81 (12AT7) one might choose working conditions such that $\mu = 60$, $r_a = 17$kΩ, $A = 34$, $R_k = 22$kΩ, $R_g = 1$MΩ, $r_s = 100$kΩ. With these values, the input resistance is 35MΩ, and the output resistance is about 300Ω (compared with 275Ω for a true cathode-follower using the same valve). So for most practical purposes the circuit can be regarded as an ordinary cathode-follower. In some circumstances, it may be positively useful to increase the output impedance; for example, one might want to match a line impedance. On the other hand, there is no difficulty in raising the output resistance of a true cathode-follower: all one needs to do is to connect a suitable resistor in series with the live output terminal.

Hybrid Circuit.—The foregoing analysis shows

(*Continued on page 23*)

that the behaviour of the circuit is conditioned largely by the impedances to which its input and output terminals are connected. The impedance of the source of input voltage is usually the most important, since it governs the output impedance. When $r_g = 0$, the circuit becomes a true cathode-follower (shown in idealized form in Fig. 5(a)). This has a gain of $A/(A + 1)$ where A is the gain without feedback, in other words the gain defined as V_{out}/V_{gk}. The output resistance of the valve is then low, being $r_a/(\mu + 1) \approx 1/g_m$. (In practical circuits, the output is usually shunted by something, so that the net output resistance is less than this.)

When r_g is infinite; i.e., when the triode is driven from a constant-current source, the valve presents the usual non-feedback output resistance r_a. Under these conditions the circuit becomes as shown in Fig. 5 (b); it has no feedback, and the input voltage is IR_g. This voltage is developed directly between grid and cathode, as in an ordinary triode amplifier. The difference is that the output is taken from the cathode, the anode being earthy. Now, a triode amplifier with a floating input voltage and cathode output is a bootstrap amplifier, and this is what our circuit becomes under these conditions.



(a) (b)

Fig. 5 (a) True cathode-follower. (b) "Bootstrap follower" with current drive. This has the same characteristics as a bootstrap amplifier with voltage drive.

Practical signal sources have neither zero nor infinite resistance, so the circuit behaves in practice like a hybrid between a cathode-follower and a bootstrap amplifier. It seems logical to call it a bootstrap follower. No originality is claimed for this title: it is so obvious that somebody must have used it before now.

In a slightly modified form (Fig. 6) this circuit forms part of the phase-splitter described in this journal by Jeffery[1]. Advantage is taken of the impedance multiplication effect to present the pentode with a high effective load, thereby increasing its gain to an appreciable fraction of the pentode μ, instead of the miserable fragment of it which is all one usually gets. The great advantage of making use of impedance multiplication is that the anode load resistor can have the usual sort of resistance and the pentode can be operated with the usual anode current (say 1mA) yet a large gain can still be obtained. Moreover, because the pentode is operating under normal conditions, as opposed to "starvation" conditions, it can deliver a large output voltage. For example, one might have an effective anode load of 3MΩ, even though the actual load resistance is only 100kΩ. With an anode current of 1mA, the voltage drop across the load is only 100V. With a high tension voltage of 250V, the remaining 150V is available for the valve, which might well deliver a peak voltage of something approaching 100V before "bottoming" begins: this is more than the triode could handle. The gain of the pentode might be 1,000 or more.

While one might get a high gain by operating the pentode under starvation conditions with a physical anode load resistance of a few megohms, it is unlikely that the gain would be as high or that the available output voltage would be as large as the values obtained using the bootstrap follower.

These facts have led to the use of a *single-ended* combination of a pentode and a bootstrap follower as a means of obtaining high overall gain from a pentode and a triode. An equivalent circuit for this combination, neglecting direct voltages, is given in Fig. 7. This is the same as Fig. 1 (b), except that r_g is now the anode resistance of the pentode (r_{ap}) and v_g is $\mu_p V$, where μ_p is the pentode μ, which may be several thousand.

The maximum gain of the combination cannot exceed the pentode amplification factor. This is much less than the maximum possib.. gain of the

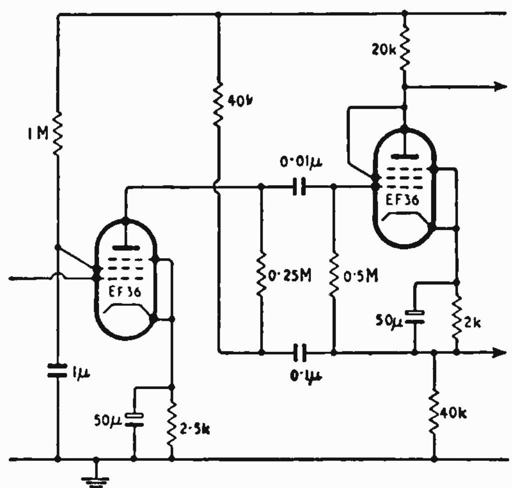
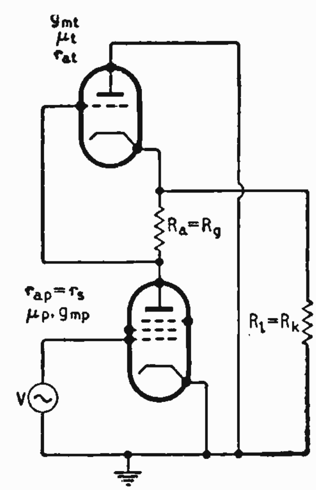


Fig. 6. Jeffery's phase splitter.

Fig. 7. Single-ended pentode—b.f. triode combination. Simplified circuit neglecting direct voltages.



two valves in cascade, which is the product of the two amplification factors. In practice, however, a cascaded circuit would have an overall gain much less than this product. All the same, the cascade amplifier might be expected to produce more gain than the bootstrap follower with pentode drive.

However, one requires gain over a band of frequencies, and to compare the two circuits on this basis it is useful to calculate the products of gain and bandwidth. This is done in the Appendix. In terms of the stray capacitances of Fig. 8, the ratio of the gain-bandwidth product of the cascade amplifier to that of the pentode-bootstrap follower combination is:

$$\frac{GB_1}{GB_2} = \left[\frac{(c_{s1} + c_{ga})(A_2 + 1) + c_{gk}}{c_{ga}(A_1 + 1) + c_{s1} + c_{gk}}\right]\left(\frac{A_1}{A_2}\right)$$

where A1 is the gain of the triode in the cascade circuit and A2 is the gain (V_{out}/V_{gk}) in the bootstrap follower circuit. In the numerator, the stray capacitance c_{s13} which contains the output capacitance of the pentode in Fig. 8, is multiplied by (A2 + 1), but it is not multiplied by anything in the denominator. In practice, c_{s1} usually exceeds c_{ga}, so the effect of this difference can be very large.

The effect of c_{s1} in the cascade circuit is to add to c_{gk}. This is comparatively harmless, since the important capacitance is the Miller capacitance $c_{ga}(A_1 + 1)$. But in the bootstrap follower amplifier, cs_1 adds to c_{ga}, and the result is disastrous. In the bootstrap follower amplifier, the impedance seen by the preceding stage is the normal sort of triode input impedance, including the part due to Miller effect, multiplied by $(A_2 + 1)$. The effect of adding c_{s1} to c_{ga} is the same as would be the effect of adding it in the cascade circuit, only in the cascade circuit it is not added.

Before leaving the subject of gain and bandwidth, it should be mentioned that, with the cascade circuit, one has the opportunity of putting the triode in the first stage and the pentode in the second. With some values of signal-source impedance and load capacitance this might produce a marked improvement. In the bootstrap follower combination there is no point in putting the triode in the first stage since its amplification cannot exceed about 100 even with the best high-μ valves. We shall continue to consider circuits in which the pentode is always in the first stage, partly to preserve a sound basis for comparison, and partly because the best audio pentodes are rather better than the best triodes in regard to hum. In a high-gain amplifier it would be logical to use a pentode such as the EF86 in the first stage.

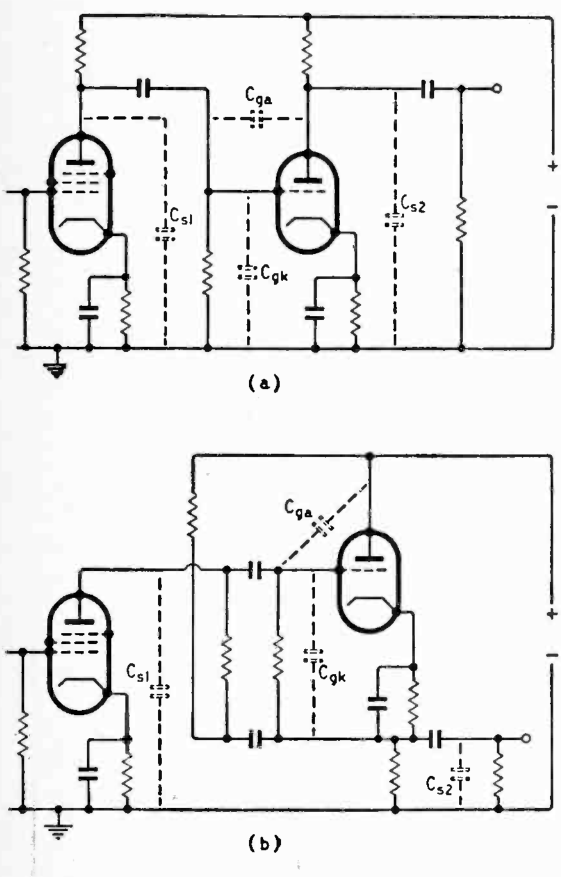


Fig. 8 (a) Cascade amplifier and (b) bootstrap follower combination showing stray capacitances

Appendix

Gain-Bandwidth Products

To find these, we calculate the pentode gain and bandwidth for each circuit and multiply their product by the triode gain. (The effect of the triode bandwidth is discussed in the article). To find the pentode gain, we need to know the load resistance and capacitance. In the cascade amplifier, the load resistance is just R_a in parallel with the triode grid resistance R_g. The load capacitance, however, contains a portion due to Miller effect. This portion is here taken to be $c_{ga}(A + 1)$, where c_{ga} is the inter-electrode capacitance (grid-anode) of the triode, plus any stray capacitance between grid and anode. This is not strictly correct, because the Miller capacitance is not a pure capacitance. A small resistance appears in series with it, but at audio frequencies, with c_{ga} of a few pF, this resistance is negligible, and for all practical purposes the Miller capacitance is a pure capacitance. Similarly, in computing the anode load of the pentode when the triode is a bootstrap follower, a resistance which appears in series with $R_g(A + 1)$ is neglected. (See under "Input Resistance"). Again, this is justified in practical circuits, where $R_g(A + 1)$ is nearly always much larger.

By neglecting these unimportant resistances, we get the equivalent circuits shown in Fig. A, which have the advantage of being readily comparable. In each case, the pentode is shown by the current generator g_mV and the anode resistance r_a. The circuits are simple parallel RC circuits. The pentode gain is g_mR, where R is the net resistance, and the bandwidth is $1/2\pi RC$, where C is the total capacitance.

R and C are different for the two circuits. If we call the values in the cascade circuit R_c and C_c, and the values in the bootstrap follower amplifier R_b and C_b, we have for the pentode in the cascade circuit, a gain-bandwidth product

$$g_m R_c \times 1/2\pi R_c C_c = g_m/2\pi C_c$$

The overall gain-bandwidth product is A_1 times this, where A_1 is the triode gain in the cascade circuit,

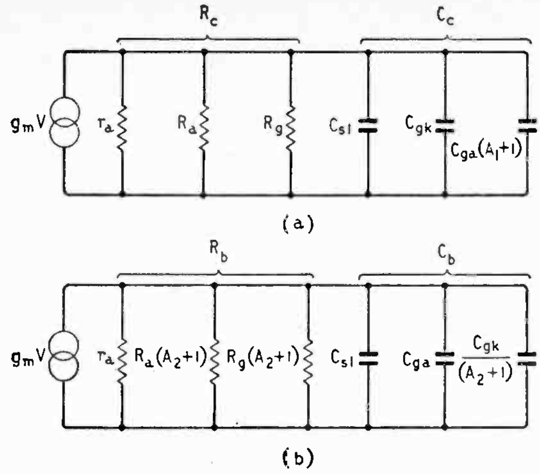


Fig. A (a) Pentode operating conditions in the cascade amplifier. (b) Pentode operating conditions in the bootstrap follower combination.

so we can put, for the cascade amplifier, $GB_1 = A_1 g_m / 2\pi C_c$

For the pentode in the bootstrap follower amplifier, the gain is $g_m R_b$ and the bandwidth is $1/2\pi R_b C_b$. The gain-bandwidth product for the pentode is thus $g_m/2\pi C_b$. To obtain the overall gain-bandwidth product for the bootstrap follower amplifier, this must be multiplied, not by A_2, the gain V_{out}/V_{gk} of the bootstrap follower triode, but by $A_2/(A_2 + 1)$. This is because the output of the pentode is applied between the grid of the triode and " earth," like V_{in} in Fig. 1(b). The " gain " of the triode is then $A_2/(A_2 + 1)$, as shown in the article. So the overall gain-bandwidth product for the bootstrap follower amplifier can be written

$$GB_2 = \frac{g_m}{2\pi C_b} \times \frac{A_2}{A_2 + 1} = \frac{(A_2)\, g_m}{2\pi C_b (A_2 + 1)}$$

The ratio of the gain-bandwidths is

$$\frac{GB_1}{GB_2} = \frac{A_1 g_m}{2\pi C_c} \times \frac{2\pi C_b (A_2 + 1)}{A_2 g_m} = \frac{C_b A_1 (A_2 + 1)}{C_c (A_2)}$$

If $A_1 = A_2 = A$, this approximates to

$$\frac{AC_b}{C_c} = \frac{A(c_{s1} + c_{ga}) + c_{gk}}{Ac_{ga} + c_{s1} + c_{gk}}$$

In practical circuits, c_{s1} is the largest of the strays, so the cascade amplifier is much superior. However, A_1 is not likely to be the same as A_2. For greater precision, we must write the full formula,

$$\frac{GB_1}{GB_2} = \frac{A_1(A_2 + 1)\left[c_{s1} + c_{ga} + \frac{c_{gk}}{A_2 + 1}\right]}{A_2\left[c_{s1} + c_{gk} + c_{ga}(A_1 + 1)\right]}$$

$$= \frac{(c_{s1} + c_{ga})(A_2 + 1) + c_{gk}}{c_{ga}(A_1 + 1) + c_{s1} + c_{gk}} \times \frac{A_1}{A_2}$$

To get an idea of what this means in practice, we substitute the following typical values:
$c_{s1} = 10\text{pF}$, $c_{ga} = 2\text{pF}$, $c_{gk} = 5\text{pF}$, $A_1 = 30$, $A_2 = 25$
This produces a ratio of just under 5. For equal bandwidths, the gain of the bootstrap follower, amplifier is nearly 14 dB below that of the cascade amplifier.

(*To be concluded*)

Electronic Pointer Generator

ALTHOUGH a conventional lecture pointer can usually be used with large-scale diagrams for illustrating television talks, there are often occasions when this is impracticable, for example, in describing surgical operations or in microscopy. To meet these and other requirements, Pye, Ltd., have developed an electronic pointer generator by means of which an arrow can be superimposed on the picture and moved to any desired point by a remote-control "joystick," which carries a push-button for switching on or off. An auxiliary switch reverses the direction of the pointer.

The "joystick" movement is resolved into settings of horizontal and vertical potentiometers which provide d.c. shifts for the arrow blanking pulses in the line and field periods. The arrow formation is generated by mixing sawtooth waveforms in diode coincidence circuits and can be adjusted in size. It is made more clearly visible by filling with black and white vertical striations which are generated by bursts from a triggered Hartley oscillator.

The equipment is designed to operate on 405-, 525- or 625-line systems and is available for rack mounting (Type 2443) or in portable form (Type 2444).

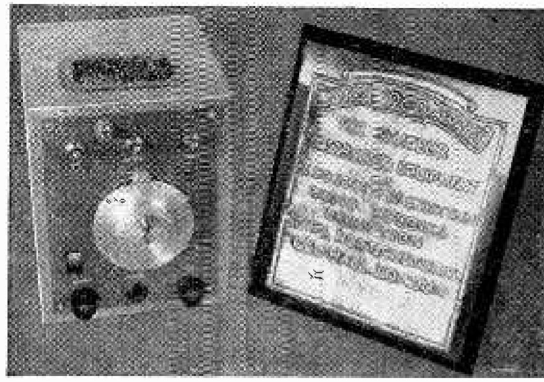
"Permeability Tuners for Television"—a correction

In the formula for the conditions for balance (right-hand col., p. 476 of the October 1960 issue) it is regretted that a term was omitted from the denominator of the left-hand expression. The equation should read:—

$$\frac{C_{gk} C_c}{C_c C_d + C_g C_d + C_g C_c + C_{gk} C_c + C_{gk} C_d} = \frac{C_{ak}}{C_{out} + C_{ak}}$$

RADIO HOBBIES EXHIBITION

AMATEUR TRANSMISSION, "HI-FI" AND MUSIC-MAKING ON SHOW



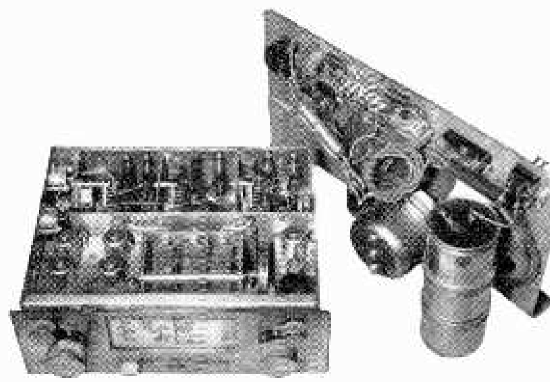
E. St. B. Sydenham's silver plaque winning wavemeter.

IN the competition organized by the R.S.G.B. for home-constructed apparatus a heterodyne wavemeter, made by E. St. B. Sydenham, G3LOK, was the Silver Plaque winner. R. H. Hammans' (G2IG) transistor communications receiver, covering 1 to 30Mc/s with a.m., s.s.b. and c.w. facilities, was judged the best entry from the outside-London area: this set is only 4½in by 6in by 5½in. The best club entry was from Aquila Radio Club, who submitted a six-band transistor car receiver covering 1.8 to 30Mc/s, made by C. J. Salvage, G3HRO. This receiver is split into two units, as is fairly common practice, with the output stage on the loudspeaker panel. The receiver proper has three i.f. stages, an r.f. stage, and b.f.o. for c.w. reception. The band switch on the front panel takes the form of a sliding control and this is coupled to a rotary switch at the rear of the set by a mechanical linkage.

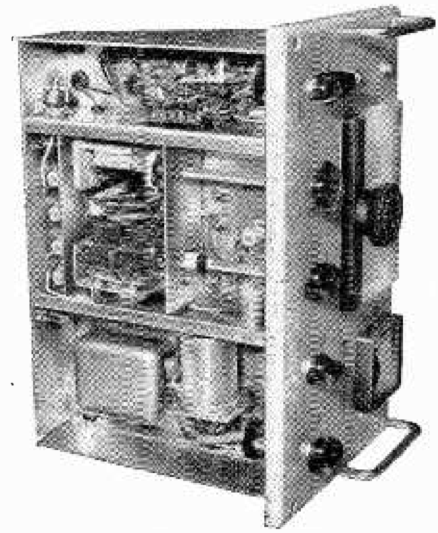
The interest shown by R.S.G.B. members in mobile operation extends to the motor cycle—exemplified by s.s.b. equipment shown by V. Page, G3IVP—and even the humble "push-bike": R. G. Scutt's (G3IBI) 2-metre bicycle transmitter-receiver does not depend on foot power, but uses a miniature 24-V accumulator.

Another exhibit by E. St. B. Sydenham showed how members of the Royal Amateur Emergency Reserve may be alerted automatically. A super-regenerative 2-metre receiver fitted with an r.f. stage to eliminate the characteristic radiation, covers, due to its wide bandwidth, the whole 144Mc/s band. The output from this feeds, through a tuned a.f. amplifier, a pendulum relay. This relay will respond only when fed with pulses at its resonant frequency, and these pulses must be composed of a.f. to which the amplifier responds. Thus only a transmission satisfying these requirements broadcast at any frequency in the 144Mc/s band will energize the pendulum and ring the alarm bell. In the event of a mains failure, the receiver is automatically switched to battery operation.

Five companies producing equipment for the amateur were seen in the "commercial" section for the first time. Electroniques (Felixstowe) (who also produce temperature-compensated tuning coils and coil packs) were showing a complete "top-band" (160m) transmitter called the "Pathfinder." This uses germanium

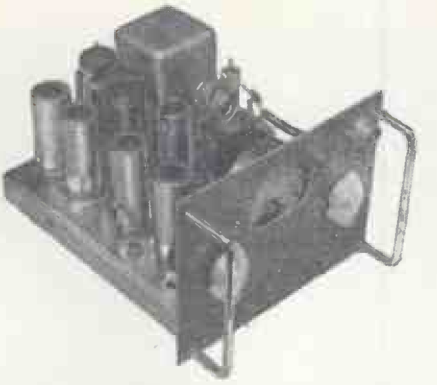


Aquila Radio Club entry—transistor mobile communications receiver made by G3HRO. Band selection is achieved by the rotary switch at the rear, operated by the slide-bar below the dial.

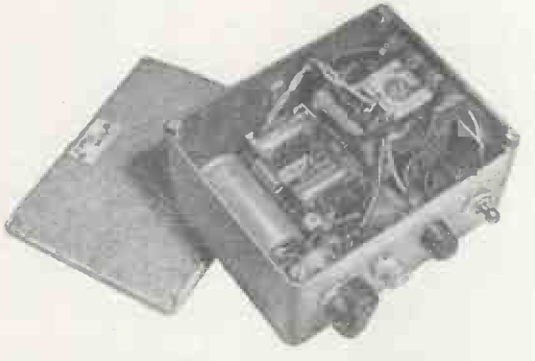


Underside of "Pathfinder" 160m transmitter by Electroniques (Felixstowe). Four-stage TV interference filter is adjustable and is seen in back compartment of centre row.

K. W. Electronics "One Sixty" top-band transmitter.



TW2 10-watt 144Mc/s transmitter by Withers.



Interior of "Tiger Talking Box" transistor modulator-drive amplifier.

diodes as a speech clipper, which enables a high level of modulation to be achieved without danger of over-modulation. A four-stage low-pass output filter (to prevent television interference) is fitted in a screened compartment and the aerial current is monitored permanently by a plug-in thermocouple feeding the front-panel meter. Another new "top-band" transmitter on show was the K.W. "One-Sixty," which uses multiplication from the v.f.o. frequency of about 900kc/s. Like the "Pathfinder" this transmitter is complete in a small case, and can run at over the 10 watts input permitted. K.W. Electronics (who incidentally are importing Hammarlund receivers) won the award for commercial equipment this year, with their Viceroy s.s.b. exciter unit. Another new exhibitor was Tiger Radio, who were showing a very wide range of equipment. Items that particularly caught our eye were a 750W p.e.p. linear r.f. amplifier for 10 to 80 metres and the "Tiger Talking Box." The tetrode output stage (QY3-65) of the amplifier has its screen grid supplied from a cathode follower whose control grid is normally at chassis potential. When drive is applied a diode rectifies it providing a positive potential for the cathode-follower grid, consequently lifting the screen potential of the QY3-65 and allowing it to amplify. Complete absence of p.a. anode current (and output) is thus assured until drive is applied. Power supplies for the unit are derived by a chain of silicon rectifiers, whose good regulation is an advantage, and a bias control allows operation in any condition between Classes AB1 and C.

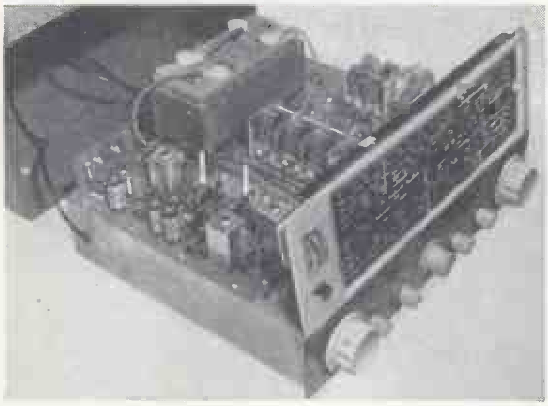
The "Tiger Talking Box" is a small transistor a.f. amplifier which derives its power supply from the 6.3V heater line. It is designed to be used as a microphone stand and it is capable of driving fully a pair of KT88 or 807 valves as the final stage of the modulation amplifier. The sensitivity is 10mV at an impedance of 750kΩ and the 150-V grid-to-grid output is achieved by two OC74s feeding two transformers.

Equipment made for the amateur for use in the 144Mc/s band is a comparative rarity; but this is a speciality of Withers Electronics. This company were showing for the first time a 10-watt transmitter, receiver converter and aerial, all suitable for mobile or fixed-station working. The TW2 transmitter is crystal controlled, tripling and doubling from 24Mc/s, whilst a clamp valve operates on the QQV03-10 output stage. The aerial is a $\lambda/2$ dipole, bent into a circle to reduce the directional characteristics and fed with a γ-match section which allows an 80-Ω feeder to be used although the basic aerial impedance has been changed by the "rolling up" process.

Another unusual form of aerial—called the "birdcage"—was shown by Minimitter: this is designed to act as a directional high-gain aerial for 14Mc/s. Its mode of operation can best be visualized by considering two V-dipoles, stacked, with reverse-V reflectors behind them. Little loss of performance of a dipole is incurred by bending away at right-angles to the main axis half of each of the "rods." The lower dipole and reflector have their ends "bent" upwards to meet and join, as the stacked arrays are $\lambda/4$ apart vertically, the ends of the upper array so forming the coupling between the two arrays. A gain of 10dB is claimed for the "birdcage" which, Minimitter point out, is roughly equivalent to a five-element Yagi with a boom length of nearly 60ft. The "diameter" of the birdcage aerial is under 20ft.

Sound Vision Services—the fourth of the newcomers—were showing telescopic masts embodying an ingenious principle. The lowest extending section is raised by winding up on a ratchet barrel a wire rope joined to its base and passing over a pulley at the top of the fixed section; but the upper sections have the guy-wires attached to their bases in a similar manner. Thus having made fast the guys, winding up the lowest extending section raises the upper sections. For non-telescopic rotating masts a rotating guy-ring using nylon bearing inserts which do not need greasing should eliminate the necessity for climbing the mast which always seems to be necessary during the worst blizzard of the winter.

James Scott, importers of Hallicrafters receivers, have added Dow-Key accessories to their range. Items on



Heathkit "Mohican" transistor communications receiver using ceramic i.f. transformers (arrowed).

show included a.c.-energized coaxial relays for aerial switching and automatic TR switches which operate by allowing the transmitter output to build up a high bias on the grid of a valve connected as an amplifier in the aerial lead to the receiver. On "receive," the bias decays, allowing the valve to give a slight gain.

Judging by the R.S.G.B. exhibits, transistors have made an enormous impact on the amateur during the last two or three years, particularly for use in receivers; but this year sees the first introduction of a commercial communications receiver using them. The Heathkit "Mohican" was certainly the centre of attraction among the kits on Daystrom's stand: this set covers 550kc/s to 32Mc/s in five bands, using OC171s for r.f., mixer and local oscillator stages. The 455kc/s i.f. is amplified by three type OC45, and to achieve a bandwidth of 3kc/s piezoelectric ceramic i.f. "transformers" are used. Two of these are of ring and dot construction and approximate to double-tuned transformers, whilst two more behave as single-tuned "acceptor" circuits in the emitter leads of the second and third i.f. stages. Control of the b.f.o. is exercised by a voltage-variable capacitance diode and the whole receiver with its 400-mW output stage takes only 35mA from the 12-V battery—much less than the dial lamps, for which a separate switch is provided!

Minimitter were showing a transistor converter covering the amateur bands up to 14Mc/s. This has an i.f. of 600kc/s, to feed into an ordinary receiver and the consumption is 1mA (one) from the internal 4.5-V battery.

Not all the exhibition was devoted to amateur radio—high fidelity enthusiasts would have found something to interest them from say, Jason, Heathkit or Aveley, who were showing American Dynakit designs and new output and mains transformers using toroidal windings. For mains transformers this offers the valuable advantage that the hum field is greatly reduced.

For those who want to make their own music the British Recording Club were demonstrating "electronic music" with the aid of a tape reproducer, and showing some of the equipment used. For instance, a ring modulator can be used to produce the very thing that most of us spend time getting rid of—intermodulation—which has many musical possibilities, or another undesirable—valve noise—can be turned into a "new sound" by passing it through filters.

Finally, for those who want to make the means of making music, Jennings, our fifth newcomer, were showing a basic electric guitar kit. This consists of guitar body parts, strings, etc., and a magnetic pickup unit placed under the strings, which are of steel. Thus an output is produced when a string is plucked and, after passing through a volume and a "top-cut" control (which, as it is connected in an inductive circuit, has a greater variety of effect than is usual) mounted on the instrument this can be fed into an amplifier. Jennings claim that the output is comparatively high and, as most modern radio receivers are fairly sensitive, the gramophone amplifier section of a radio-gram or radio can be used.

NEW DATA RECORDING EQUIPMENT

UNUSUAL TAPE TRANSPORT MECHANISM

A NOVEL design of magnetic-tape transport mechanism is a feature of new digital data recording equipment manufactured by the Computer Department of Redifon Limited. This mechanism moves the tape past the recording and reading heads in small separate steps, instead of continuously as in conventional systems. The new mechanism permits controlled variations to be made independently in the speed of recording and read-out data: controlled variations can also be made in the time delay produced by the passage of data from the recording to the reading heads.

The tape (35mm wide) accommodates up to sixteen recording tracks side by side. The drive system operates in such a way that the tape is quickly started, advanced at a uniform speed during most of the step, and then quickly stopped. The interval of uniform forward motion in each step is made to coincide with a recording or read-out period.

To get the variation in tape transit time between the recording and read-out heads two sprocket drive wheels are used; one wheel is near the recording heads and the other near the read-out heads. If both sprocket wheels drive the tape at the same speed, then the length of tape between the wheels remains the same, and the time delay between the two heads is constant. If, however, the "read-out" sprocket wheel is made to move at a different speed from the "recording" sprocket wheel, then the length of tape between the two wheels alters, and the time delay between the recording and read-out heads varies accordingly. For driving the two sprocket wheels at independent speeds two separate stepping motors are used. These are energized by pulses from variable-frequency pulse generators—the recording or read-out rate varying according to the pulse repetition frequency.

A great advantage of this type of data recording system is that, since the tape velocity is fast during each step, cumbersome high-frequency carrier or flux-sensitive head recording techniques can be avoided, and simple saturation recording by d.c. pulses is effective.

RING AERIALS

By H. PAGE*, M.Sc., M.I.E.E.

INSTALLATION AT MOTALA LONG-WAVE BROADCASTING STATION

IT is unusual nowadays to read of major developments in long-wave broadcasting, and this makes the recently published description of the station under construction at Motala, Sweden[1], all the more interesting.

The station works on a wavelength of 1,571m (191kc/s), and at present the transmitter power of 150kW is radiated from a single relatively low aerial; this arrangement is similar to the B.B.C. long-wave station at Droitwich. The useful range of such a station may be limited by interference (either man-made or from stations working on nearby channels), by fading, or both. Interference can be minimized by increasing the transmitter power, and it is proposed to increase the power of Motala fourfold, i.e., to 600kW. However, this by itself would not be worth while unless at the same time the aerial is made "anti-fading," i.e., unless the upwards radiation towards the ionosphere is reduced. The usual way of achieving this on medium wavelengths is to use a mast between 0.5 and 0.6 wavelength high, but this is impracticable for long-wave broadcasting—the mast would have to be about 3,000ft high. However, substantially the same performance can be achieved by using, instead of a single tall mast radiator, a number of low aerials in the form of one or more concentric rings, and the interest of the Motala project centres round the decision to use a system of this kind.

Let us consider first a ring containing an infinite number of aerials; from considerations of symmetry we can see that two arrangements will give uniform radiation in all horizontal directions—the usual requirement for a broadcasting station. The aerials may be driven with equal co-phased currents (in-phase ring), or with the currents of the same amplitude but with the phase progressing uniformly round the ring, the total phase shift being an integral multiple of 2π radians (progressive-phase ring).

In order to achieve anti-fading characteristics the in-phase ring must be associated with a central aerial,

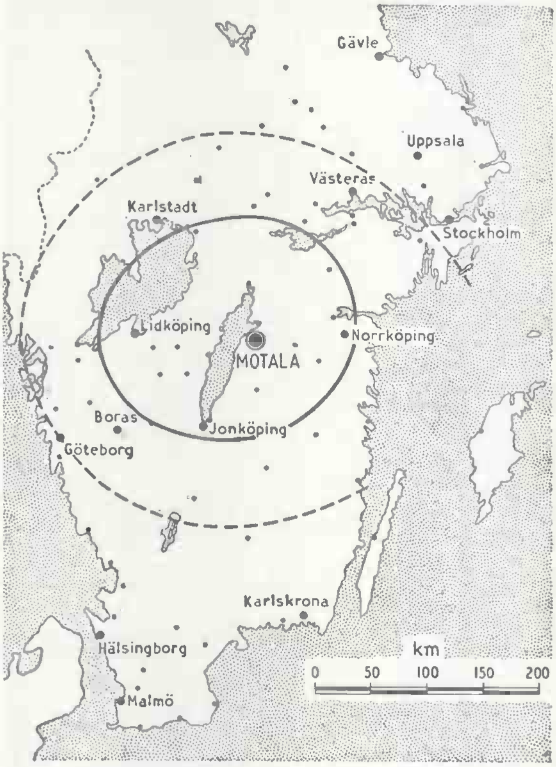


Fig. 2. Fading limits of the old (solid line) aerial system at Motala together with estimated limits of the new ring aerial. This map is reproduced from Magnusson and Stranden's article in the E.B.U. Review.

carrying a current opposite in phase to that of the ring (the central aerial can be regarded as a ring of zero radius). By changing the ratio of the current in the central aerial to that in the ring, the radiation at any specified angle to the vertical can be reduced to zero; in other words, we can achieve a vertical radiation pattern which is very like that for a single aerial of the optimum height. The progressive-phase ring does not require a central aerial, but the vertical radiation pattern is similar to that for a half-wavelength aerial, so that the anti-fading characteristics are less favourable than for the in-phase ring.

The above discussion has been in terms of a ring containing an infinite number of aerials. The effect of using a finite number is to introduce serrations in the horizontal radiation pattern, and a sufficient number of ring aerials must be used to reduce these serrations to an acceptable value. For the in-phase ring it is advantageous to use an odd number.[2]

The Motala ring aerial, shown schematically in Fig. 1, will employ a central mast 820ft high,

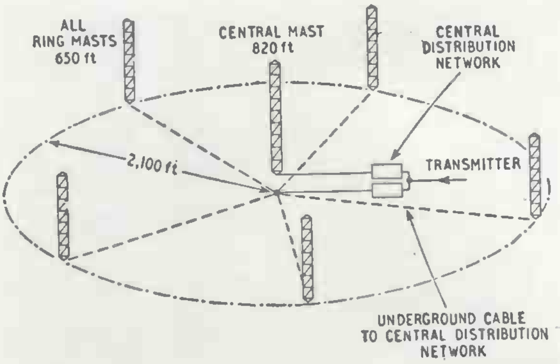


Fig. 1. Schematic diagram of the Motala ring aerial system.

* B.B.C. Research Department.

and an in-phase ring comprising five masts, 650ft high, fed by underground cables from a central point. The ring radius will be 2,100ft and the earth system will occupy an area of 725 acres. For a system adjusted to give zero radiation at an angle of 45° to the vertical (i.e., having a vertical radiation pattern similar to that for a single mast 0.59 wavelength high) the current in each mast is expected to be approximately 200A and the voltage at the base to be approximately 30kV r.m.s. The initial complication of a ring aerial is therefore very high in respect of the number of masts, the area of the site required, and the equipment for energizing aerials. It is, however, the only practicable way of achieving a worth-while increase in the coverage of long wavelengths. The estimated fading limit for the new Motala station, shown in Fig. 2, is almost double that of the present installation.

The use of ring aerials to achieve anti-fading characteristics is by no means new. An in-phase ring was first used (but only experimentally) in Germany in 1931.[3] In 1939 the B.B.C. also tested an in-phase ring aerial on a wavelength of 342m at Brookman's Park; here the object was to increase the range of the Regional medium-wave service without infringing a severe Air Ministry restriction on the height of masts permitted at this station. However, when this restriction was lifted after the Second World War the B.B.C.'s aim was achieved more economically in the case of this medium wavelength station by erecting a single high mast, which is still in service.

The progressive-phase ring aerial was first proposed in 1936.[4] One was put into service in 1939 at Allouis, France, working on a wavelength of 1,648m, and designed for a power of 900kW.[5] The station was destroyed during the Second World War and the aerial system was not rebuilt in ring form.

Although much thought has been given over the past thirty years to the application of ring aerials to long- and medium-wave broadcasting, as far as the author is aware the Motala station, when completed, will be the only such system in service. Broadcasting engineers will await with interest to hear how the performance of the station compares with the expectations of the designers.

REFERENCES

[1] Magnusson, E., and Stranden, F: "Planning the New Motala Long-Wave Broadcasting Station," *E.B.U. Review*, Part A—Technical, No. 61, June, 1960, p. 107.

[2] Page, H.: "Ring-Aerial Systems — Minimum Number of Radiators Required," *Wireless Engineer* (now *Electronic Technology*), October, 1948, p. 308.

[3] Harbich, H., and Hahnemann, W.: "Vorläufiger Bericht über Versuche zur Bekämpfung der Schwundererscheinungen im Rundfunk mit Antennengebilden Üblicher Höhe (λ/4) and Grosserer Horizontalausdehnung," *Elektrotechnische Zeitschrift*, 17th December, 1931, p. 1545.

[4] Chireix, H.: "Antennes à Rayonnement zénithal réduit," *L'Onde Electrique*, July, 1936, p. 440.

[5] Adem, M.: "Le Nouveau Poste National de la Radiodiffusion Française à Allouis (Cher)," *Le Génie Civil*, 11th November, 1939.

BOOKS RECEIVED

Television Antenna Handbook by Jack Darr. Practical handbook for the service technician covering the principles, choice and installation of all types of television aerials (v.h.f. and u.h.f.). Profusely illustrated by examples of American commercial practice and including a chapter on roof techniques and safety precautions. Pp. 248; Figs. 260. Howard W. Sams & Co., Inc., 2201 East 46th Street, Indianapolis, Indiana, U.S.A. Price $3.95, U.S.A. Obtainable in U.K. through R. S. R. Hutchison, 60 Arno Vale Road, Woodthorpe, Nottingham.

Antennes voor FM, KG en TV by Ing. H. J. A. Smit and A. J. Dirksen. Practical handbook (in Dutch) of design and installation of f.m., short-wave and television aerials systems. Calculation of element length and spacing, impedance matching; mechanical problems of aerial erection, and a chapter on communal aerial systems. Pp. 191; Figs. 239. De Muiderkring N.V., Bussum, Netherlands. Price Fl. 5,90.

Electronische Muziekinstrumenten by H. Meijer Jr. and W. Heggie. Circuits in theory and practice, with descriptions (in Dutch) of the electrical and mechanical details of some representative designs. Pp. 168; Figs. 153. De Muiderkring N.V., Bussum, Netherlands. Price Fl. 7,50.

Grundzüge der Electroakustik by F. A. Fischer, Dr. Phil. Second edition, revised and enlarged, of an authoritative treatise on the theoretical foundations of electroacoustics. Provides a succinct mathematical treatment of transducers both as emitters and receivers of acoustic energy. Pp. 210; Figs. 141. Fachverlag Schiele & Schön, Markgrafenstrasse 11, Berlin, S.W. 61. Price, DM 24.

Handbuch des Rundfunk-und Fernseh-Grosshandels 1960/61. Illustrated guide with specifications and prices of current West German radio and television receivers, car radios, record players and tape recorders. Pp. 315, Verlag für Radio-Foto-Kinotechnik G.m.b.H., Berlin-Borsigwalde. Price DM 4,80.

Glossary of Terms Used in Telecommunications (including Radio) and Electronics. British Standard 204: 1960. Third revision of this standard, including the five supplements to the previous edition. Based on current usage, but with guidance in the choice of preferred terms. Covers general electrical terms, telecommunication components and circuits, radio terminal equipment, propagation and media, classification of radio waves and transmissions services, e.g., telegraphy, telephony, broadcasting, radar and navigational aids, and inductive co-ordination (design of systems to minimize interference from power supplies). Pp. 351. British Standards Institution, 2, Park Street, London, W.1. Price 35s.

Radio Engineering Formulæ and Calculations by W. E. Pannett, A.M.I.E.E. Collection of useful formulæ covering a wide field in radio transmission and reception, and dealing with problems in the every-day practice of design, installation and operation of radio stations. Pp. 200; Figs. 165. George Newnes, Ltd., Southampton Street, London, W.C.2. Price 17s 6d.

The Story of the Ionosphere by J. A. Harrison, M.A., M.Ed., Ph.D. Elementary exposition of radio propagation from Hertz to the first artificial satellite with sidelights on the development of radio technique, radar and radio-astronomy. Pp. 103; Figs. 123. Hulton Educational Publications, Ltd., 161/166, Fleet Street, London, E.C.2. Price 10s 6d.

TRANSISTOR NOISE

By "CATHODE RAY"

EVERYTHING must have a beginning, and incredible though it may seem there are people for whom this will be their very first *Wireless World*. They must be warned that in order to avoid vain repetition such as the heathen use I am assuming readers' knowledge of my remarks—or their equivalent (if any)—on valve noise in the last issue, and indeed of those on k in the issue before that. It being unrealistic to suppose that such knowledge will return instantly and fully to the minds of even those who read the said remarks, I will recapitulate.

Quite apart from any man-made interference, all amplification is limited by random (or "white") noise caused by electricity and matter not being continuous but made of particles. That is why very weak signals are heard against a background of escaping gas, or seen on a background of animated graininess. There are two main sources of such noise. One of them is the continuous agitation of electrons in matter, caused by heat. (You may say it *is* a form of heat.) The constant that connects the electrical noise power with the absolute temperature is the k mentioned above, equal to 1.38×10^{-23} joules per degree. The maximum noise power of this self-generated kind that can come from any bit of circuit is

$$kTB \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where T is the absolute temperature (beginning at $-273°$C) and B is the frequency bandwidth in cycles per second. In practice this power usually yields a few microvolts, and the only source of it worth bothering about is the input circuit of the amplifier. The maximum electrical power of any kind always results when a source works into a resistance equal to its own (say R), and from that it follows that the equivalent noise e.m.f. E_N is given by

$$E_N{}^2 = 4RkTB \quad \ldots \quad \ldots \quad (2)$$

That is Johnson or circuit noise.

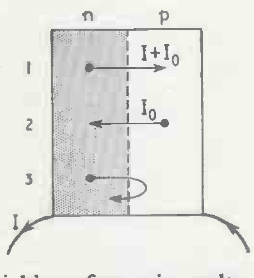


Fig. 1 Diagram of a p-n junction, showing the movements of typical electrons. Internal arrows show directions of electrons; external arrows, positive direction of current.

The other main kind is shot noise, caused where electrons stream from one electrode to another under the influence of an electric field, as in a valve. The individual electrons do not follow one another at exactly equal intervals of time, but randomly, and it is the resulting irregularities that constitute shot noise. The basic equation is

$$I_N{}^2 = 2eIB \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where I_N is the noise current, e is the charge on an electron, and I is the total current.

In any valve as normally used, the anode current I is not limited by the temperature of the cathode but by the crowd of electrons hanging about just outside it (the space charge) and these have a considerable smoothing effect on the noise, reducing it to perhaps only a tenth of the amount given by the above equation. On the other hand, whenever the current divides up—say between an anode and a screen grid—a further random element is introduced which is not smoothed. This contribution, which in a pentode usually exceeds the former kind of shot noise, is called partition noise.

Now we are about ready to start on transistors. But to prevent disappointment I had better make clear that transistor theory is almost always more complicated than valve theory, and the noise aspect is no exception. In fact, until fairly recently I wouldn't have presumed to expound it at all. A paper by an (perhaps *the*) outstanding authority on the subject, van der Ziel, published in 1955,[1] had a most discouraging appearance. But, as so often mercifully happens, theory which at first looks beyond the reach of any but Nobel prizewinners is eventually found to be capable of being explained to school children. By 1958,[2] van der Ziel (with a collaborator, Becking) had been having second thoughts to such good effect that they produced what has been described as a more rigorous proof in about half the number of pages, and in spite of that condensation most of it is intelligible even to me. What follows is based on it.

The original transistors, of the point-contact variety, were excessively noisy, and their workings mysterious withal, so it is fortunate that they soon retired in favour of junction types, which are the only ones to be considered now. A feature of the treatment by van der Ziel and Becking that particularly appealed to me was the type of diagram shown here as Fig. 1, in which the various possible ways in which particles could move were considered in turn. This diagram, which applies to junction diodes, shows electrons only, and divides them into three classes. Most of the free electrons in the diode crystal are those belonging to atoms of the "donor" impurity put there to make one end of the crystal n type. These diffuse around, and of those that cross the frontier into the p-type zone some of them—the majority, if the p end if positive or forward-biased—are gone for good. They form Class 1. Others, in their aimless wanderings, find themselves back again in the n zone; they are Class 3. There are also a few electrons liberated by heat throughout the crystal, regardless of the type of impurity present. Those in the n zone need not be separately considered, because all that cross the frontier can be

[1] *Proc. I.R.E.*, Nov. 1955, p. 1639.
[2] *Proc. I.R.E.*, March 1958, p. 589.

included in Classes 1 or 3. Those in the p zone that cross over to n form Class 2.

Note that this classification is the same whatever external e.m.f. may be applied, but of course the numbers of electrons in the three classes are greatly affected thereby. The external current is denoted by I. If I_o stands for the reverse current due to Class 2 (remember, electrons being negative move oppositely to the conventional direction of current) Class 1 must add up to $I+I_o$. Class 3, unable to make up its own mind, obviously adds nothing to the external current.

The "emission" of electrons in Classes 1 and 2 from their zones, and their journeys to the opposite zones, are analogous to the crossing of electrons from cathode to anode in a thermionic diode—except for the absence of space charge, which is one respect at least in which semiconductor electronics is simpler than valves. (The electron charges are neutralized by the equal positive charges of their parent atoms.) So the shot-effect formula in its simpler form without space-charge smoothing (eq. 3) applies:

$$i_1^2 = 2e\,(I+I_o)B \qquad (4)$$

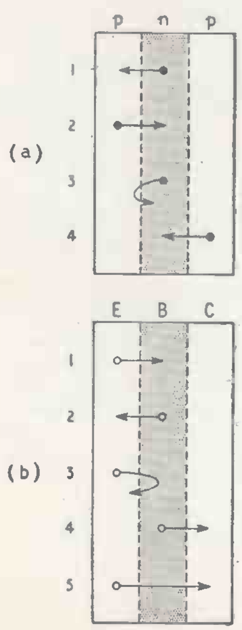
$$\text{and } i_2^2 = 2e\,I_o\,B \qquad (5)$$

where i_1 and i_2 are the r.m.s. noise currents due to all the electrons in Classes 1 and 2 respectively. These formulae are for current-squared, partly because they are simpler that way, and partly because random noise powers (proportional to current-squared or voltage-squared) can be added together simply, whereas currents and voltages can't—if one wants a correct answer.

The movements of Class 3 are random, due entirely to thermal agitation, and so their contribution to noise is given by an adaptation of eq. 2. That was in terms of voltage, but "Ohm's law" enables us to adapt it:

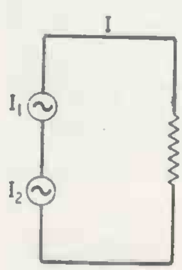
$$i_3^2 = \frac{E_N^2}{R^2} = \frac{4kTB}{R} = 4kTGB$$

where G is the appropriate conductance. The



(Left): Fig. 2 A transistor consists of two diodes back-to-back, and here are shown the typical movements of (a) electrons and (b) holes.

(Below): Fig. 3 Given I_1 and I_2, what is the total, I ?



question of what is appropriate here is a little tricky. It turns out that G is equal to $G_a - e(I+I_o)/kT$, where G_a is the conductance of the junction to a.c. So

$$i_3^2 = 4kT\left(G_a - \frac{e(I+I_o)}{kT}\right)B \qquad (6)$$

The total noise-current-squared (say i^2) is $i_1^2+i_2^2+i_3^2$ and substituting their values from (4), (5) and (6) we get

$$i^2 = i_1^2+i_2^2+i_3^2 = 2e\,(I+I_o)\,B + 2eI_oB + 4kTG_aB - 4e(I+I_o)B = 4kTG_aB - 2eIB \qquad (7)$$

I_o very conveniently disappears, leaving us with i^2 in terms of the external current I.

This calculation may seem a bit dodgy in places, but it is confirmed by practical measurements, which is a comfort.

So far our currents have been composed exclusively of electrons. In an actual junction diode each class of electrons has its counterpart in a class of holes moving in the opposite direction. The current I includes both, and I don't think it would have occurred to me to doubt that the noise currents are in the same proportion therein as they are in the electron currents just calculated. But just to make sure, van der Ziel gives formal proofs that what holds for holes alone does also for electrons alone and for both combined.

Skipping that, we pass on to transistor triodes. Unlike a triode valve, a transistor consists of a pair of diodes back to back. So it can be tackled as an extension of what we have just done. Fig. 2(a) shows how the electrons move in a p-n-p transistor. The first three classes correspond to those in Fig. 1, with the base as the n zone and the emitter as the p. One might expect the same three to be duplicated in the base-collector junction. But, unlike the base-emitter junction, under working conditions it is always biased in the "reverse" direction, preventing electrons from flowing towards the collector. So Classes 1 and 3 are absent.

Fig. 2(b) shows hole movement. The first four classes are the same as for electrons in reverse, but there is one extra class which is in fact the most important of all, comprising the holes that pass right through and on into the external circuit.

If equation (1) is true for diodes in general it should be true of the two transistor diodes in particular. Let us apply it first to the emitter diode, in which the current and conductance can be called I_e and G_e respectively to distinguish them, and of course i_e is the corresponding noise current. Substituting these in (7) we get

$$i_e^2 = 4kTG_eB - 2eI_eB \qquad (8)$$

The formula for the collector diode is the same except for c instead of e, but we can save ourselves the trouble of writing the first term, because we have already decided that the collector diode is reverse-biased and so its conductance is negligible. And because I_c in this case flows from n to p instead of p to n (which we have taken as the positive direction without actually saying so) it is negative. So

$$i_c^2 = 2eI_cB \qquad (9)$$

The noise current i_e can be regarded as coming from a current generator in parallel with the input junction of a noise-free transistor, and i_c as coming in parallel with the output junction. But that is not quite all.

In Fig. 3, I_1 and I_2 are currents from two a.c.

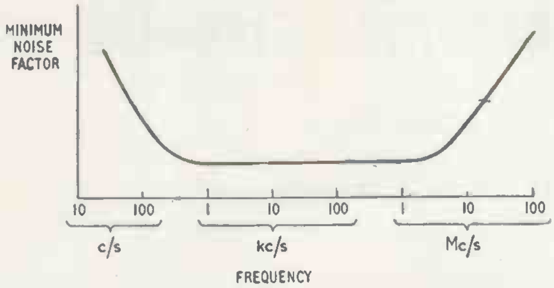


Fig. 4 Typical noise/frequency characteristic for a transistor.

generators working simultaneously. How much is the total current, I? The answer is that it depends on whether the two generators are synchronous or not. If not, then the rule we have been following is correct: $I^2 = I_1^2 + I_2^2$. But if they have the same frequency, then $I^2 = (I_1 + I_2)^2$. For example, if I_1 happened to be equal to $-I_2$, I would clearly be 0. But if they were unequal in frequency, or random, then it wouldn't even be possible to say $I_1 = -I_2$, because there couldn't be a constant 180° phase difference between them.

The second method of addition applies even when the currents have no definite frequency—as with noise currents—so long as they are synchronous. This is so with the straight-through current of Class 5, but as that is not the whole current the total result is somewhere between the two extremes. In technical language, the noise currents i_e and i_c are *partially correlated.* Note that the difference between $i_e^2 + i_c^2$ and $(i_e + i_c)^2$ is $2i_e i_c$. We might think that even a partially correlated current would therefore be larger than a totally uncorrelated one, but in this case the correlated parts of i_e and i_c have opposite signs, so the total noise is reduced by the correlation. Because i_5 is the main current, correlation is nearly complete, at least at low frequencies.

To calculate the total noise, one has to fit the noise generators given by eqs. 8 and 9 into a transistor equivalent circuit, and, since one is very much interested in how it depends on frequency, this equivalent circuit should include capacitors and anything else that may be necessary to simulate high-frequency effects in the transistor. The calculations then become no easy task. They have been performed—and, what's more, checked with measurements on actual transistors—by J. M. Stewart.[3] The badness of noise is best expressed as noise factor or figure, which is a measure of the extent to which it affects weak signals and so limits effective amplification. Stewart used a common-base circuit for his analysis, but found that the noise factor was essentially the same for the other two configurations. He circumvented another complication—that the noise factor depends on the external impedances connected to the transistor—by assuming that they would be adjusted to give the lowest and therefore best noise factor.

An interesting point is that the forking of emitter current into collector current and base current causes partition noise, analogous to that in multi-electrode valves; but because the base current is usually a very small fraction of emitter current the effect is relatively small.

[3] *Proc. I.E.E.*, Part B Supplement No. 17, May 1959, p. 1056.

A more serious thing is that there is also Johnson noise due to the resistances of the various parts. The most important is that due to what is usually denoted by $r_{bb'}$—the resistance between the base terminal and the active part of the base.

Such calculations reveal a frequency characteristic in which noise is flat or " white " over a wide middle range, but slopes upward at each end somewhat as in Fig. 4. Why?

At the low-frequency end the additional noise is more or less inversely proportional to frequency, so it is often called $1/f$ noise. Like the rather similar " flicker " noise in valves, it seems to lack a comprehensive explanation, but for our purpose it may be sufficient to note that it has been traced to surface leakage and similar imperfections of manufacture. While at one time it seriously affected the a.f. band, it has been pushed progressively down towards the sub-audio frequencies. Even those strange types who work among such things as servo-mechanisms and bio-electricity, to whom 20 c/s is an ultra-high frequency, are helped by this, because the lower the frequency at which the $1/f$ noise starts the less there is of it at any given frequency.

At the other end the rise is due chiefly to the various effects that cause transistor performance in general to fall off. Even " white " noise sources, if inserted in networks that include capacitors, give a net output that varies with frequency, Correlation becomes less, for one thing. It must be remembered that noise factor is worsened by anything that reduces signals more than noise. Against this gloomy thought there is the information that over the valuable middle frequencies the noise factor for junction transistors can be lower even than that for valves. But don't assume that this is necessarily so with the transistors you buy!

Brit.I.R.E. Premiums

THE first recipients of the newly established Associated-Rediffusion premium of the British Institution of Radio Engineers are K. G. Freeman (Mullard) and D. C. Brothers (B.B.C.) who share the £50 prize. Their papers " A Gating Circuit for Single-gun Colour Television Tubes " (Freeman) and " The Testing and Operation of 4½-in Image Orthicon Tubes " (Brothers) were read at the Institution's 1959 Convention.

The Heinrich Hertz premium (20 gn.) goes to P. B. Helsdon (Marconi's) for his Convention paper " Transistors in Video Equipment." K. Burrows, of Imperial College, receives the new A. F. Bulgin premium (15 gn.) for his paper " A Rocket Borne Magnetometer."

Four co-authors who are with the National Research Council of Canada receive the Brabazon award (15 gn.) for " A Low-drain Distress Beacon for a Crash Position Indicator." T. C. R. S. Fowler, of Bristol Aircraft, is awarded the Leslie McMichael premium (10 gn.) for " A Six-channel High-Frequency Telemetry System."

The new Charles Babbage award for an outstanding paper on electronic aspects of computers (15 gn.) is shared by Dr. T. B. Tomlinson (Southern Instruments) whose paper was " Switching Circuits Using Bi-directional Non-linear Impedances " and Dr. M. Prutton (I.C.T.) for " Ferro-electrics and Computer Storage."

I. J. P. James' paper " A Vidicon Camera for Industrial Colour Television " has been awarded the 10 gn. Marconi award. He is with E.M.I.

All three recipients of the graduateship examination prizes are from overseas—C. S, Sujan (India), O. Smikt (Israel) and W. W. Cridland (Canada).

Elements of Electronic Circuits

21.—Differentiation and Integration

By J. M. PETERS, B.Sc. (Eng.), A.M.I.E.E., A.M.Brit.I.R.E.

EARLY sections in this series have illustrated how a simple series C-R combination can " differentiate " or " integrate " a rectangular input waveform with an accuracy depending on the relation between time constant employed and the length of the waveform. These circuits, with the aid of feedback amplifier, can be used to produce waveforms approximately proportional to the derivative or the integral of the input waveform. If certain precautions are taken it is possible for high accuracies to be achieved.

Most of the commonly-used methods are based on the fact that

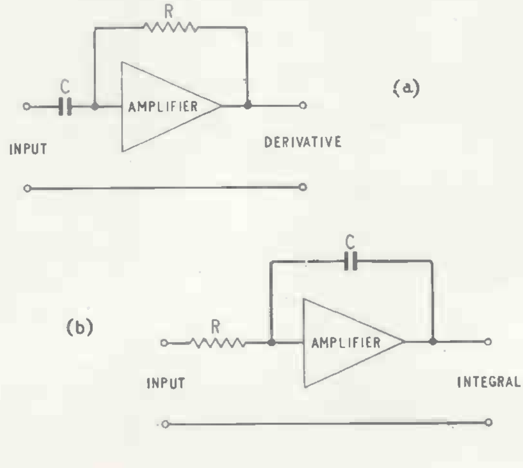
$$v_c = \int i_c \, dt \quad \text{or} \quad i_c = dv_c/dt$$

where v_c is the voltage developed across the capacitor and i_c is the current taken by it.

L-R differentiating networks may also be encountered but the resistance of the inductor introduces errors. However, in some applications these errors can be tolerated.

Figs. 1 (a) and (b) illustrate an improvement on the simple C-R circuit for differentiating and integrating respectively. It can be shown mathematically that if the gain of the amplifier without feedback (A) is constant; then the time constant of the differentiating circuit of Fig. 1(a) is effectively divided by (A+1). This is accomplished without the corresponding decrease in amplitude of the output (which would have occurred in the ordinary way with the simple C-R circuit). The gain of the amplifier compensates for this and an improvement in accuracy of waveforms due to the decreased time constant results. A similar treatment for the integrating circuit of Fig. 1 (b) leads to the result that the use of the feedback amplifier effectively multiplies the time constant by the factor (A+1), resulting again in a more accurate integrated waveform.

To compensate for stray capacitances which introduce time delays in the feedback loops of differentiators, and leakage resistance and dielectric absorption in the integrating capacitor of integrators, it is usual to introduce compensating circuits. Fig. 2 shows an integrating circuit of the Miller type (see description of the Miller time base in No. 14, June 1960) followed by a compensating amplifier. The object of this amplifier is to provide a current which is always equal and opposite to the leakage current through the integrating capacitor and the variable resistor is set so that balance of charge and discharge is achieved. One of the aims in both feedback differentiating and integrating circuits is to keep the voltage variations at the first grid to a minimum. The closer one can get to this ideal the nearer will the output be to either the derivative or the integral of the input. A high loop gain is essential and several stages of amplification are often used to achieve this.



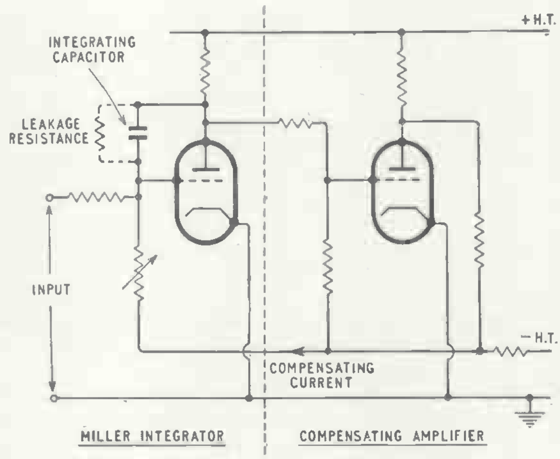


Fig. 2

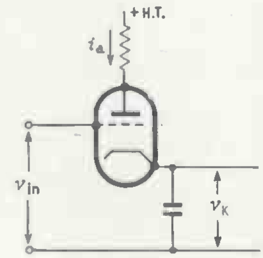


Fig. 3

Mention must be made of current, as opposed to voltage, feedback for differentiation or integration. Referring to Fig. 3, it will be seen that this circuit acts as a differentiator.

$$v_K \propto \int i_K = i_a$$

and due to feedback $v_K = v_{in}$. The anode current therefore varies as the derivative of the input voltage.

Before leaving this section it should be noted that a number of mechanical and electro-mechanical devices are available for carrying out these operations, but their response time is much longer than that of the circuits considered here.

LETTERS TO THE EDITOR

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

Stereo Broadcasts

I HAVE listened with interest and enjoyment to the B.B.C.'s series of experimental stereo broadcasts.

Presumably the original intention of these tests was to assess the relative merits of stereo and mono reproduction. This task has recently been made more difficult by the use of a TV sound a.m. transmitter for the right-hand channel. This inevitably produces a marked difference in the signal-to-noise ratio of the two channels. Similar performance from each channel can only be provided by using two similar transmitters or, preferably, one transmitter using a multiplex system.

In the meantime the case for stereo has been amply demonstrated by the gramophone record industry. After a somewhat shaky start they are issuing and selling vast numbers of stereo discs to a public which is obviously no longer in any doubt.

Now that the burden of proof has been lifted from the B.B.C., surely they could demonstrate a single-transmitter method of stereo broadcasting. The Mullard system (with its crosstalk 45dB down) seems to have much to recommend it, including the facility of radiating two separate programmes from a single transmitter.

Now seems the ideal time to start regular stereo transmissions from a single transmitter in each B.B.C. region. If this is not possible surely we could have an initial pilot scheme operating from Wrotham only, as was done during the f.m./a.m. controversy.

Saffron Walden, Essex. M. S. GOTCH.

Television Standards

MR. BANTHORPE (Oct. 1960 issue) advocates a change of field frequency from 50 c/s to 60 c/s for the purpose of reducing flicker. The price to be paid would include an increase of bandwidth and a loss of the mains-hold feature as already mentioned by Mr. Banthorpe. But American experience shows that telecine and telerecording process become more involved and give inferior performances under those conditions. Once a field frequency has been reached which is sufficiently high to enable rapid movements to be depicted satisfactorily, then it would appear logical to achieve freedom from flicker by selection of afterglow time.

Mr. Heffernan, in the same issue, claims that "a real advantage . . . is gained in getting one's peak aerial power in the blacks and the all-important synchronizing pulses." Has Mr. Heffernan forgotten that an unmodulated carrier contains no intelligence and that a voltage change from 0-3 produces just the same signal as a change from 7-10?

Mr. Charles Rogers (Nov. 1960 issue) writes of the bandwidth needed for equal horizontal and vertical definition. Concentrating first on the word "needed," is this not putting the cart before the horse? A *suitable* number of lines is incidental to the bandwidth *available*. It is the bandwidth which is the raw material and which costs money, lines do not. There is no single correct relationship, and discussion* has shown that the country's experts disagree strongly amongst themselves as to what is the *best* relationship, their opinions covering wide ranges.

As for equal horizontal and vertical definitions, I suggest that there is no such condition. If there are l lines in a picture, then the number of different vertical heights which images may have is l. But images may be shown with an infinite variety of horizontal lengths. In the vertical plane an image may take up one of l positions. In the horizontal plane it may take up one of an infinite number of positions.

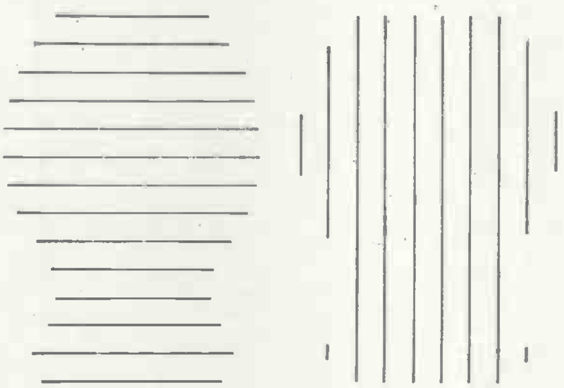
It has been known for at least a decade that the conventional relationship, usually expressed in cart-before-horse fashion as

$$f_{max} = Al^2 f_p/2$$

gives, when transposed, a number of lines which is too small. The Television Advisory Committee's recommendation for increasing vertical definition to a greater extent than horizontal definition merely recognizes this fact.

I believe that the *logical* approach to this problem is to determine the *available* bandwidth, and with a multi-standard camera channel, limited to this bandwidth, to select that number of lines which gives the most pleasing results. This, of course, has been done, but it is surprising how old ideas stick. This is probably because the subject makes a neat (but very misleading) examination question.

I believe that the fallacy of the conventional equation can be demonstrated in the following manner:—



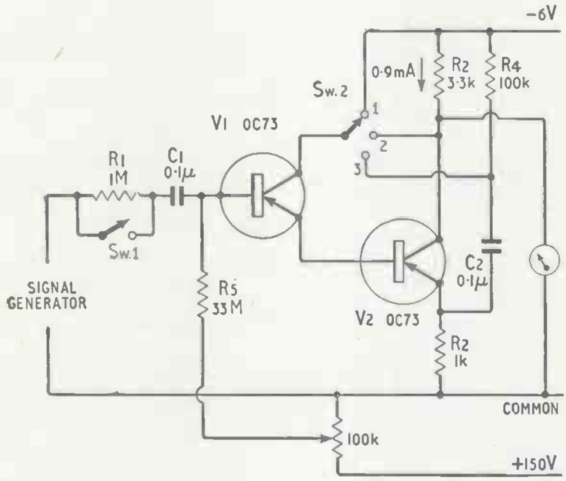
I reason that if this equation were valid, then the definition of an image would be governed by the sum total of the line lengths that lay within the boundaries of the image of an object, irrespective of whether they coincided with the major or the minor axis of an elongated image. The above sketches are of the *same* object drawn in these two different ways.

Sutton, Surrey. R. C. WHITEHEAD.

(* See, for example, "Relation Between Picture Size, Viewing Distance and Picture Quality," L. C. Jesty, *Proc.I.E.E.*, Part B, No. 23, Vol. 105, Sept. 1958.)

Transistorized Wein Bridge Oscillator

THE use of the super-alpha pair as the input stage in the article in your August 1960 issue has already provoked considerable comment, but one feature of the arrangement has been misrepresented by Mr. F. Butler and overlooked by subsequent correspondents. On page 388 he says that the super-alpha stage is an emitter follower directly coupled to a common-emitter stage, the collector of the emitter follower being taken to the collector of the common emitter stage and not the supply rail. He then says: "The principal effect of this change is to place in series with the collector circuit of the first transistor the whole output voltage developed across the load resistance. This voltage is opposite in phase to the amplifier input voltage and constitutes a large series negative feedback signal. The effect of this [feedback] is to cause a further increase in the already high input resistance . . ." Surely the effect of this feedback is to reduce the input



resistance, for, when the collector voltage of an emitter follower is reduced, an increase in the input current is required to maintain the emitter current constant. Thus the stage appears to have a resistor connected between base and emitter, the value using hybrid parameters, being $(B + 1)/h'_{22}$. By using the super-alpha stage this resistor is connected between input and output of the pair and thus appears as if it were across the input $k + 1$ times smaller, k being the stage voltage gain. At high frequencies the collector to base capacitance shunts the input still further, an effect which is $k + 1$ times greater with the super-alpha stage than with the conventional arrangement.

Using the circuit shown a set of measurements was made with the same two transistors throughout. With Sw2 in position 1 the circuit is that of an emitter follower driving a common-emitter stage, in position 2 the super-alpha stage results, and in position 3 the collector of V1 is connected so that it closely follows the input voltage. The input impedance is measured by inserting R_1 in series with the input and observing the change in the output voltage.

At 100 c/s the change of Sw2 from position 3 to position 2 reduces the input impedance from 1.6 to 1.3MΩ. This gives $(B + 1)/h'_{22}$ as 30MΩ (very approx.) and hence if $B = 30$ (and experiments show that B is maintained at very low currents) $1/h'_{22} = 1$MΩ, which is much higher than the value at normal currents.

At 3 kc/s changing from position 3 to position 1 reduces the input impedance from 1.4 to 0.8MΩ. This gives the collector to base capacity of V1 as 5½pF.

At 3 kc/s changing from position 3 to position 2 reduces the input impedance from 1.4 to 0.17 megohms. This gives the collector to base capacity as 7½pF, i.e. larger at the lower collector voltage, which seems reasonable though both values of the capacitance are smaller than the value at normal currents.

A table setting out the input impedance of the three circuits at various frequencies is shown below

	Frequency (kc/s)	0.1	1.0	3.0	10	30	Sw 2
Input impedance in megohms	Conventional circuit	1.6	1.4	0.8	0.19	0.05	1
	Super-alpha	1.3	0.6	0.17	0.045	0.02	2
	Collector "lifted"	1.6	1.6	1.4	0.5	0.07	3

The technique of lifting the collector of an emitter follower is used in Application Report No. 6 of Texas Instruments. Here a d.c. amplifier is described with an input impedance of 200MΩ.

Barnet, Herts. **J. C. A. TALBOT**

The author replies:—

Mr. Talbot has drawn attention to what in some circumstances may be a fundamental defect of the super-alpha transistor pair. I accept his conclusion that the effect of feedback from the collector load is to reduce the input impedance of the first stage and not to increase it as I stated. Nevertheless, from Mr. Talbot's tabulated figures it is clear that at low frequencies the input impedances of the three circuit arrangements he describes are all of the same order of magnitude but that, partly because of collector-base capacitance, the input impedance of the super-alpha circuit falls off more rapidly with an increase in frequency than is the case with the other two circuits. It turns out, quite fortuitously, that this characteristic is acceptable in the present case because, on any given frequency range, the Wien bridge network has its lowest impedance at the highest frequency. Thus we have in effect an amplifier of variable input impedance driven from a source of variable output impedance and any mis-match is of little practical consequence. Naturally the effect of collector capacitance is much worse in the case of audio-frequency transistors than it is for h.f. or v.h.f. transistors in which this capacitance is very small. If outputs extending up to 100 or 200 kc/s are desired it would be advisable to use transistors with alpha cut-off frequencies in the range 30-100Mc/s.

I have a copy of the excellent Texas Instruments Application Report referred to by Mr. Talbot, but it was issued after my paper was written. It is possible that their techniques for designing transistor circuits of very high input impedance might have applications in the R-C oscillator field but, if carried to extremes, these techniques become too elaborate to incorporate in a simple piece of apparatus.

F. BUTLER.

P.V.C. holders have been produced by Bush Radio to protect the miniature circuit diagrams which they now issue to dealers for the servicing of television and sound receivers.

MANUFACTURERS' PRODUCTS

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Automatic Circuit Tester

THE American Lavoie Laboratories' "Robotester" can test to any one of four alternative tolerance limits the resistance and a.c. or d.c. voltage between any two of up to 250 test points at a rate of about 80 tests per minute.

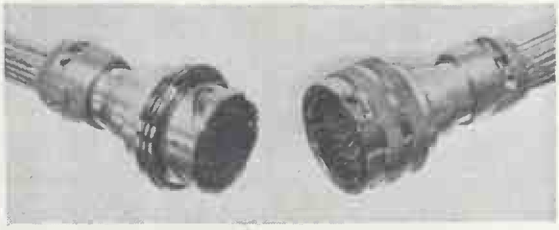
Lavoie Laboratories "Robotester" automatic circuit tester.

The tolerance limit as well as the resistance or voltage to be tested are individually set for each test by means of a punched tape which is fed into the Robotester. If a fault is found the machine automatically stops until switched on again, and at the same time the measurement accuracy can be checked. Alternatively, an additional unit can be attached which automatically records the fault and then restarts the tester. It is claimed that with this instrument on production runs final test times can be shortened by about 80%. The Lavoie Laboratories' Robotester costs £2,850 and is distributed in this country by Metrix Instruments Ltd., of 54 Victoria Road, Surbiton, Surrey.

Versatile Multi-pin Connectors

A NEW range of aluminium-cased, multi-pin connectors, the Mark 6, is now available from The Plessey Company. These connectors embody many singular features and they also accommodate a considerably greater number of contacts than other Plessey connectors of similar size.

Mark 6 connectors are available in four sizes with a fixed and free unit in each; both units are obtainable with either plugs or sockets and are easily convertible to coupler units. A silicone-rubber moulding forms the insulator and fully shrouds individual contacts, cable joint and a portion of the cable dielectric.



The new versatile Mark 6 Plessey multi-pin connector.

Insulation resistance between contacts and earth throughout is greater than 10^4MΩ at 500V.

The voltage rating is 1kV r.m.s., irrespective of contact class, at ground level, reducing to 350V at 70,000ft, or under equivalent conditions. Current ratings range from 5A to 12A and the connectors are satisfactory for operation in ambient temperatures between −55°C and +155°C.

Contacts are silver-plated brass and socket inserts are designed to give equal mating loads irrespective of the length of engagement.

These new connectors can be used in four alternative positions by merely varying the position of the bayonet couplings. This feature prevents mis-coupling to wrong units and also prevents mis-mating. The connector is designed to meet the major performance requirements of British Military Specifications EL1987 and DEF5321, and American Military Specifications MIL-C-5015D and MIL-C-26500 (U.S.A.F.).

A special high quality connector with nickel-plated housings and gold-plated contacts is available to special order. Further details can be obtained from The Plessey Co., Ltd., Ilford, Essex.

Multi-channel Oscillograph

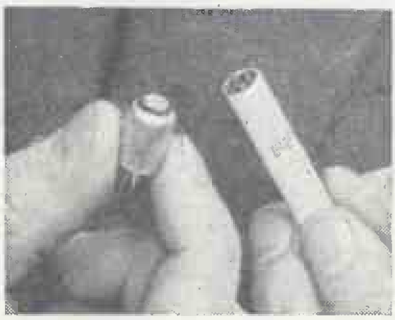
THE new Savage and Parsons Type RG32-12/15 multi-channel oscillograph has a response of up to 1000c/s at a sensitivity of 7.5mA/cm. Eight alternative paper speeds from 5in/min to 150in/sec can be used, and a well-defined trace is obtainable at writing speeds of 12,000in/sec. Up to 200 feet of paper can be recorded at any one time and this can either be run continuously or alternatively automatically stopped after 2, 5, or 10 feet have been used. Identification of each channel every two feet irrespective of the paper

Savage and Parsons Multi-Channel Oscillograph.

speed is provided by a sequential interruption of each trace. The signals are obtained from mirror galvanometers and the traces developed spontaneously within a few seconds by using ultra-violet sensitive paper. The magnet block carries fifteen galvanometers but some of these will usually be used as time markers or, connected to the mains, as a reference frequency. The cost of this oscillograph is in the region of £1,200, the exact value being obtainable on application. It is manufactured by Savage and Parsons Ltd., of Watford, Herts.

Sub-miniature I.F. Transformers

A TRULY sub-miniature transformer, the "Fidis," which measures only ⅜in in diameter and ⅜in high, is being produced in France primarily for use in pocket-



Orega "Fidis" sub-miniature i.f. transformer compared in size with a cigarette.

sized transistor receivers, but it has, also, applications wherever space is strictly limited. The base soldering pins are positioned so that the transformer can be used in printed circuits.

Despite its diminutive size it is fully screened and the "Q" of the windings is claimed to be of the order of 150.

Further details can be obtained from the French company Orega, 106, rue de la Jarry, Vincennes (Seine) France, a subsidiary of the Compagnie Générale de Télégraphie Sans Fil of Paris.

Transistor DC/DC Converters

RECENTLY introduced by Aveley Electric is a range of transistor converters supplying h.t. voltages from 6V to 24V batteries. A special feature of the Avel converters as they are called, is the use of toroidally-wound transformers on H.C.R. square-loop type magnetic cores, together with bifilar windings to ensure accurate balance and fast switching of the transistors with over-shoot voltages kept to a minimum.

The converters, which are available with ratings of 5W to 120W, provide normally 300V d.c. output with intermediate tappings of 200V and 250V. Adequate protection is provided to prevent damaging the transistors by inadvertently reversing the polarity of the input or by other wrong connections.

Chassis of a typical Avel transistor DC/DC converter made by Aveley Electric.

Shown in the illustration is one of the basic units employed in the converters, the massive chassis block forming a heat sink for the transistors. This basic unit can be fitted in a variety of housings to meet users' requirements. By duplicating and triplicating the basic units in a single housing higher power, or voltage, outputs and/or multiple voltages are readily obtainable.

The basic units are very compact, the chassis, or heat sink, measuring only 3⅝in × 2¼in with height dependent on output rating. In a 45-Watt unit, for example, this is about 3in.

Further details can be obtained from Aveley Electric Ltd., South Ockendon, Essex.

Television Aerial Isolator

TO the Egen range of components has now been added an aerial isolator, Type 364. It isolates the aerial on a.c./d.c. television receivers and is a single compact rugged unit which complies fully with the individual requirements of BS415. Insertion loss is very low and its

Egen television aerial isolator.

electrical specification ensures maximum performance at all frequencies envisaged for domestic receivers.

It is completely co-axial with full screening of the inner conductor. The series inductance of the feed-through capacitor in the outer conductor is exceptionally low, which is a desirable feature. Feed-through capacitors in both conductors are each 470pF. They are tested to 3,000V d.c.

Provision is made for direct mounting to the receiver chassis or to a separate bracket and the isolator can be supplied with any required length of coaxial cable for connection to the receiver input circuit. The external socket accepts a standard coaxial plug to R.E.C.M.F. specification. The makers are Egen Electric Ltd., Charfleet Industrial Estate, Canvey Island, Essex.

Transformer Kits

THE introduction of a range of transformer kits comprising a stack of laminations, a bobbin and fixing clamps where appropriate, will come as welcome news to many concerned with the construction of a prototype iron-cored transformer, and these also include home constructors.

Fifteen sizes and three different lamination materials, Silcor, Radiometal and Mumetal respectively, are available and prices for single kits range from 9s 3d to 15s 6d in Silcor, 9s 3d to 63s 9d in Radiometal and 9s 6d to 93s in Mumetal. Further details and prices for quantities are obtainable from The Belclere Company Ltd., 171 Cowley Road, Oxford.

New Plastic Foil Capacitors.—The following corrections should be made to the report on the Tropyfol capacitors on page 616 of the December issue. The largest capacitance in the 400V range is 0.47μF. The 125V type measuring 4.5 × 12mm is a 0.01μF capacitor while the 13 × 24mm capacitor of 1μF is a 125V type.

Iron-Cored Coupling Transformers

With Particular Reference to the Design of Iron-Cored A.F. Components

BY D. SAULL

A TRANSFORMER is like the conjunction in English language—it correctly joins two or more individual circuits together; e.g., a microphone to the input of an amplifier, one stage of an amplifier to the next stage, an amplifier output to a speaker or transmission lines, etc. And for each particular application a transformer must usually be specifically designed. The range of such designs is therefore very large.

The block diagram in Fig. 1 shows the family tree, as it were, illustrating some of the many uses to which transformers may be put in electronic circuitry. If the reader pauses to consider that a complete book could be written on the subject matter of any one application—say pulse transformers—it becomes evident that a single article in a journal could not possibly cover the complete subject of transformers.

The purpose of this article is, therefore, most certainly not a comprehensive study of impedance matching transformers; neither is this article intended to be read by transformer designers. No, its purpose is to aid the engineer, whose mind is centred on the equipment he is designing and from which he does not wish to be deviated, to reach a starting point if he is obliged to get down to designing his own transformer. Alternatively, to assist the engineer to call up his requirements if he is fortunate enough to possess the facility of a transformer design department to supply his needs. For these reasons, the author intends to generalize in his statements to avoid entering into details, which would defeat the purpose of this article.

Before leaving the reference to a transformer design department, it may be worth explaining the value of such a department to a firm employing a fair number of design and development engineers.

It can be shown that the average transformer design time for a transformer design department, over a period of time, is half to two thirds the average time taken when individual design and development engineers design their own transformers. This is a money-saving consideration for readers in a managerial position in industry to ponder.

The reason for this shorter design time, claimed by transformer design departments, is twofold. First, although the transformer designer is no more skilled than the development engineer, and perhaps even less skilled, he has the advantage of constantly designing transformers and so learns the short cuts; whereas the development engineer is called upon only infrequently to design transformers. Secondly, one design frequently assists another design, and often a transformer is a modification of a previous design; a transformer design department has records of the work carried out but—in the case where separate designs are done by various engineers—Fred doesn't know what George is doing.

As the subject matter of this article is not intended to be "the management of industry," let us press on with transformer design.

A transformer is basically a number of turns of conducting wire wound round a block of iron. If two such windings, consisting of any number of turns, are wound round any block of iron and an a.c. signal is applied to one winding some form of a.c. signal will appear across the second winding. What relation the output signal will bear to the input signal, in this case, is anyone's guess. And, perhaps, here we come very near to the heart of the subject.

As was said earlier, a transformer correctly joins together two or more electric circuits. It may serve to connect a low-output impedance microphone to the high impedance grid circuit of a valve, or the high-output impedance of a valve to the low-input

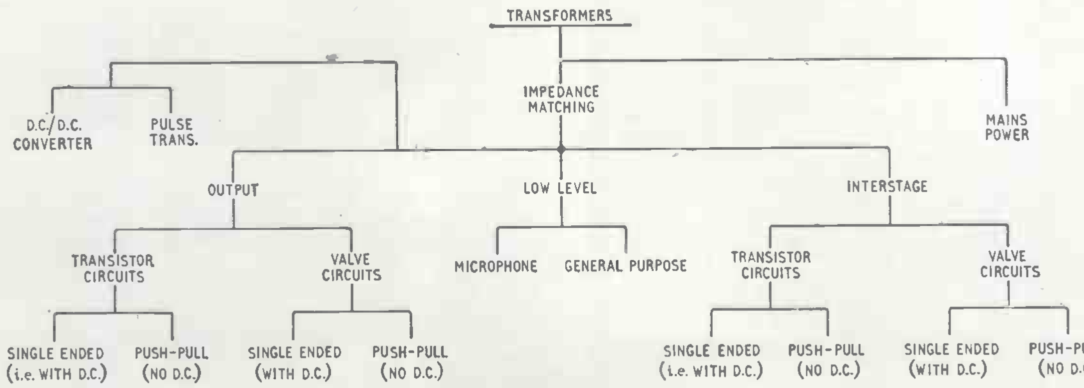


Fig. 1. Transformer family tree showing some of its numerous applications

impedance of a speaker. Whichever the case, if the transformer is ideally designed, each circuit will be correctly terminated and the respective circuits do not know that the transformer is there at all—like the broody hen and the china egg. However, the china egg is cold to sit upon, and the practical transformer is not ideal, having losses, phase shift, etc.

How near to the ideal may the engineer expect to get? The problem is rather like a tug-of-war contest with perfection on one end of the rope and costs on the other. The road to perfection leads to higher grade transformer laminations, larger lamination sizes, and longer development time; factors which may be expressed in terms of £, s, and d.

So a compromise must be made; and usually the engineer is obliged to specify the lowest standards that he can tolerate. The maximum insertion loss and harmonic distortion, together with the minimum frequency response, that is acceptable to the engineer, must be specified.

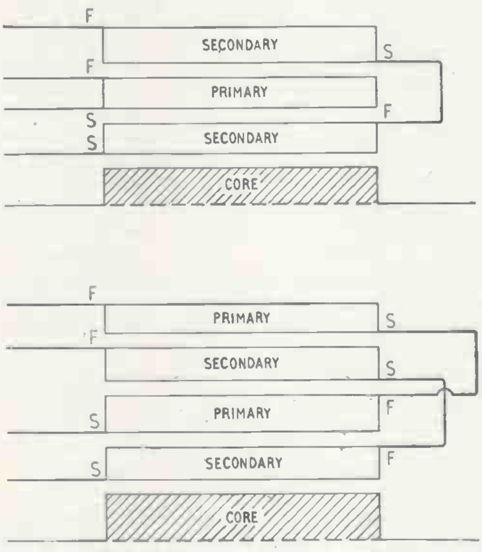


Fig. 2. Two methods of sectionalizing windings

A transformer functions electrically the same whatever its application, and its design is a compromise of a number of variables. For one application insertion loss is an important factor, for another it is of little importance; the same applies for winding d.c. resistance, leakage inductance, etc.

Perhaps the easiest method of reaching a compromise between perfection and costs is to examine the merits of the various lines of action that the engineer may take. The author will, therefore, try to take the reader briefly, in turn, through the practical considerations required for the design of each transformer application illustrated in the family tree in Fig. 1. But, before passing on, it might serve well to discuss some of the various grades of transformer irons available, the methods of winding, and three different ways of assembling the laminations.

Winding Methods.—There are two main methods of winding transformers, (*a*) paper interleaved layer winding on a cheekless former and (*b*) layer winding without interleaving paper on a former with end cheeks.

In the author's opinion, type (*a*) is more suitable for the larger variety of transformer, e.g., the output transformer of a high-quality 10-watt a.f. amplifier. The figures for overall space factor and the turns-per-inch-squared quoted in the Tables 1 and 2 of the article "Power Transformer Design," published in the June (1960) issue of WIRELESS WORLD, will hold good for this application. Type (*b*) should be employed in the smaller variety of transformer for the reason that, when interleaving paper is employed, the thickness of the paper becomes comparable with the diameter of the winding wire used. For this smaller variety, an overall space factor of 30 to 35%, which includes the former, should be assumed.

Flux Gradient.—The flux density across the window area of the laminations is not constant due to the increasing length of the iron path; if the lines of flux are compared with the rings of water ripple surrounding a stone thrown into a pond, this idea becomes more evident. This flux gradient increases the leakage inductance. To reduce the leakage inductance the primary winding may be split into two or more sections and sandwiched between the secondary windings. The result of so dividing the primary winding into sections unfortunately increases the capacitance between windings. This capacitance may in turn be reduced by separating the primary and secondary windings by several layers of interleaving paper. Further sectionalizing and reversing the direction of the windings, but connecting the windings in the same magnetic sense, results in improved characteristics; Fig. 2 illustrates two possible methods.

A compromise must be arrived at to obtain the required results. For the above considerations, the number of turns on the primary winding should tend towards a minimum, which suggests in order to maintain the required primary inductance, that a core material with as high a permeability as possible—consistent with costs—should be employed. The latter applies particularly to low level transformers.

Grades of Iron.—Commencing from the lowest, in permeability and cost, the following list of core materials will give an approximate guide to the respective applications:

(*i*) *Silcor 25;* 0.014in and 0.020in thickness—1% silicon content.

(*ii*) *Silcor 107;* 0.014in and 0.020in thickness—3½% silicon content.

(*iii*) *"C" Cores;* 0.002in to 0.013in thickness—cold rolled grain-oriented silicon steel—may be worked at 30% higher flux densities than (*i*) or (*ii*).

These first three grades are suitable for use in output transformers employed with higher-power, good-quality a.f. amplifiers. For this application, it is better to have a large core of cheaper material than a smaller core of the higher, more expensive, grade material such as Radiometal or Mumetal.

"C" cores are particularly adaptable to such uses due to their shorter mean magnetic-path length and higher permeability, and may be conveniently worked at 5×10^3 gauss. This material saturates at

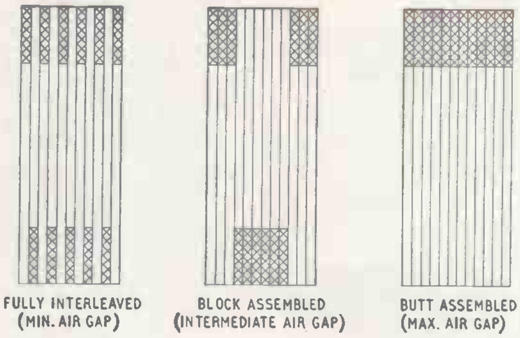


Fig. 3. Methods of assembling core laminations.

a higher value of d.c. component, which is worth bearing in mind when designing transformers carrying d.c. The range of sizes obtainable extends down to small sizes suitable for interstage transformers with a d.c. component.

(*iv*) *Radiometal* lies between silicon steel and Mumetal, and may be worked at flux densities twice that for Mumetal, but does not have as high a permeability as the latter material.

(*v*) *Mumetal.* The use of this material, with its high permeability, makes possible the design of miniature transformers for transistor circuits and transformers of smaller size with high primary inductance and low leakage inductance. The material saturates at low values of d.c. and is, therefore, not suitable for applications where a d.c. current is present. However, where the d.c. is of low value, and the primary inductance is not high, this material may be used, i.e., transistor a.f. interstage transformers.

Average Permeability:

Silicon Steel—350

Radiometal—1,600

Mumetal—15,000

Turns Reduction for a Given Inductance:

$$\frac{\text{Radiometal}}{\text{Silicon Steel}} = 2.14 \text{ to } 1$$

$$\frac{\text{Mumetal}}{\text{Silicon Steel}} = 6.8 \text{ to } 1$$

$$\frac{\text{Mumetal}}{\text{Radiometal}} = 3.3 \text{ to } 1$$

Methods of Assembling Laminations.—Fig 3 illustrates the three main methods of assembling the laminations to produce various degrees of effective air gap in the iron core.

Low-Level Transformers.—A low-level transformer is one which is used to couple two circuits where the power available from the primary circuit is of a small order, i.e., milliwatts. Such applications might be a microphone transformer, a transformer connecting a 600-ohm signal generator to a 20-ohm load, a moving-coil meter transformer to extend the current measuring range, etc.

The first consideration might be a low insertion loss, which calls for a low-loss, high-permeability type of lamination—Mumetal or Radiometal—the author's choice would be Mumetal. The second consideration is frequency response; the third consideration, closely related to frequency response, is second harmonic distortion.

Low Frequencies.—The distortion in a transformer at the lowest frequency is dependent upon the maximum operating flux density, and falls off sharply with frequency increase.

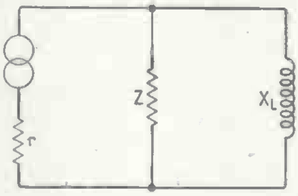
The frequency response at the lowest frequency is dependent upon the value of shunt inductance of the primary winding. Fig. 4 illustrates how this fall off at the lower frequencies arises, and the table gives practical values.

High Frequencies.—At high frequencies the leakage inductance and the capacitance of the windings increases the frequency fall-off. A well-designed low-level transformer may have a frequency response of from 20c/s to 100kc/s. The design problems of such a transformer might be listed as follows:

(*a*) High primary inductance.
(*b*) Low leakage inductance.
(*c*) Low flux density—order of 600 gauss.
(*d*) Low winding capacitance.
(*e*) Low d.c. resistance—dependent upon application.

Factors (*a*) and (*b*) plus (*d*) work in opposition because by increasing the number of turns, to increase the primary inductance, the leakage inductance increases proportionately (i.e., leakage inductance and primary inductance are both a function of the square of the number of turns). The capacitance of the windings also increases.

Fig. 4. Equivalent transformer primary circuit.



r = SOURCE IMPEDANCE
Z = GENERATOR LOAD (REFLECTED FROM SECONDARY WINDING)
X_L = REACTANCE OF PRIMARY WINDING

Increasing the stack size increases the primary inductance but does not reduce the leakage inductance to the extent that might at first be expected, due to the increased mean turn length of the windings.

The answer lies in using core materials of high

Table

At flux density = 600 gauss		
X_L equal to	**Total % harmonic distortion**	**Frequency fall-off**
6R	0·3	
4R	0·4	
2R	0·7	1dB
R	1·7	3dB

permeability—hence a very good reason for using Mumetal. Radiometal follows some little way behind—if the purse strings are tied.

The tighter the specification, the greater the time taken to produce the completed design. The designer is fortunate indeed if he produces the finished transformer at the first attempt. The procedure is more likely to result in a first-off version to be tested and the shortcomings noted. This is where the transformer design department again has the advantage—the second-off and final design, in this case, will be the modification to a previous near design.

Making a Start.—The required primary inductance should first be calculated from $\omega L=R$, 2R, 4R or 6R according to the permissible distortion at the lowest frequency to be reproduced (see table).

The next step is the choice of lamination size, which, unless a direct selection can be made based on previous experience, must satisfy the two following equations:—

(*i*) $N^2=\dfrac{L\times 10^8 l}{3.2\times A\times \mu}$

(*ii*) $B=\dfrac{E\times 10^8}{28.6\ fNA}$

Where:

μ = Initial permeability.
L = Henries.
A = Cross-sectional area of the core in sq in.
l = Mean magnetic path length in in.
N = Number of turns.
f = Frequency (lowest).
B = Flux density (order of 600 gauss).
E = Applied maximum voltage when the transformer is in circuit.

Having selected a suitable lamination size, the number of primary turns required should be evaluated from equation (*i*) and then a check made using equation (*ii*) to ascertain that the flux density is not in excess of 600 gauss.

The secondary turns are then evaluated from:—

$$\text{Turns ratio}=\sqrt{Z_1/Z_2}$$

where Z_1 and Z_2 are the input and output circuit impedances.

When a sample transformer has been wound it should be tested for frequency response. This may be done with the aid of a signal generator and a valve voltmeter. The transformer should be correctly terminated in a resistive load and the voltage appearing across the primary winding at A (see Fig. 5) should be adjusted, with the aid of the valve voltmeter, to be that which will appear across the winding when the transformer is connected in circuit. Fig. 5 illustrates the circuit required for testing such a transformer with a turns ratio of 2 to 1. The valve voltmeter is then connected across the secondary B and the voltage noted. This procedure is repeated in steps throughout the frequency range for which the transformer is designed. A frequency response graph is then plotted and the insertion loss evaluated.

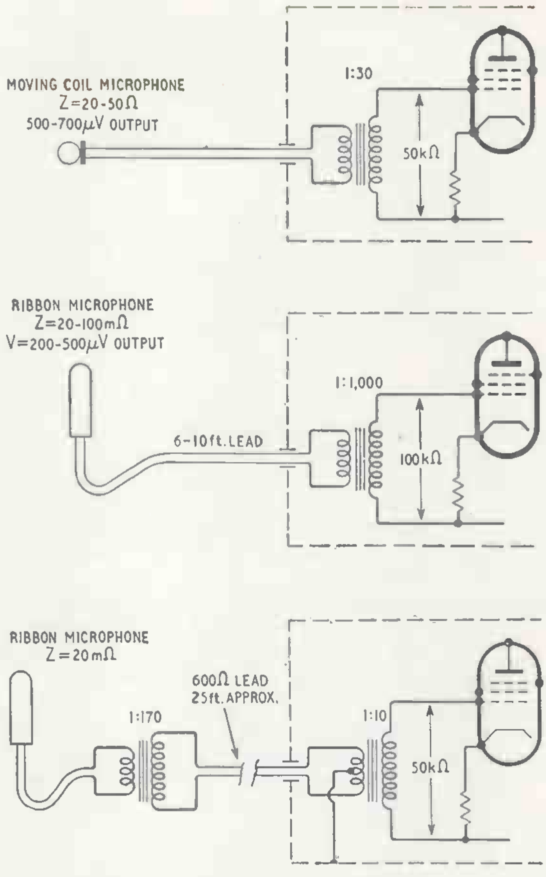


Fig. 6. Matching microphone to input of amplifier

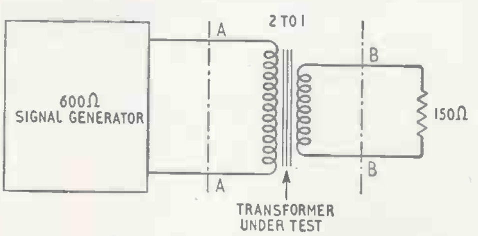


Fig. 5. Arrangement of circuit for testing a transformer

Frequency fall-off at the low-frequency end calls for an increase in primary inductance; frequency fall-off at the high frequency end is due to either leakage inductance or winding capacitance. The latter factors may be identified by connecting a small capacitor across the secondary winding and if the fall-off in frequency response does not increase at this end the trouble is leakage inductance—if it does fall off more sharply, then the trouble is capacitance. The alterations necessary to improve these short-comings have already been discussed earlier in "Flux Gradient."

Microphone Transformers.—The low-impedance ribbon and moving-coil type microphones require a matching transformer to connect the low-impedance of the microphone to the high-impedance grid circuit of the first amplifier valve.

Fig. 6 illustrates these two types of microphone matching. The transformer windings are wound for Radiometal or Mumetal laminations.

To reduce hum pick-up when the transformer is mounted in the amplifier, narrow "U" laminations are used, the induced hum voltage cancelling out in the coils wound equally on either limb. The secondary winding is usually wound with fine wire—order of 50 s.w.g.—the high d.c. resistance being unimportant in this application. The windings of the secondary may conveniently be six separate bobbins, three on either limb of the "U" laminations; the primary consisting of thin copper strip.

Fig. 7 shows a suitable transformer of turns ratio 1 to 1,000; the secondary is made up of six bobbins each of 1,000 turns and the primary consists of 6 turns of thin copper strip.

Fig. 7(b) shows the direction of the winding and the resulting magnetic polarity due to the signal current at any instant. It will be seen that, although the two sets of coils are connected to be additive in inductance, the coils on each limb produce magnetic fields that are in opposite directions in plan view. Hence a magnetic field, caused by hum, would produce a hum voltage equal and opposite in polarity in the windings on either limb. The narrow "U" laminations are used to ensure that both sets of coils are in a field of equal hum flux, which might not be so if the limbs were spaced well apart.

Output Transformers.—This type of transformer covers a very wide range and could not be dealt with fully in an article of this nature. They do, however, fall into two main groups, those for push-pull operation and those for single-ended operation. The former have no d.c. component in their windings whereas the latter may have.

For medium power a.f. amplifiers, ordinary silicon irons function quite well. For higher power a.f. amplifiers, in the order of 20 to 30 watts, it is an advantage to use "C" core laminations.

A good rule-of-thumb guide to lamination size is the weight of the core in lb should be 0.17 times the output watts of the amplifier and the volume in cubic inches should be 0.7 times the output watts of the amplifier. For good fidelity these figures should be doubled.

The maximum flux density of operation should not exceed 5 kilogauss for a reasonable distortion factor. The calculations for primary inductance are the same as under "Low-Level Transformers."

When the primary windings carry a d.c. component it may be necessary to increase the effective air gap in the core by block or butt method of assembling the laminations.

The frequency response of output transformers is a similar consideration to the factors effecting interstage transformers.

The permeability of the core will vary with applied signal level—thus the frequency response will normally extend lower as the signal level is increased.

When a transformer is connected to a source of zero impedance there is no voltage drop incurred by the magnetizing current. As in the practical case there is source impedance, a voltage drop will occur due to the magnetizing current; since the magnetizing flux is not by any means a sine-wave for an input sine-wave current, due to the B/H curve, distortion resulting from the out-of-phase magnetizing current occurs.

The ratio of $\omega L/R$ (where R is the resultant of anode and load resistances in parallel) should be kept as low as possible consistent with other requirements. The d.c. resistance of the primary, and of the reflected secondary, windings may be regarded as part of the source impedance for this purpose. Further to this consideration, the maximum flux density should be restricted to the straight part of the B/H curve. Fig. 8 illustrates these principles.

Interstage Transformers for Class A and Class B Working.—The amplification of the stage at mid-frequency is very nearly equal to the product of the

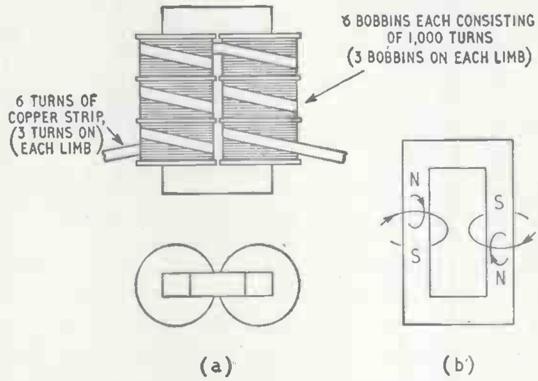


Fig. 7. Hum pick-up by microphone transformer minimized by an "astatic" form of winding using both limbs of a "U"-shaped core. (a) shows practical assembly and (b) the direction of winding

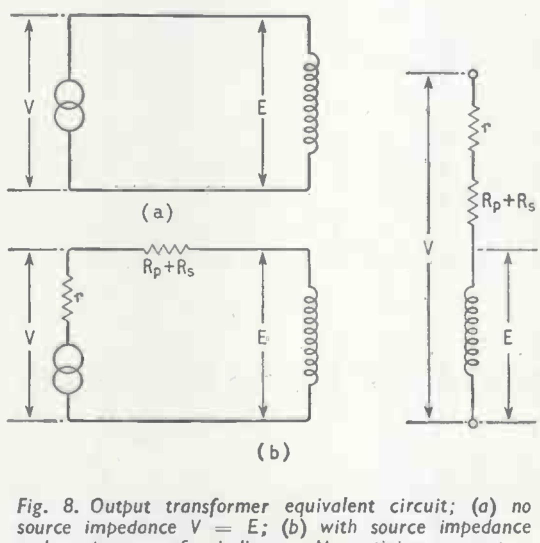


Fig. 8. Output transformer equivalent circuit; (a) no source impedance V = E; (b) with source impedance and resistance of windings. Magnetizing current a function of frequency and load current

amplification factor of the valve and the turns ratio of the transformer.

The gain falls off at low frequencies due to the decrease in the reactance of the transformer primary winding. At frequencies at which $\omega L = R$ the response will fall off 3dB; at frequencies $\omega L = 2R$ the response will fall off 1dB.

The leakage inductance and shunt capacitance of the transformer, in conjunction with the anode and the winding resistances, form a low-Q resonant circuit. The gain will fall off sharply above this resonant frequency. This resonant frequency may be varied by altering the value of the leakage inductance or the winding capacitance.

Transistor Output and Interstage Transformers.—These transformers may be wound on very small Mumetal laminations. Because the impedances associated with transistors are small compared with those for valves, primary inductances are of a low order—e.g. 250 to 500 millihenries.

Pulse Transformers.—It is not intended to more than mention this type of transformer in passing except to say that, due to the wave shape of the pulses the transformer is required to pass, the harmonic content may reach high frequencies. Trouble is frequently experienced when the leakage inductance resonates with the winding capacitance producing unwanted spikes.

To minimize this effect, a copper screen may be placed between the primary and the secondary windings and the screen connected to an earthy point in the circuit. This screen consists of one turn of 0.002-in copper foil interleaved with paper to prevent a short-circuited turn.

D.C./D.C. Transistorized Converters.—Toroidal cores are usually found most efficient for these types of circuits, particularly when the VA output is of a small order. However, transformers utilizing medium grade silicon-iron laminations can be designed for this application which are fully satisfactory for VA ratings in excess of 6VA, working at frequencies up to 1,000c/s.

Ferrite materials are also employed for circuits operating at several kc/s where, due to the low value of smoothing components at this frequency, the overall size of the complete apparatus may be kept small.

The nature of the converter circuit requires that saturation of the core is reached twice in each cycle of operation. The use of silicon-iron laminations therefore restricts the frequency of operation. The iron losses in the core are the chief losses in this type of circuit—hence a minimum VA rating for a high efficiency working is fixed by the relation between total losses and the output VA. Since this type of equipment is mostly used working from storage batteries, efficiencies are important.

Although the subject matter in this article is, of necessity, very briefly dealt with it is hoped that it will serve some use to the engineer, even if only as a pointer to select a starting point from which he may approach his objective, and to the management in the electronic industry in illustrating the advantages of setting aside a department, however small, for the specific purpose of designing transformers.

HI-FI P.A.

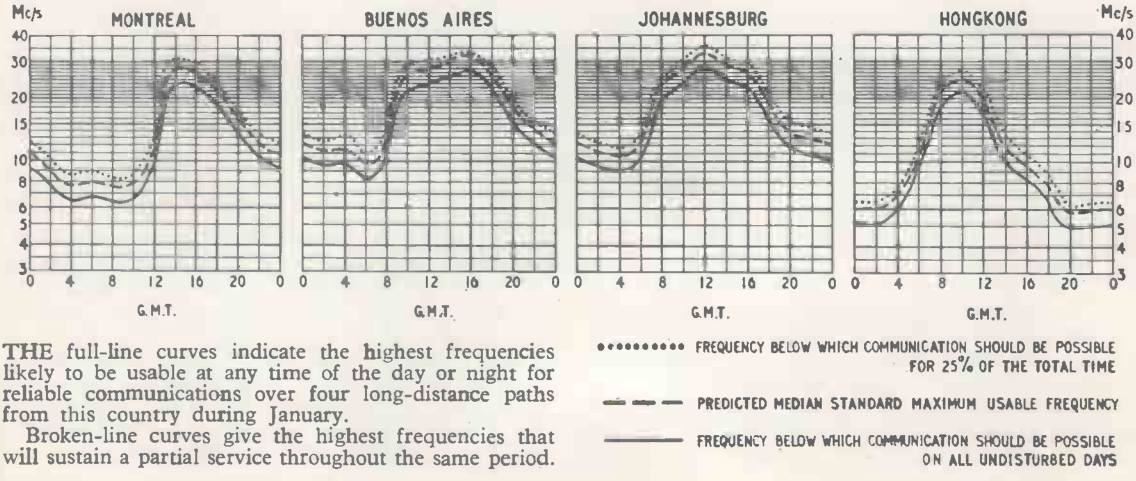
READERS who visited the National Radio Show and were impressed with the quality of reproduction on the B.B.C. Gramstand may be interested in the following brief details of the installation:—

The requirements were for high-quality public address coverage over a large area to feed a standing audience of up to 1,500 at one time. Anything less than high quality would not have served the purpose because the main output from this exhibit was commercial records which nowadays employ such "gimmicks" as close-balance, pre-emphasis, accentuated reverberation and frequency correction which would be lost on the normal type of public address system.

Six high-quality monitoring loudspeakers of a type normally used in control rooms and control cubicles and known as the LSU/10 were sited at strategic points round the audience area. The loudspeakers, mounted on plinths so that the sound output was not baffled by people standing in front of them, were built into the auditorium walls and in pillar casings.

Basically, the construction of an LSU/10 loudspeaker consists of an acoustic cabinet with a vented enclosure containing a large unit with a 15-in cone carrying a 3-in speech coil. The middle and high-frequency unit is mounted concentrically with the large unit and has a light domed aluminium diaphragm, 1¾-in diameter, attached to a speech coil of the same diameter. There is an additional tweeter unit separate from the main loudspeaker units to extend further the top frequency response. The 10-watt amplifier feeding the speaker units is also contained in the cabinet.

SHORT-WAVE CONDITIONS *Prediction for January*

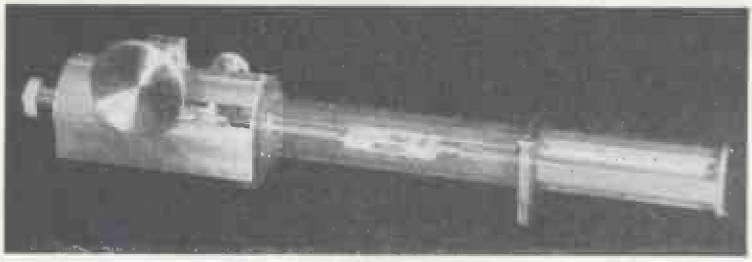


THE full-line curves indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during January.

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

TECHNICAL NOTEBOOK

Adjustable Waveguide Termination recently developed at the U.S. National Bureau of Standards has two moving parts: a short-circuiting plunger and a resistive vane. The double-exposure illustration shows the plunger and vane positioned inside a rectangular waveguide.



Independent mechanical controls are provided for rotating the vane, longitudinally sliding the vane relative to the short circuit, and sliding the entire termination assembly along the waveguide. In operation, the resistive vane reflects some energy back towards the signal source. The remaining energy is either partially absorbed by the vane or reflected by the short circuit back towards the signal source. The relative phase of the reflections from the vane and short circuit can be altered by varying the distance between them. The amount of energy reflected by the short circuit depends upon the amount left unabsorbed by the vane, and this can be varied by rotating the vane.

New Transistor Manufacturing Technique developed by Bell Telephone Laboratories reduces switching times and collector resistances of diffused-base transistors by factors of more than ten. Diffused-base transistors require a collector region of relatively high resistivity in order to attain a low capacitance and high voltage breakdown. A lightly-doped collector region is thus used, and ideally this should only be about 0.1 mil thick. However, if the collector wafer were made as thin as this, it would be extremely difficult, if not impossible, to handle mechanically. Thus a collector thickness about thirty times greater is normally used, although increasing the collector thickness increases both its resistance and also, through carrier-storage effects, the transistor switching time. Thinner collector regions can, however, be made and utilized by growing them on a low-resistivity heavily-doped mechanically supporting wafer. When the thin collector film is a direct extension of a single-crystal supporting wafer it is said to be "epitaxial". Diffused-base transistors have been made at Bell Telephone Laboratories on epitaxial layers of both germanium and silicon and have shown the improvements to be expected from a thinner collector region. For example, the switching time in a typical circuit was reduced from 200 to 20 mμsec and the collector series resistance was decreased by a factor of more than ten.

Digital Voltmeter using a stroboscopic technique is being imported into this country from America by Scientific Furnishings Ltd. of Poynton, Cheshire. In this voltmeter the 250 indicating numbers are registered on a drum which is rigidly coupled to the spindle of a potentiometer. This potentiometer has a standard voltage developed across it and its spindle is rotated at 1500 r.p.m. so that its wiper generates a sawtooth voltage. This sawtooth voltage is continually compared electronically with the unknown voltage so as to fire a stroboscopic lamp whenever the sawtooth and unknown voltages are equal. For a fixed input voltage the stroboscopic lamp will thus be fired at corresponding points on each ramp of the sawtooth waveform, so that the same number on the drum will be illuminated by each flash of the lamp. A slowly-varying input voltage will be indicated by a slowly varying number, and interpolation between two partially-visible numbers will give a measure of a voltage between these two numbers. Alternatively, only the nearest number to the actual voltage can be indicated. This is done by making use of an additional set of pulses produced as the numbers pass a phototransistor.

JANUARY MEETINGS

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

LONDON

4th. Brit.I.R.E.—"Automatic techniques in civil air line communications systems" by W. E. Brunt at 6.30 at the London School of Hygiene, Keppel Street, W.C.1.

5th. Institution of Mechanical Engineers.—Discussion on "The reliability of mechanical engineering parts of data processing systems" at 10.30 at the Institution, 1 Birdcage Walk, S.W.1.

5th. I.E.E.—Hunter Memorial Lecture on "The application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 5.30 at Savoy Place, W.C.2.

9th. I.E.E.—"Recent research in thermionics" by Dr. G. H. Metson at 5.30 at Savoy Place, W.C.2.

10th. I.E.E.—"Precision measurement" by G. H. Rayner and A. Felton, with supporting papers, at 5.30 at Savoy Place, W.C.2.

11th. Brit.I.R.E. — "Multi-layer switching devices" by Dr. G. F. Taylor at 7.15 at the London School of Hygiene, Keppel Street, W.C.1.

12th. Radar and Electronics Association.—"Programme circuits on telephone plant" by G. Stannard at 7.30 at the Royal Society of Arts, John Adam Street, W.C.2.

13th. Television Society.—"A wide range standards converter" by E. R. Rout and R. F. Vigurs at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

19th. Brit.I.R.E. — Symposium on "Alpha numeric displays" at 6.30 at the London School of Hygiene, Keppel Street, W.C.1.

20th. Institute of Navigation.—"Presentation of height information in aircraft" by A. Stratton and K. R. Honick at 5.15 at the Royal Geographical Society, 1 Kensington Gore, S.W.7.

20th. B.S.R.A.—"Modern electrostatic microphones" by F. W. O. Bauch at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

20th. Junior Institution of Engineers.—"Radio investigations of the solar atmosphere" by J. Heywood at 7.0 at Pepys House, 14 Rochester Row, S.W.1.

23rd. Institute of Physics and Physical Society.—"Some new applications of radar" by Dr. E. Eastwood at 6.0 at 47 Belgrave Square, S.W.1.

24th. I.E.E. — Discussion on "Machine-tool control" opened by Dr. E. H. Frost-Smith at 5.30 at Savoy Place, W.C.2.

25th. I.E.E.—"Generation and amplification in the millimetre wave field" by W. E. Willshaw at 5.30 at Savoy Place, W.C.2.

25th. Brit.I.R.E.—"Noise correlation measurements" by K. R. McLachlan at 6.30 at the London School of Hygiene, Keppel Street, W.C.1.

26th. Television Society.—Fleming Memorial Lecture on "Behind the eye" by Prof. D. M. MacKay at 7.0 at the Royal Institution, Albemarle Street, W.1.

BIRMINGHAM

2nd. I.E.E.—Discussion on "Broadening university courses" opened by Dr. H. E. M. Barlow at 6.30 at the James Watt Memorial Institute.

13th. Society of Instrument Technology.—"Controls associated with flying" by Capt. A. M. A. Majendie at 7.0 in the Lecture Theatre, Byng Kendrick Suite, Gosta Green College of Technology, Aston Street.

18th. Television Society.—"Video recording" by J. Southgate at 7.0 at the New Physics Lecture Theatre, the University.

23rd. I.E.E. — "Applications of microwaves" by Prof. A. L. Cullen at 6.0 at the James Watt Memorial Institute.

BRISTOL

20th. Institute of Physics and Physical Society.—"The physicist and the technologist in industry" by G. W. Warren at 7.0 at the College of Science and Technology.

CARDIFF

11th. Brit.I.R.E.—"The measurement of ionizing radiation" by R. G. Wood at 6.30 at the Welsh College of Advanced Technology.

CHESTER

26th. Society of Instrument Technology.—"Satellite instrumentation" by Dr. R. C. Jennison at 7.0 in the Lecture Theatre, Associated Ethyl Co., Oil Sites Road, Ellesmere Port.

EDINBURGH

11th. Brit.I.R.E—"A survey of microwave valves" by C. R. Russell at 7.0 at the Department of Natural Philosophy, the University, Drummond Street.

17th. I.E.E. — "Applications of microwaves" by Prof. A. L. Cullen at 7.0 at the Carlton Hotel, North Bridge.

24th. I.E.E.—"The changing face of electronics" by W. E. J. Farvis at 7.0 at the Carlton Hotel, North Bridge.

EVESHAM

16th. I.E.E.—"Magnetic recording of TV programmes" by H. E. Farrow at 7.30 at the B.B.C. Training School, Wood Norton.

FARNBOROUGH

17th. I.E.E.—"Modern ferromagnetic materials" by Dr. F. Brailsford at 6.15 at the Technical College.

24th. Brit.I.R.E.—"Masers and parametric amplifiers" by Dr. W. A. Gambling at 7.0 at the Technical College.

FAWLEY

6th. Society of Instrument Technology.—"Electronics and instrumentation in the glass industry" by J. R. Beattie at 5.30 at the Administration Building, Esso Refinery.

GLASGOW

12th. Brit.I.R.E.—"A survey of microwave valves" by C. R. Russell at 7.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent.

16th. I.E.E.—"Applications of microwaves" by Prof. A. L. Cullen at 6.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent.

LEEDS

26th. I.E.E.—Faraday Lecture on "Transistors and all that" by L. J. Davies at 7.0 at the Town Hall.

LIVERPOOL

18th. Brit.I.R.E.—"Microminiaturization" by H. G. Manfield at 7.0 at the Adelphi Hotel.

23rd. I.E.E.—"Cybernetics" by Prof. J. C. West at 6.30 at the Royal Institution, Colquitt Street.

MALVERN

26th. Brit.I.R.E. — "Stereophonic broadcasting" by G. D. Browne at 7.0 at the Winter Gardens.

MANCHESTER

10th. I.E.E.—"Radio communication in the power industry" by E. H. Cox and R. E. Martin at 6.15 at the Engineers' Club, Albert Square.

11th. I.E.E. — "The ultrasonic microscope" by Dr. C. N. Smyth at 6.15 at the Engineers' Club, Albert Square.

17th. I.E.E.—"A universal nonlinear filter, predictor, and simulator, which optimizes itself by a learning process" by Prof. D. Gabor, Dr. W. P. L. Wilby and Dr. R. Woodcock at 6.15 at the Engineers' Club, Albert Square.

24th. I.E.E.—Faraday Lecture on "Transistors and all that" by L. J. Davies at 7.30 at the Free Trade Hall.

MIDDLESBROUGH

4th. I.E.E.—"The Fylingdales early warning station" by D. R. Evans at 6.30 at the Cleveland Scientific and Technical Institution.

NEWCASTLE-UPON-TYNE

9th. I.E.E.—Hunter Memorial Lecture on "The application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 6.15 at the Neville Hall, Westgate Road.

11th. Brit.I.R.E.—"The applications of photo-multipliers in industry and research" by J. Hambleton at 6.0 at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road.

16th. I.E.E.—"Precision measurement" by G. H. Rayner and A. Felton, with supporting papers, at 6.15 at the Rutherford College of Technology, Northumberland Road.

19th. Society of Instrument Technology.—"Recent advances in photoelectronic instruments" by H. Loebl at 7.0 in the Conference Room, Roadway House, Oxford Street.

NOTTINGHAM

19th. Society of Instrument Technology.—"The electrical synthesis of music" by A. Douglas at 7.15 at Nottingham & District Technical College, Burton Street.

SHEFFIELD

4th. I.E.E.—Christmas Holiday Lecture on "Colour television" by Dr. R. Feinberg at 3.0 at the City Hall.

18th. I.E.E.—Hunter Memorial Lecture on "The application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 6.30 at the Memorial Hall, City Hall.

SOUTHAMPTON

4th. I.E.E.—"The planning and economics of telecommunication plant" by C. J. Stubbington at 7.0 at the University.

10th. I.E.E.—Discussion on "New semiconductor devices" at 6.30 at the University.

WEYMOUTH

12th. I.E.E.—"Electronic aids to banking and commerce" by Dr. R. Feinberg at 6.30 at the South Dorset Technical College.

WOLVERHAMPTON

11th. Brit.I.R.E.—"An equipment for automatically processing time-multiplexed telemetry data" by N. Purnell and T. T. Walters at 7.15 at the College of Technology.

18th. Institution of Production Engineers.—"The application of electronic computers to production control" by B. L. J. Hart at 7.0 at the College of Technology, Wulfruna Street.

CONFERENCES AND EXHIBITIONS

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

LONDON

Jan. 16-20	**Physical Society Exhibition** (Exhibition Secretary, 1 Lowther Gardens, S.W.7.)	R.H.S. Halls
Mar. 8	**Public Address Exhibition** (A.P.A.E., 394 Northolt Road, South Harrow, Middx.)	King's Head, Harrow
Mar. 21-25	**Electrical Engineers Exhibition** (A.S.E.E. Exhibition Ltd., Museum House, Museum Street, W.C.1.)	Earls Court
Apr. 5-7	**Electrical Contacts Symposium** (The Institute of Physics and the Physical Society, 47 Belgrave Square, S.W.1.)	Brunel College
Apr. 6-9	**Audio Festival and Fair** (C. Rex-Hassan, 42 Manchester Street, W.1.)	Hotel Russell
Apr. 20-21	**Television and Film Techniques Convention** (Television Society, 166 Shaftesbury Avenue, W.C.2.)	Savoy Place

Apr. 20-May 4	**Engineering, Marine, Welding and Nuclear Energy Exhibition** (F. W. Bridges & Sons, Grand Bldgs., Trafalgar Sq., W.C.2.)	Olympia
May 30-June 2	**Components Exhibition** (R.E.C.M.F., 21 Tothill Street, S.W.1.)	Olympia
June 12-17	**Components and Materials used in Electronic Engineering (Conference)** (I.E.E., Savoy Place, W.C.2.)	Central Hall
June 21-July 1	**INTERPLAS, International Plastics Exhibition and Convention** (*British Plastics*, Dorset House, Stamford Street, S.E.1.)	Olympia
July 7-29	**Soviet Trade Fair** (Industrial & Trade Fairs Ltd., Drury House, Russell Street, W.C.2.)	Earls Court
Sept. 6-8	**Microwave Measurement Techniques Conference** (I.E.E., Savoy Place, W.C.2.)	Savoy Place
Oct. 4-12	**Computer Exhibition and Symposium** (E.E.A., 11 Green Street, W.1.)	Olympia
Nov. 8-10	**Non-Destructive Testing in Electrical Engineering (Conference)** (I.E.E., Savoy Place, W.C.2.)	Savoy Place
Nov. 13-18	**Factory Equipment Exhibition** (Industrial & Trade Fairs Ltd., Drury House, Russell Street, W.C.2.)	Earls Court
FARNBOROUGH		
Sept. 4-10	**Farnborough Air Show** (Society of British Aircraft Constructors, 29, King Street, London, S.W.1.)	
NEWCASTLE		
Feb. 28-Mar. 2	**North East Electronic Engineering Exhibition** (Secretary N.E.E.E.E., c/o N.E.I.D.A., 9 Eldon Square, Newcastle-upon-Tyne 1.)	
OXFORD		
July 5-9	**Communications and Space Research Convention** (Brit. I.R.E., 9 Bedford Square, London, W.C.1.)	
OVERSEAS		
Jan. 9-11	**Reliability and Quality Control Symposium** (R. Brewer, G.E.C. Research Laboratories, Wembley, Middx.)	Philadelphia
Feb. 15-17	**International Solid State Circuits Conference** (J. J. Suran, General Electric Co., Syracuse.)	Philadelphia
Feb. 17-21	**International Components Exhibition** (Fédération Nationale des Industries Électroniques, 23 rue de Lubeck, Paris XVIe.)	Paris
Feb. 20-25	**International Symposium on Semiconductors** (Fédération Nationale des Industries Électroniques, 23 rue de Lubeck, Paris XVIe.)	Paris
Mar. 9-14	**International Hi-Fi and Stereo Exhibition** (Fédération Nationale des Industries Électroniques, 23 rue de Lubeck, Paris XVIe.)	Paris
Mar. 20-23	**I.R.E. National Convention** (Dr. G. K. Teal, I.R.E., 1 E.79 St., New York 21.)	New York
Apr. 30-May 9	**German Industries Fair** (Schenkers Ltd., 13 Finsbury Square, London, E.C.3.)	Hanover
May 2-4	**Electronic Components Conference** (I.R.E., 1 E. 79 St., New York 21.)	San Francisco
May 9-17	**Measurement, Control, Regulation and Automation Exhibition and Conference** (MESUCORA, 40 rue du Colisée, Paris 8.)	Paris
May 19-June 4	**British Trade Fair** (Industrial & Trade Fairs Ltd., Drury House, Russell Street, London, W.C.2.)	Moscow
May 22-24	**National Telemetering Conference** (I.R.E., 1 E. 79 St., New York 21.)	Chicago
May 22-24	**Global Communications Symposium** (I.R.E., 1 E. 79 St., New York 21.)	Chicago
May 23-25	**Large Capacity Computer Memories Symposium** (Miss J. Leno, Office of Naval Research, Washington 25, D.C.)	Washington
June 26-July 1	**International Measurement Conference** (Prof. J. F. Coales, The University, Cambridge.)	Budapest
June 28-30	**Joint Automatic Control Conference** (Dr. R. Kramer, M.I.T., Cambridge 39, Mass.)	Boulder
July 16-22	**Medical Electronics Conference** (Dr. H. P. Schwan, School of Electrical Engineering, University of Pennsylvania, Philadelphia)	New York
Aug. 1-12	**International Sydney Trade Fair** (Industrial & Trade Fairs Ltd., Drury House, Russell Street, W.C.2.)	Sydney
Aug. 22-25	**Western Electronics Show and Convention** (Wescon, 1435 LaCienega Blvd., Los Angeles.)	San Francisco
Aug. 25-Sept. 3	**German Radio Exhibition** (Berliner Ausstellungen, Charlottenburg 9, Berlin.)	Berlin
Sept. 11-15	**International Cybernetics Congress** (International Association of Cybernetics, 13 Rue Basse-Marcelle, Namur, Belgium.)	Namur
Oct. 9-11	**National Electronics Conference** (N.E.C., 228 N. LaSalle St., Chicago.)	Chicago

RANDOM RADIATIONS

By "DIALLIST"

Good Shot, Sir

JUST how electronic translating machines work I don't know; but work they certainly do, as is shown by the number now in use. There's no polished prose about their translations, which are more or less literal. Their vocabulary is necessarily somewhat limited, but they undoubtedly serve a most useful purpose by making books and articles understandable to people who don't know a word of the language in which they're written. Sometimes the machine is completely baffled by words which aren't in its vocabulary; but it always has a shot—and a pretty good one too as a rule. One machine kept on writing "water sheep" in the course of a translation on which it was engaged. The words occurred again and again. At first their meaning was dark to the mind of the would-be reader. Then light dawned. What it had been trying to set down was "hydraulic ram"!

Tiros II

THE latest American satellite, Tiros II, started to do useful work very soon after it had been launched. One of its jobs is to televise pictures of cloud formations back to earth and this it is doing most satisfactorily. It travels in an almost circular orbit a little over 400 miles aloft and enables a kind of weather forecast map to be made for all the areas within its range. It will thus become possible to track hurricanes with great accuracy. The satellite, besides carrying two television cameras, also has seven infra-red detectors for measuring the heat reflected from the earth, which again provides information about the gathering and the advancement of severe storms. The chief of the U.S. Weather Bureau says that information such as Tiros II sends to earth could have saved thousands of lives lost in the recent tidal waves in Pakistan. This satellite is the forerunner of the complete weather system "Nimbus" which is planned for 1962.

Underwater TV

ONE of the many interesting items shown at the recent Industrial Photographic and Television Exhibition was the latest model of the Marconi-Siebe Gorman underwater television camera. It can be so adjusted that it is almost weightless and can be carried by a diver, but it can also be lowered from the surface. The camera will be used by the North of Scotland Hydro-Electric Board chiefly to examine the big protective grilles (some 120ft below the surface) which prevent young salmon and other fish being carried into the turbines. Experiments have shown that at considerable depths and in water that is far from clear the TV camera can "see" a good deal better than a diver. The equipment will also be used for investigating fish life and behaviour in the various lochs. Closed-circuit TV has already become an invaluable aid to many branches of science and industry and new uses are always being found for it.

Scaring 'em Off

STARLINGS are a major menace on aerodromes used by jet planes. A recent appalling crash was almost certainly caused by their being sucked into the intakes of the engines and another disaster was averted by the presence of mind of a pilot who saw flocks of them as he was taking off and switched off his engines. Feathers and bits of starling were later found in the intakes. How to get rid of starlings is a real problem and so far it has proved baffling. A new approach to finding a solution is being made by the Ministry of Aviation in conjunction with the Trix Electrical Company. It consists in making hi-fi recordings of the alarm calls of starlings and other birds which frequent airfields and transmitting them from strategically placed loudspeakers. It is said to have given very promising results during the experimental stages. And it's not only aviation people who are interested in large-scale bird scaring. Farmers, fruit growers and others who suffer from damage to their crops would have a ready welcome for a system proved to be successful. And so, one imagines, would authorities in London, Birmingham and other cities in which huge flocks of starlings arrive to roost every evening.

TV in N.Z.

AT the moment I think I'm right in saying that New Zealand has only one television station in action, the 500-W experimental transmitter in Auckland. Three others, though, should be at work early this year. These are to be 5-kW stations at Christchurch, Wellington and Dunedin. All the equipment, except the aerials, which are to be supplied by the New Zealand Broadcasting Service, will be made in this country by

Marconi's. It's going to be a difficult task to cover the whole of that mountainous country as the system grows and it'll certainly take some time to complete.

Talking Books

OURS is, I believe, the first country to introduce books recorded on tape for the blind. An entirely novel feature of the new Talking Book machine being introduced by the National Institute for the Blind is a tape cassette containing two spools mounted one above the other and also housing and protecting the play-back head. Half-inch tape is used, the 18 tracks recorded on it provide up to 20 hours of playing time. Near the end of each track the user is warned and all that he has to do to start on the next track is to turn over the cassette and press a button. And there are safety devices to prevent damage. The new tape equipment will gradually replace the disc machines now in use. Assistance in installing and servicing the machines is needed from volunteers in most parts of the country. Any reader who is able and willing to give it should write to: E. Read-Jones Manager, Nuffield Talking Book Library for the Blind, Mount Pleasant, Alperton, Wembley, Middx. Offers will be most warmly appreciated.

A Long Time Coming

IT appears that we are to adopt the metric system for some purposes, at any rate. The old and quite outdated apothecaries' weight, with its scruples and drams and that sort of thing, is to be replaced fairly quickly by the metric system of weights. Scientists have, of course, largely adopted metric methods already and they're widely used in wireless. No one would now dream of expressing a wavelength in yards, feet and inches. But we've been as a country a very long time in making up our minds to discard our antiquated weights and measures in favour of the more sensible system. Some of our units are just nonsensical: why, for instance, are there 112 lbs in a *hundred*weight? I suppose that originally it deserved its name by consisting of 100 pounds; then the extra twelve were added for good measure. Now that they're about to adopt decimal coinage in the Antipodes I hope we shan't be long in following their lead. The metric system would save an immense amount of the time spent now in intricate calculations.

UNBIASED

BY "FREE GRID"

Exhibitiana

I HEAR the organizing committee is already holding meetings to discuss plans for the 1961 National Radio Show. If the committee has not advanced too far with its plans, I do hope it will consider making an innovation which I think would be welcomed by many.

My suggestion is that in addition to the individual exhibitors' stands, to which we are all accustomed, there should be special stands on which is grouped equipment of a like kind by all exhibitors. Thus I should like to see a stand on which there was nothing but tape recorders of all makes, another stand where there were shown all the available transistor midget sets, and so on.

At present if anybody wishes to examine the various types of tape recorders or other things before making a choice, it is necessary to go to umpteen stands which may be widely separated. It is, in fact, necessary to use tooth and claw, or at any rate, elbows and umbrella, to fight one's way through dense crowds of people who seem to have come to the show with the sole purpose of getting in the way of those who, like myself, have come with a serious purpose.

A splendid example of the usefulness of the grouping of exhibits in the manner I suggest was shown in the pages of our associate journal *Amateur Photographer* in its report of the world-famous biennial Photokina exhibition at Cologne. Although none of the stands at this exhibition were actually grouped in the manner I have suggested, the Editor of *Amateur Photographer* considered the interests of his readers by treating the stands as though they were so grouped. Thus, instead of a stand-to-stand report, he gave what I will call a group-by-group one.

Doubtless I shall be told that at Earls Court there is no room for these "group" stands. That is, of course, utter nonsense as can be seen from the accompanying photograph I myself took of one of the empty spaces in the gallery at last year's show.

[Logically, "Free Grid's" scheme would require additional floor area comparable with that at present allocated to firms' stands. Anything very much less would call for selection (by whom?) of representative exhibits. —Ed.]

Unwitting Offence

WE are often told that ignorance of the law is not a good defence if one is charged with a breach of it. But I have sometimes wondered if that would hold good in all circumstances. The thing which has brought this matter to my mind once more is the case recently reported in the Press of a young lady driving her invalid chair who, late at night, found her vehicle stuck in the mud in a rather lonely spot.

Because of a disability she was unable to get out of the chair and so was faced with the possibility of spending the night in this position. She remembered what she had been taught in the Girl Guides and endeavoured to attract attention by sounding on her electric horn the international distress signal in morse. She naturally expected the sound to reach the ears of some passer-by.

What actually happened was that her signals appeared as long and short flashes on the screen of a television set in a house not very far away. After a time the viewers realized that what they saw was a deliberate signal and when they went outside the house to consult the neighbours they could hear the actual sound of the horn although its signals were very faint.

The lady's rescue was obviously due to the fact that the radio signals she unwittingly sent out were picked up. Even had she known that the mechanism of the electric hooter formed a short-range spark transmitter, and had deliberately used it as such, it is hardly likely that any proceedings would have been taken against her, although it would certainly have been a technical offence as she had no transmitting licence.

Personally speaking, this incident has taught me a lesson and I intend to make provisions for the connection of my horn mechanism to my car-radio aerial so that I can send out a signal for help if I ever break down on a lonely road in evening broadcasting hours. I think that by making this provision I shall be guilty of establishing a radio transmitter even though I never have occasion to use it. I shall await with interest the service of a summons.

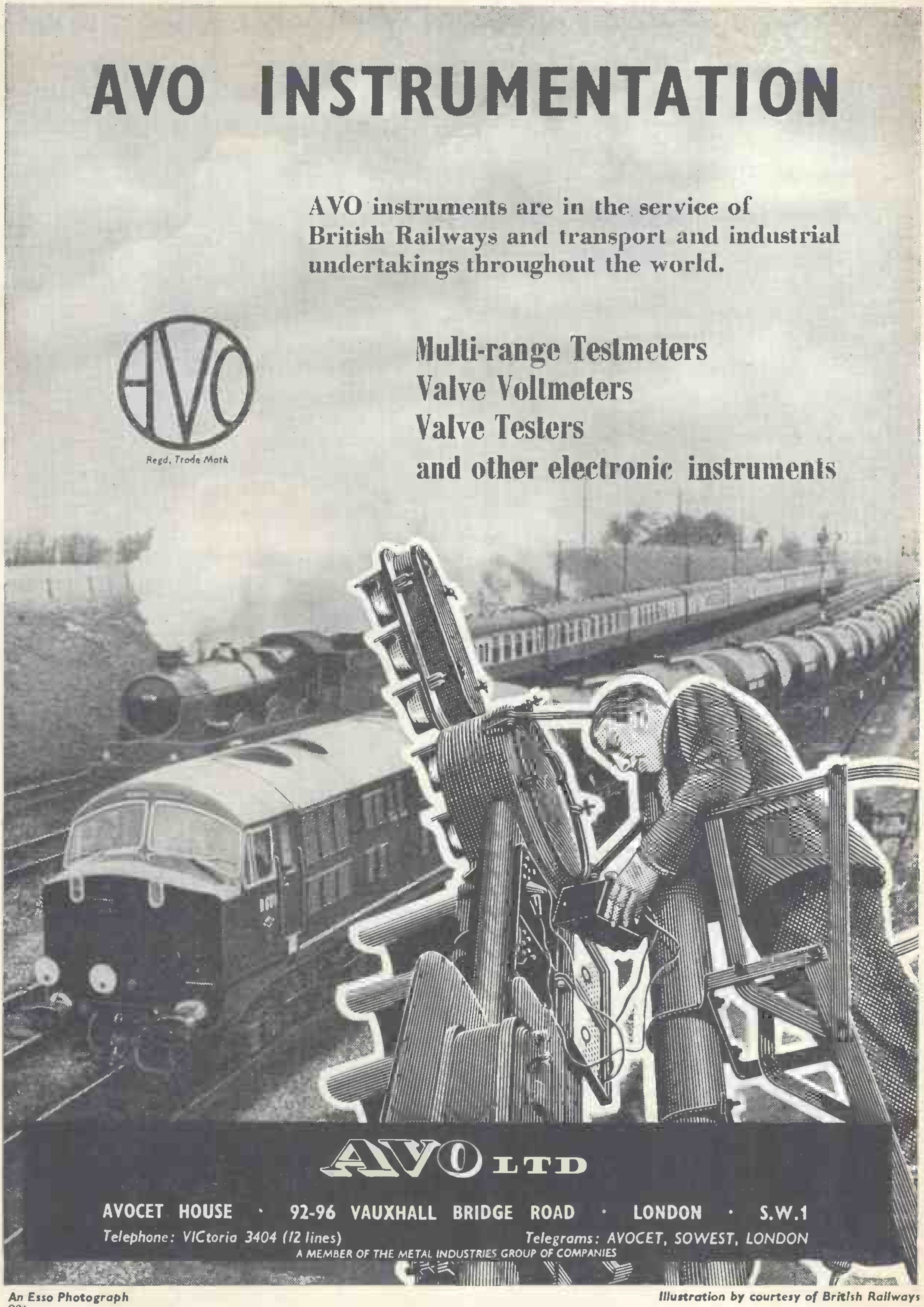
It is high time, I think, that all cars were equipped with short-range transmitters and all A.A. and R.A.C. 'phone boxes with receivers and other apparatus to enable an emergency call to be put through to the nearest depot of the motoring organizations. I have bitter memories of having to walk over two miles one stormy night to the nearest 'phone box after I had broken a half-shaft.

I Smell, You Stink

THE words in the title of this note are, of course, those used by Dr. Johnson when he was trying to teach good English to somebody who seemed to think that the verb "to stink" was merely a cacophonous vulgarism for "to smell." As the good doctor explained, the first verb in my title could only be used of the person at the receiving end of an olfactory system, and the last verb only of the person at the transmitting end.

I mention this as I think it is high time we had another Dr. Johnson to rebuke the B.B.C. for the misuse of words which it permits its announcers to make. For instance, the word "nostalgia" used to mean homesickness but the B.B.C. announcers—and in particular the ladies—seem to have changed all that. When they use the adjectival form of it, as they so often do, they seem to regard it as a synonym for reminiscent, sentimental, or half a dozen other things.

There are many other instances of this sort of thing, and I don't think Dr. Johnson would have allowed the B.B.C. the same poetic licence which he granted to Shakespeare. As the good doctor is no longer with us, could not A. P. Herbert or Eric Partridge be persuaded to undertake the task of preparing for us a dictionary of B.B.C. misusages.



An Esso Photograph
G24

Illustration by courtesy of British Railways

A new Grommet development

THE DOUBLE SEALING EMPIRE RUBBER GROMMET

infinitely accommodating in use: considerably reduces range of sizes because the same grommet can be used with several plate thicknesses or cable sizes

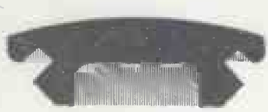
PAT. APP. No. 5255/59

This newly developed self-conforming grommet, because it is immediately self-locking against the elements, is the solution to many of an engineer's sealing problems.

Any one size will not only accommodate itself to a variety of mounting plate thicknesses, but (designed for cable or control rod) will take these in a variety of sizes and be weather-, water- and dust-proof at a variety of angles to the cable or rod.

Because of its capacity to conform to many varying requirements, it enables a workshop stock range of grommets to be reduced to perhaps one tenth of that at present maintained.

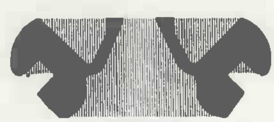
THE NEW BLIND GROMMET



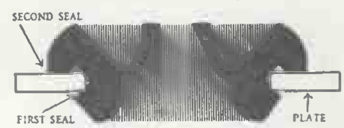
FREE

Note how when sprung into position the grommet provides a perfect double seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.

THE NEW DESIGNED GROMMET

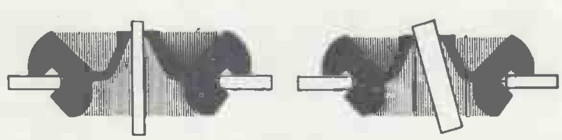


FREE

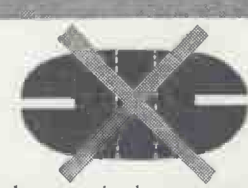


FITTED

In the cable grommet variety the same double pressure seal is created, allied to tight seal on various diameters of cable. This new grommet gives sound sealing at *all* vital points.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size are possible. This avoids necessity for special grommets with angled bores.



In the conventional grommet, only one thickness of plate and only one size of cable can be accommodated. No effective seal is afforded by the parallel groove.

Now being produced in a range of sizes

THESE GROMMETS WILL SOLVE YOUR SEALING PROBLEMS

ENQUIRE *for catalogue section and detailed particulars.*

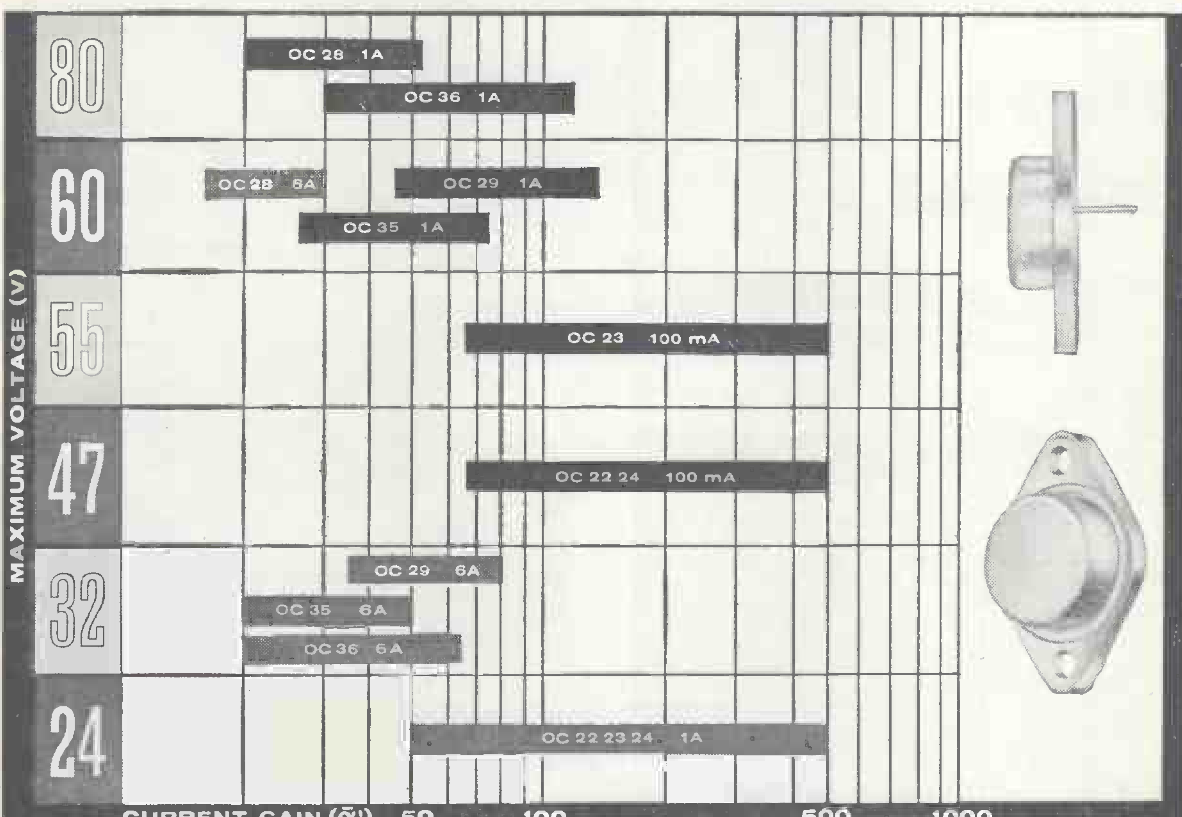
EMPIRE RUBBER COMPANY · DUNSTABLE · BEDFORDSHIRE · ENGLAND

R.B.101

GERMANIUM POWER TRANSISTORS

are best selected from this chart

—then you should contact the MULLARD technical information service, who will give you all the data you need to confirm your choice.



GREY is maximum allowable collector-emitter voltage at maximum continuous current.

BLACK is maximum allowable collector base voltage Vcb max. (Ie=0).

Here is a guide to recommended applications:

- ✲ **OC22** for high-quality industrial audio
- ✲ **OC23** for ferrite memory core drive
- ✲ **OC24** for r.f. power applications
- ✲ **OC28** for d.c. converters (24V version)
- ✲ **OC29** for extra high gain
- ✲ **OC35** for general purpose, low-cost application
- ✲ **OC36** for general purpose, high-power audio and d.c. converters (12V version)

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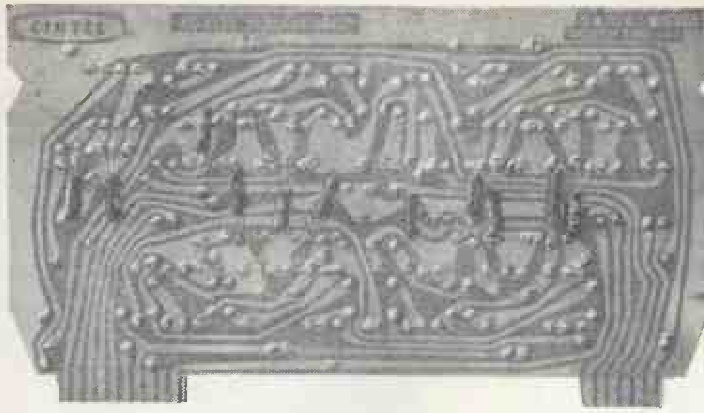
semiconductors for industry

SEMICONDUCTOR DIVISION

Mullard Limited · Mullard House · Torrington Place · London WC1 · Tel: LANgham 6633

MIS 27a

Printed Circuit Counter Panels



A complete range of transistorized counter panels of common size, fixing method and electrical connexion, designed to provide a flexible unit system whereby any special requirements in the counting or data processing fields can be quickly built up.

A fully illustrated brochure giving complete performance and specification figures for every panel in the range is available on request.

50kc/s Scaler
1Mc/s Scaler
Input Amplifier
Gate Unit
10kc/s Oscillator
1Mc/s Oscillator
Power Unit
50kc/s Read-out Scaler
1Mc/s Read-out Scaler
4 Channel Output Unit
Read-out Unit
Meter Display Unit
Lamp Display Unit
Numerical Indicator Tube
Shift Register Stage
Shift Register Driver

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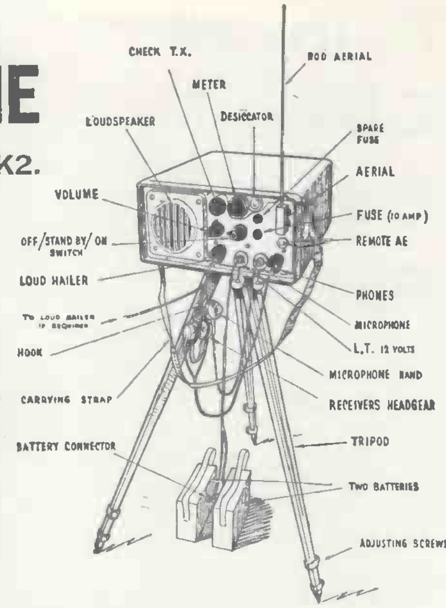
Portable/Mobile

V.H.F RADIO TELEPHONE

TYPE W.S B44 MK2.



EXPORT ONLY

CRYSTAL CONTROLLED 60-95mc/s.

A modern 14-valve superhet receiver and AM transmitter using current series of B7g valves. Valve line-up: 2–CV136/7D9, 1–CV137/EAC91, 7–CV138/EF91, 4–CV416/6F17. Robust cast aluminium case includes 5in. loudpseaker. Internal vibrator pack (synchronous type) provides operation from 12-volt accumulators or vehicle or boat 12-volt supply, in fixed or mobile use. Available, less crystals and accessories, but with connecting plugs, ex-stock. Accessories and crystals for specified frequencies in the range 60–95 Mc/s can be supplied to order at extra cost.

Each unit is fully tested and in good condition. Price (including packing FOB London), £20 each.

Special quotation for quantities up to 500 sets.

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50 MICRO AMP MOVING COIL METERS

Brand New & Boxed—Large Stocks available

Made on Government Contract by Famous British Maker

3⅛in. Square—800 ohms resistance. 4 Scales operated by lever "Set-zero"—"0–3"—"0–30"—"0–300." Easily coupled to rotary range switch by cord or lever. Ideally suitable for transistor tester, output meter, volt-milliameter. Adjustable to work as centre-zero 25–0–25 μA.

A RANGE OF METER BOXES

Useful for all kinds of testgear, a quality job in welded steel, finished in grey hammer stoved enamel. Standard panel size 4½″ x 7¼″, available in depths 2″, 3″, 4″ and 6″.

UNDRILLED: 2″ 12/6: 3″ 13/-: 4″ 13/6: 6″ 15/-. With panel punched to take one 50μA meter, add 1/6, or to take two meters 2/6.

Complete with data

ONE METER **19′6** (*plus post 6d in U.K.*)

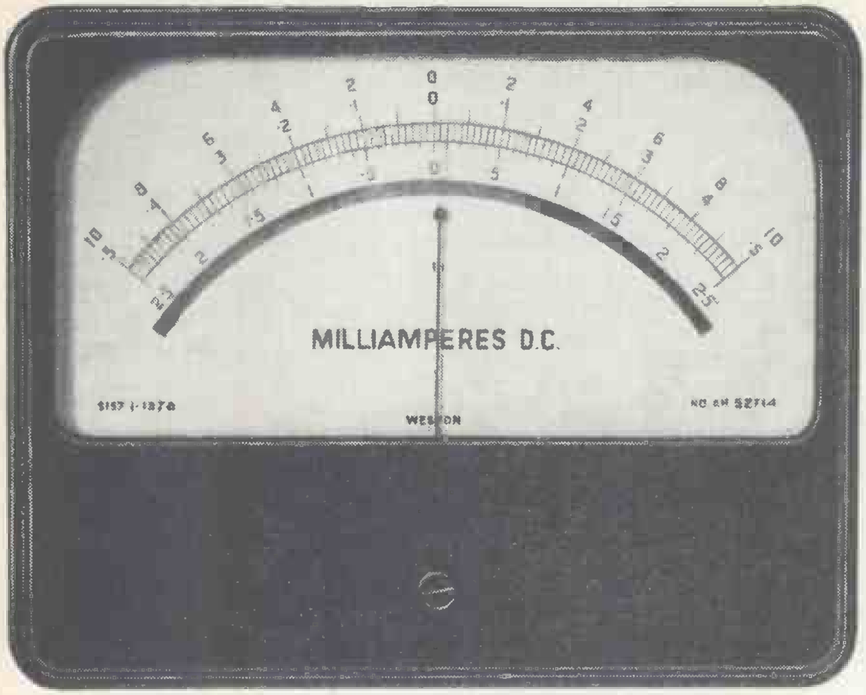
TWO METERS **35′-** (*plus post 1/- in U.K.*)

SPECIAL PRICES FOR 100 LOTS

TEST GEAR COMPONENTS (LONDON) LTD

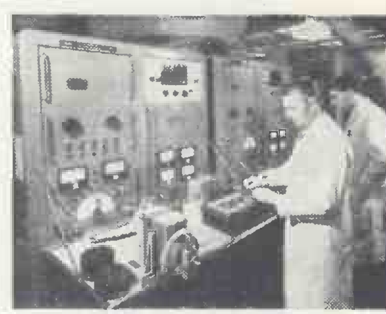
15 ARCANY ROAD, SOUTH OCKENDON, ESSEX *TEL: SOUTH OCKENDON 2610*

meters made to measure



This multi-range meter, using Sangamo Weston S.157, is one of several similar instruments produced by Anders for Ultra Electronics Limited within 14 days. The meters are used in Ground Test Equipment supplied to B.O.A.C. (shown below) for testing the Ultra Engine Throttle Control fitted in Bristol Britannia Aircraft. A typical example of the quick service Anders are giving to many famous firms. Anders are indebted to Ultra Electronics Limited and B.O.A.C. for permission to illustrate this equipment.

special multi-range meter produced for Ultra in 14 days



The Anders Instrument Centre is in a unique position to meet the most urgent, and the most unusual, meter requirements from production, development and research. Most standard meters are available immediately from stock. Non-standard meters are calibrated, tested, and normally ready within 10-14 days. All shapes; sizes from 1½" to the largest switchboard meters. All well-known makes and all types including moving coil, moving iron, thermocouples, electrostatic, dynamometers and full range of meter accessories. Anders would like to demonstrate the kind of service they can give you and look forward to your enquiries, by letter or by telephone.

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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. (±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. **£34.15.0**

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.
Hitherto 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. **£9.18.6**

RESISTANCE-CAPACITANCE BRIDGE KIT Model C-3U

Measures capacity 10pF to 1,000μF, resistance 100Ω to 5 megohms and power factor. 5-450 v. test voltages. Safety switch provided. **£7.19.6**

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. **£19.3.0**

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. **£13.18.6**

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: 0-1.5V. to 1,500V A.C. and D.C.; 150μA to 15A D.C.; 0.2Ω to 20MΩ. 4½in. 50 μA meter. **£11.8.6**

DECADE CAPACITOR KIT Model DC-1U

Capacity values 100μμF to 0.111μF in 100μμF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£5.18.6**

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 circuit and a 7in. x 4in. high-flux speaker. **£14.18.6**

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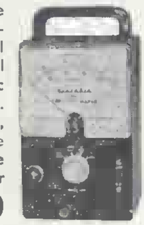
Tuning range 88-108 Mc/s. Flywheel tuning. Attractive Plastic Front Panel in two-tone grey with golden trim, surround and motif. Thermometer type visual tuning indicator. Pre-aligned I.F. transformers (eliminates adjustment). Three I.F. Stages. Wide-band low distortion. Ratio Detector. Complete R.F. Unit, wired, tested and pre-aligned (ready for mounting to chassis). Printed circuit for I.F. Amplifiers and Ratio Detector, for ease of assembly. No alignment necessary after assembling. Built-in power supply. Output sockets for stereophonic adaptor (for stereo transmission when available).

TUNER UNIT Model FMT-4U (incl. 16/11 P.T.) with 10.7 Mc/s. I.F. output	£3 2 0
FI.. AMPLIFIER Model FMA-4U complete with case and valves	£10 10 6
Sold separately ....Total	£13 12 6

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. 0-100μμF, 0-1,000μμF, 0-0.01μF, 0-0.1μF. The meter has 4½in. scale and can be used by an unskilled operator after a few minutes' instruction. **£14.10.0**

2¾in. SERVICE OSCILLOSCOPE KIT Model OS-1

Light, compact, portable, for service engineers Printed circuit board for easy construction. Wt. 10½ lb. Size 5in. x 8in. x 14½in. long. **£18.19.6**

POWER SUPPLY UNIT KIT Model MGP-1

Compact, general purpose unit suitable for FM 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. **£4.9.0**

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. **£13.18.6**

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 M ohms with internal battery. D.C. input impedance is 11 Megohms and dB measurement has a centre-zero scale. Complete with test prods, leads and standardising battery. **£13.0.0**

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. **£1.5.6**

● **Deferred Terms available on all orders above £10.** ●

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A MEMBER OF THE DAYSTROM GROUP, MANUFACTURERS OF *thoroughly* **Heathkit** DAYSTROM *dependable*

"HAM" TRANSMITTER KIT
Model DX-40U

Covers all amateur bands from 80 to 10 metres. 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. **£29.10.0**

BALUN COIL UNIT KIT
Model B-1U

Useful transmitter accessory. Will match unbalanced coaxial lines, used on most modern transmitters, to balanced lines of either 75 or 300Ω impedance. Can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will handle power inputs up to 200 watts. **£4.4.6**

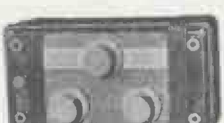
MATCHED HI-FI STEREO KIT

4-speed Transcription Record Player Model RP-1U	£12 10 0
6 w. Hi-Fi Amplifier, Model S-33	£11 8 0
Twin Stereo Speaker Systems Model SSU-1	£20 11 0
Total cost if purchased separately	£44 9 0

YOURS for **£42.10.0**

if all ordered together, or £8/8/- deposit and 9 monthly payments of £4/3/-. Pedestal speaker legs £2/14/- optional extra.

PERSONAL TRANSISTOR RADIO KIT
Model UJR-1



Operated by a 4.5V. torch battery, this sensitive dual-wave headphone set is a fine introduction to electronics for young and old. In Polystyrene moulded plastic case which accommodates battery (and amplifier if added). **£2.16.6**

Additional Amplifier Stage Model UJR-1S will enable the UJR-1 to work a loudspeaker under favourable conditions. 16/6 extra.

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All prices include free delivery in U.K.

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Models TA-1M and TA-1S

This Combined Tape Record/Replay Amplifier is available in both monophonic and Stereophonic models. Model TA-1M can be modified to the stereo version with modification kit TA-1C.

TA-1M £16/14/-; TA-1S, £22/4/-; TA-1C, £6.

4-wave TRANSISTORISED PORTABLE RADIO
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Using 7 latest type transistors and three diodes this highly sensitive set is specially designed for Short and Medium wavebands (200–550, 90–200, 18–50 and 11–18 m.). In solid leather case fitted with retractable whip aerial........... **£20.18.6**

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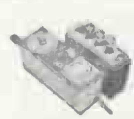
Provides extended frequency coverage on six bands from 100 kc/s.-100 Mc/s. on fundamentals and up to 200 Mc/s on calibrated harmonics. **£11.11.0**

GRID-DIP METER
Model GD-1U



Functions as oscillator or absorption wave meter. With plug-in coils for continuous frequency coverage from 2 Mc/s. to 250 Mc/s. **£9.19.6**

Two Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves, 15/-.

TRANSISTORISED GRID-DIP METER
Model XGD-1

Similar to GD-1U. Fully transistorised with a frequency range of 1.75 to 45 Mc/s. **£9.18.6**

AMATEUR TRANSMITTER KIT
Model DX-100U

The world's most popular "Ham" T.X. Kit

- Completely self-contained, compact "Ham" Transmitter.
- Built-in, high 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 back-lash free. ● VFO or Crystal control.
- Covers all Amateur bands up to 30 Mc/s. phone or CW **£78.10.0**

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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. For all Amateur Bands 160–10 metres. Ideal for Heathkit DX-40U and similar transmitters **£10.12.0**
Price less valves £8/19/6.

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Please send me FREE CATALOGUE (Yes/No).........
Full details of Model(s) ....
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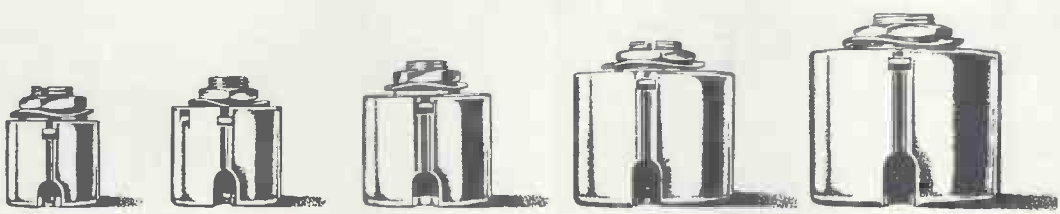
Covers frequencies from 100 Kc/s to 2 Mc/s



A new series of Vinkor adjustable pot cores has now been developed by Mullard for use in the frequency range 100 kc/s to 2 Mc/s. This series is in addition to the highly successful group already widely used for frequencies between 1 kc/s and 200 kc/s.
The world's most efficient pot core assembly, the Mullard Vinkor gives a choice of 3 permeabilities and has exceptionally high performance and stability.
Write today for full details of the wide range of Vinkors now available.

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ADJUSTABLE POT CORE ASSEMBLIES

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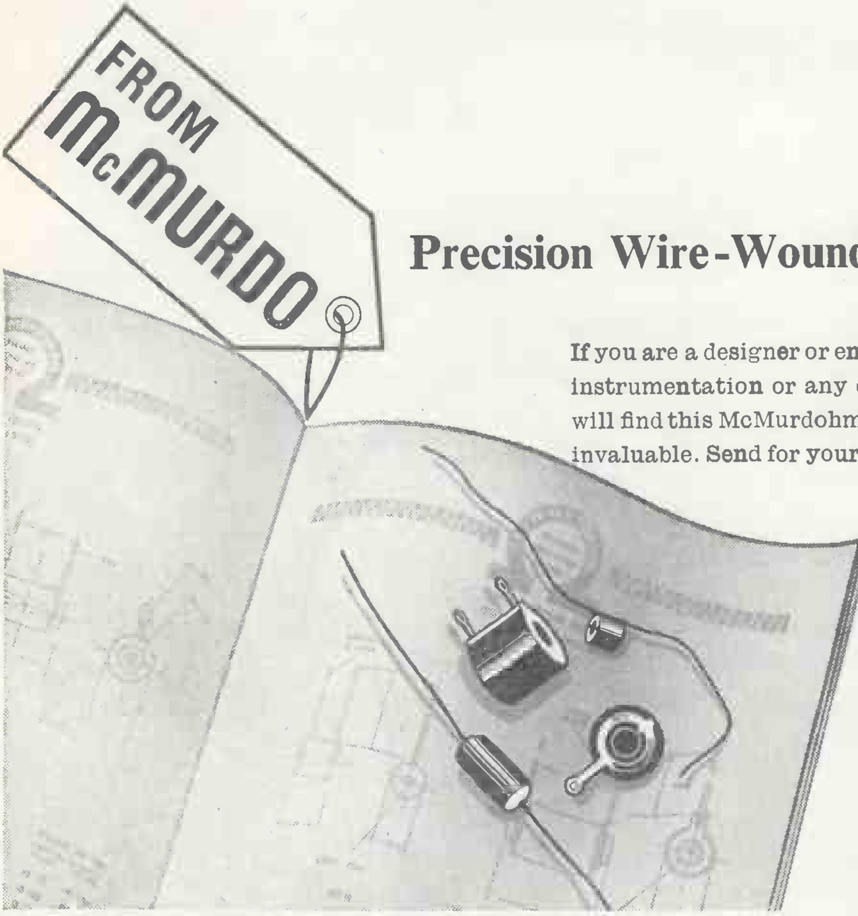

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If you are a designer or engineer in computer circuitry, instrumentation or any other field of electronics you will find this McMurdohm Resistor technical catalogue invaluable. Send for your copy.

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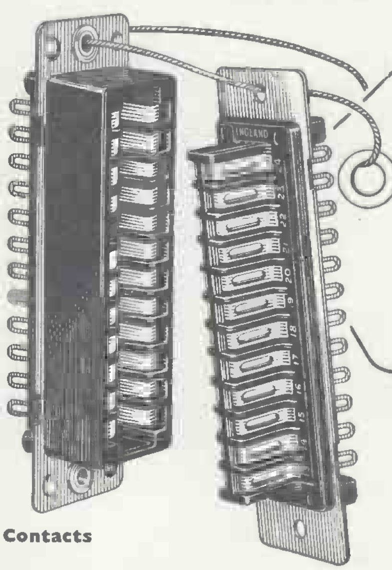
24 WAY CONNECTOR



McMURDO Red Range Connectors

- Gold plated Contacts
- Nylon loaded P.F. mouldings
- Easy insertion and withdrawal

8 WAY
16 WAY
24 WAY
32 WAY

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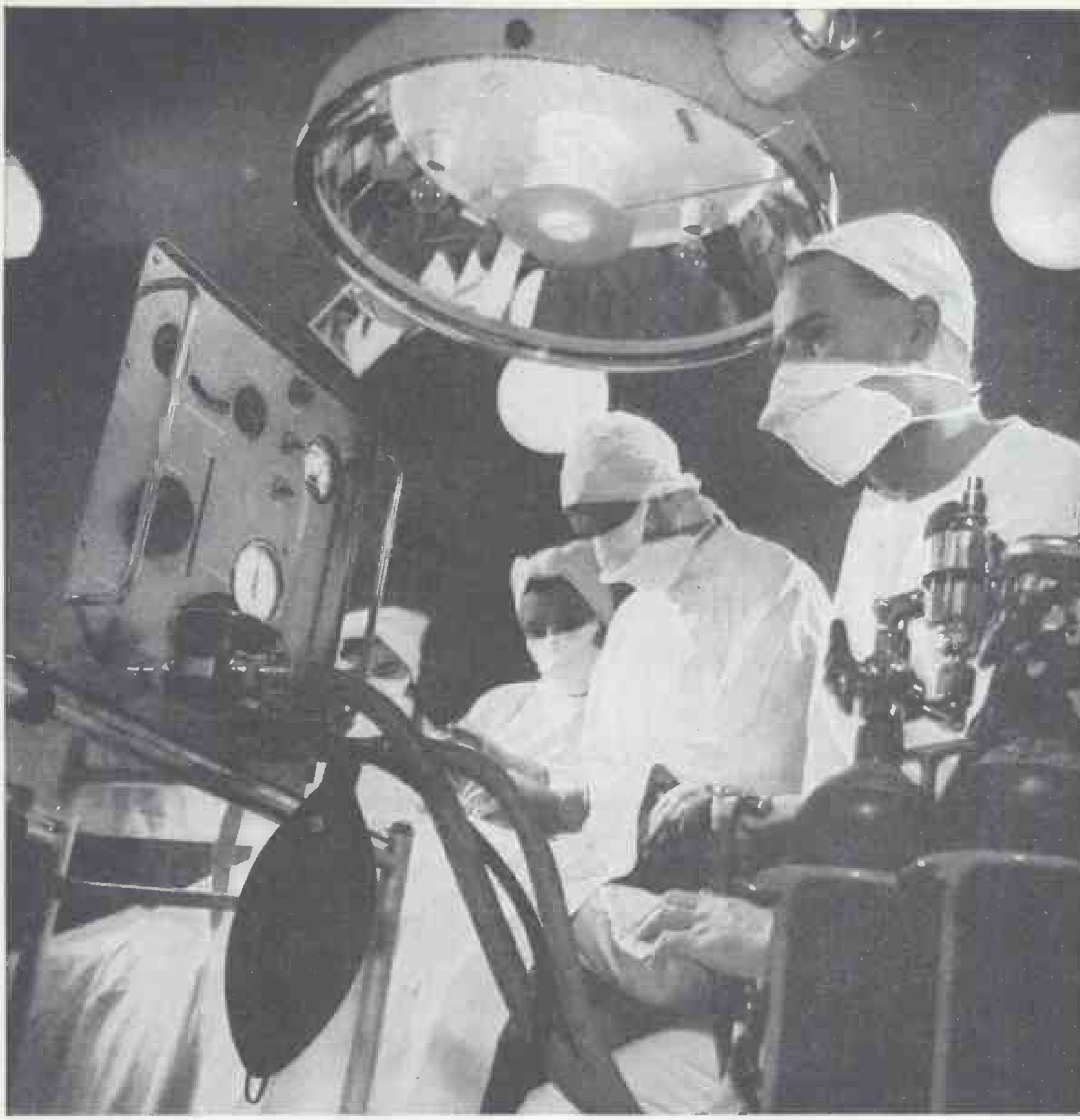

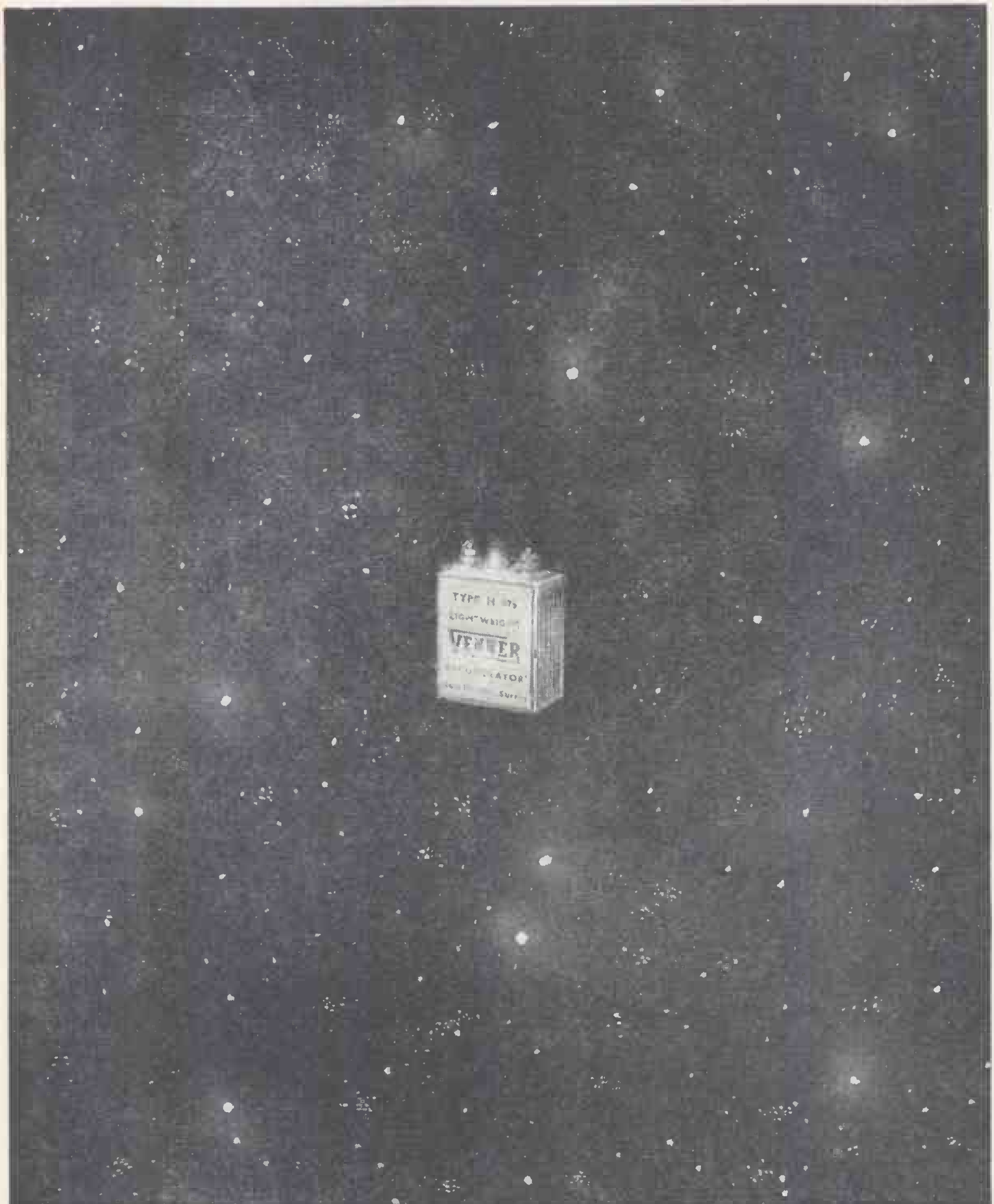
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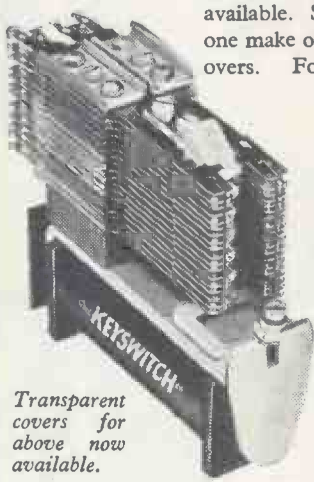
The best known and most useful relay available. Spring sets allow from one make or break to 12 change-overs. For minute or heavy switching. Sensitivity down to 20 milliwatts. Adjustable for critical timing, fast or slow operation. Standard or Tropical finish. Special adaptations can be supplied.



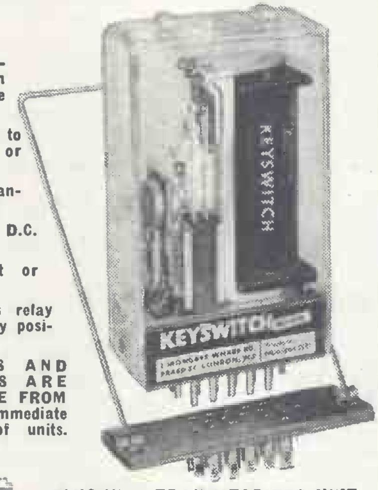
Transparent covers for above now available.

and now PLUG-IN 3000 Type Relays

Plug-in facilities in addition to all the versatility and well-established, reliable features of the world's best known relays.

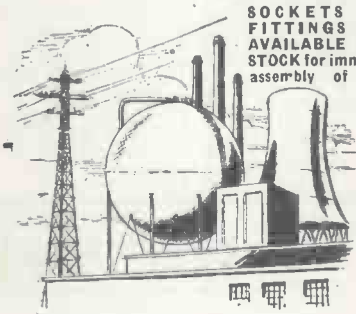
- ★ Positive contact between male and female pins.
- ★ Contacts: up to 18 light duty or 12 heavy duty.
- ★ Complete transistorized units.
- ★ A.C. or D.C. operation.
- ★ Transparent or metal cover.
- ★ Clip retains relay positively in any position.

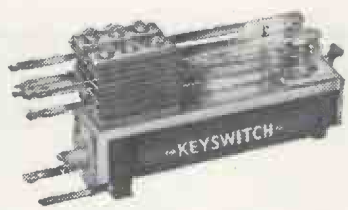
SOCKETS AND FITTINGS ARE AVAILABLE FROM STOCK for immediate assembly of units.



PLUG-IN — TRANSISTORIZED UNIT

Operation AC or DC Switching or Signal Current AC or DC 5 to 500 micro-amps. Transfer switching current 10 amps. or 500 v.

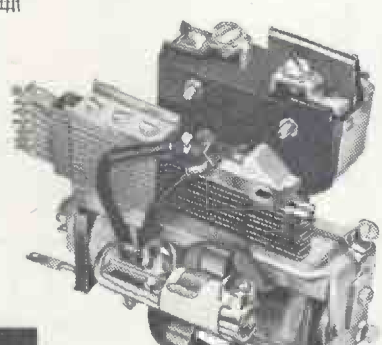




MINOR TYPE '600' (Fitted with double pole changeover for 250 volts, 2 amps.)

Ideal for simple switching operations where lightness, compactness and economy are prime considerations. When fitted with contacts similar to those of the "B.P.O. 3000" type it is faster in operation and release.

This relay incorporates 15 amp. Micro Switch; 5 amp. Mercury Switch and standard 0.3 to 8 amp. contacts.



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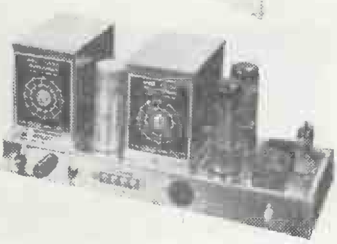
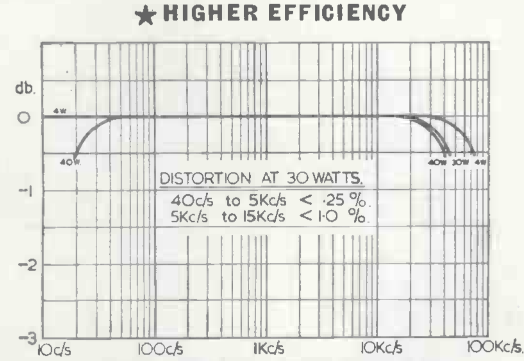


The AVEL TM120D mains transformer and the AVEL TO30D/2 output transformer mounted on a 30 watt Hi-Fidelity power amplifier.



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TOROID DIVISION

Aveley Electric Limited

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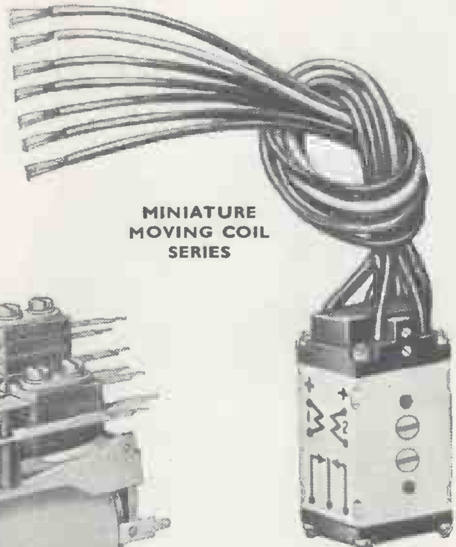

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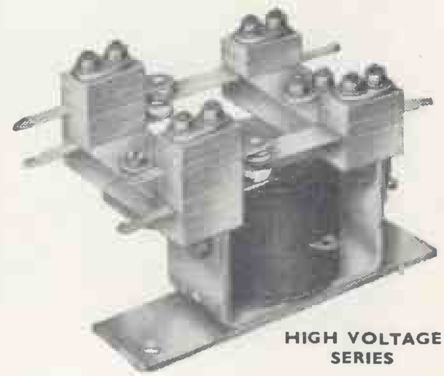

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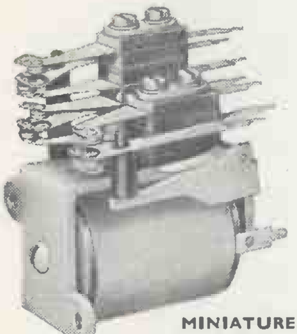

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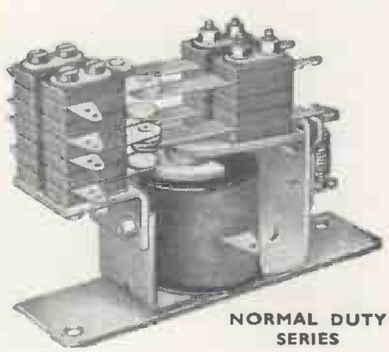

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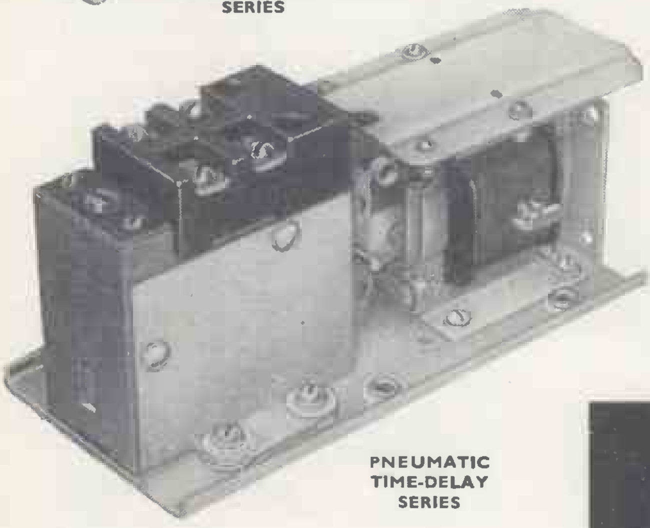

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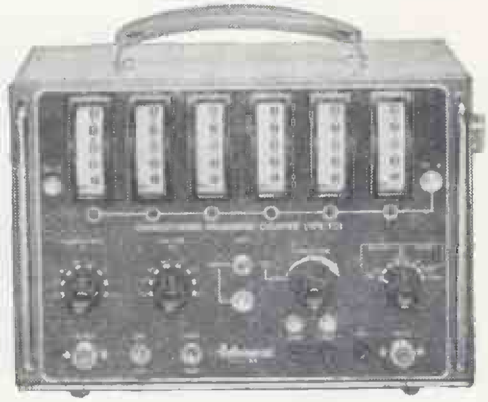

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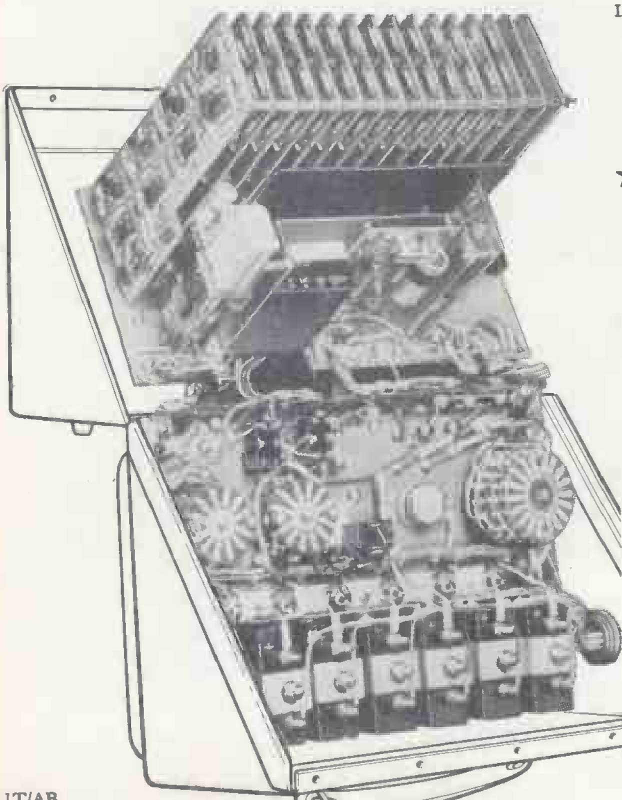

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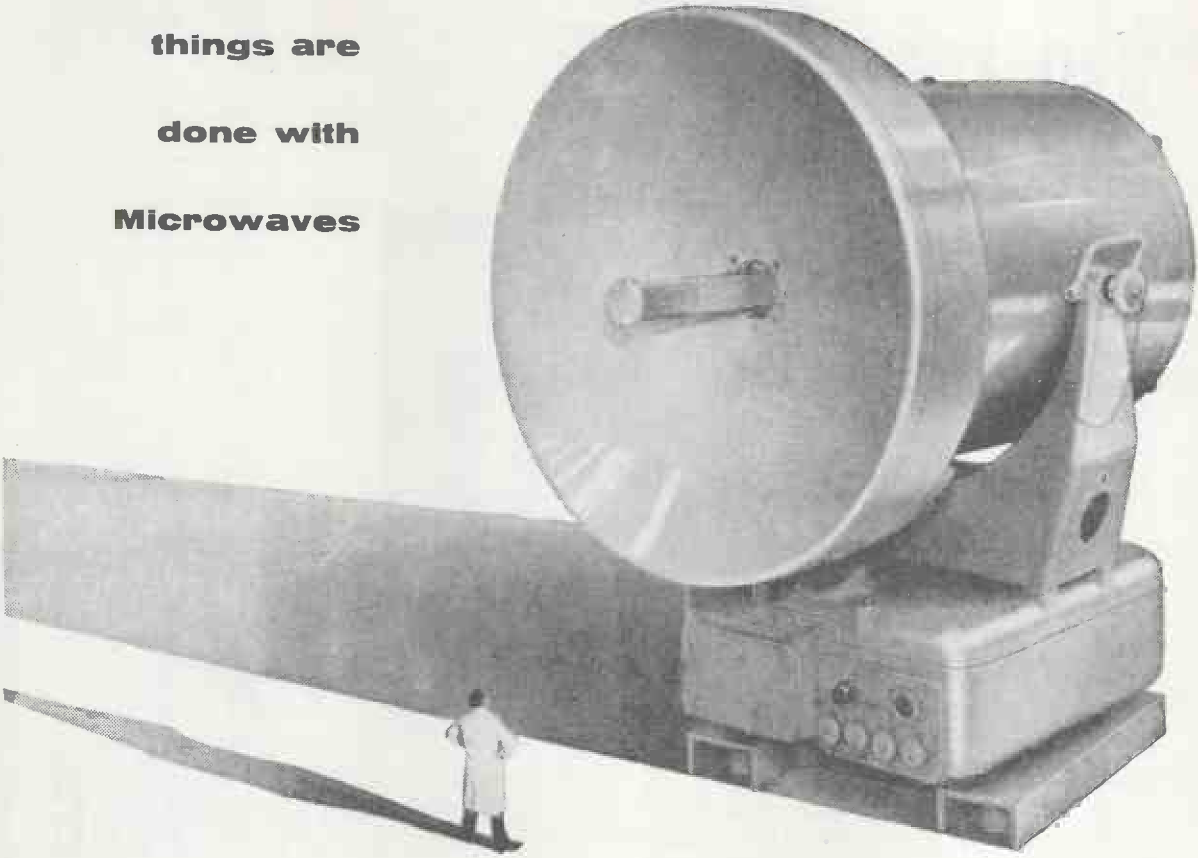

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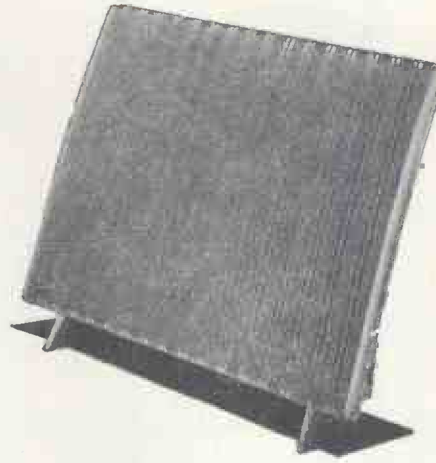

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	Input I	Input II
Measuring range:	100 μV (f.s.d.) - 10 V in 11 steps	10 mV (f.s.d.) - 1000 V in 11 steps
Input impedance:	1 MΩ (± 1.5%) in parallel with 20 μμF	100 MΩ (± 1.5%) in parallel with 10 μμF
Overall accuracy:	with respect to full scale ± 3%	
Pre-deflection:	< 5 μV	
Drift:	1 μV per hour after 1 hour of warming-up	

Automatic polarity indication
DC currents may be measured directly from 100 μμA (f.s.d.) up to 10 μA

L F Millivoltmeter, type GM 6012

Frequency range:	2 c/s - 1 Mc/s
Measuring range:	1 mV (f.s.d.) - 300 V in 12 steps
dB scale:	− 80 dB up to +52 dB (0 dB = 1 mW into 600 Ω)
Input impedance:	4 M Ω in parallel with 20 μμF (up to 3 V); 10 M Ω in parallel with 10 μμF (in the other ranges)
Overall accuracy:	with respect to full scale ± 2.5%, 5 c/s - 100 kc/s ± 5%, 2 c/s - 1 Mc/s
Pre-deflection:	< 100 μV

HF Millivoltmeter, type GM 6014

	without pre-attenuator	with pre-attenuator
Frequency range:	1 kc/s - 30 Mc/s	10 kc/s - 30 Mc/s
Measuring range:	1 mV (f.s.d.) - 300 mV in 6 steps	100 mV (f.s.d.) - 30 V in 6 steps
dB scale:	−80 dB up to -8 dB	−40 dB up to +32dB
Damping at 10 kc/s:	1 MΩ	50 MΩ
1 Mc/s:	700 k Ω	10 MΩ
30 Mc/s:	50 k Ω	2 MΩ
Input capacitance:	7 μμF	2 μμF
Pre-deflection:	compensated by electrical zero setting	

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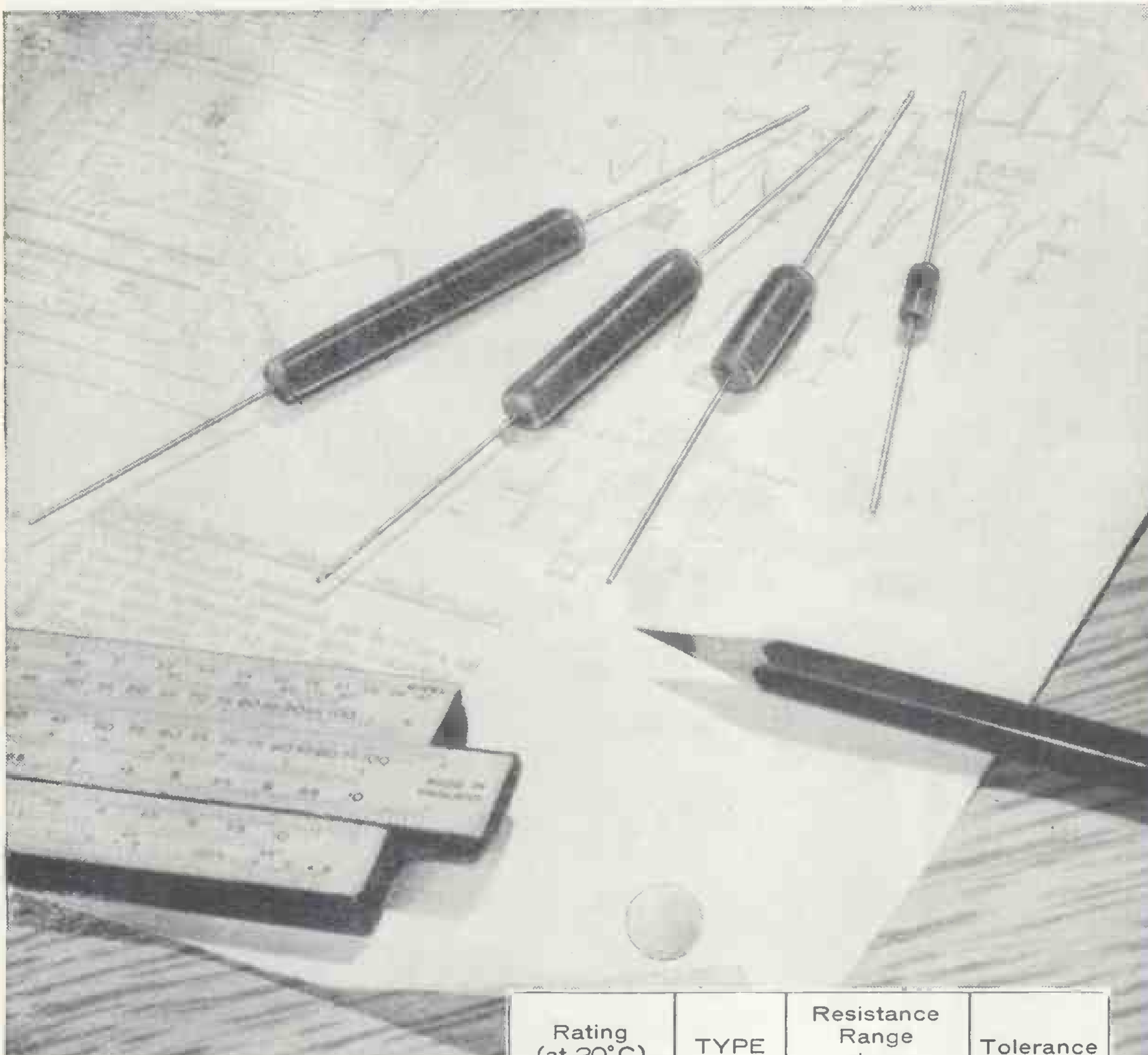

Rating (at 20°C) Watts	TYPE	Resistance Range ohms		Tolerance
		Min	Max	
4	MV1A	1 10	9·9 6,800	10% 5%
7	301A	2	68,000	5%
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A.C. voltage 1mV to 1100 V.	Accuracy ± 0.25% of full scale.
Resistance 1Ω to 1.1MΩ.	Accuracy ± 0.25% of full scale.

DVOM uses well-tried Venner packaged circuits, making for reliability in use and ease in servicing. Stepping switches, relays and need for frequent calibration have all been eliminated.

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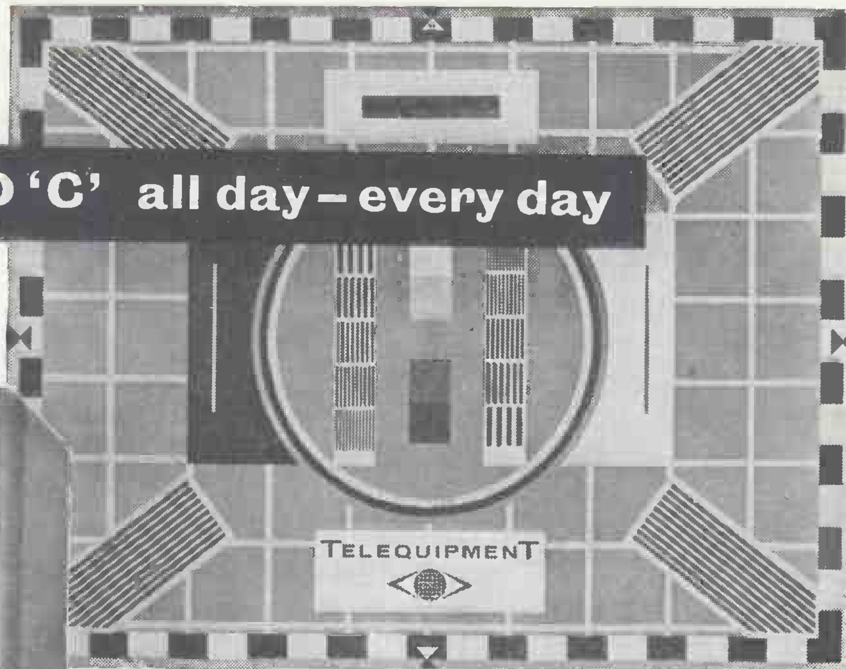

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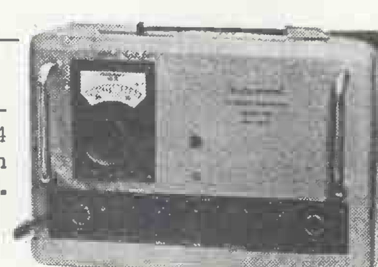

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MODEL 58C–8"x5"

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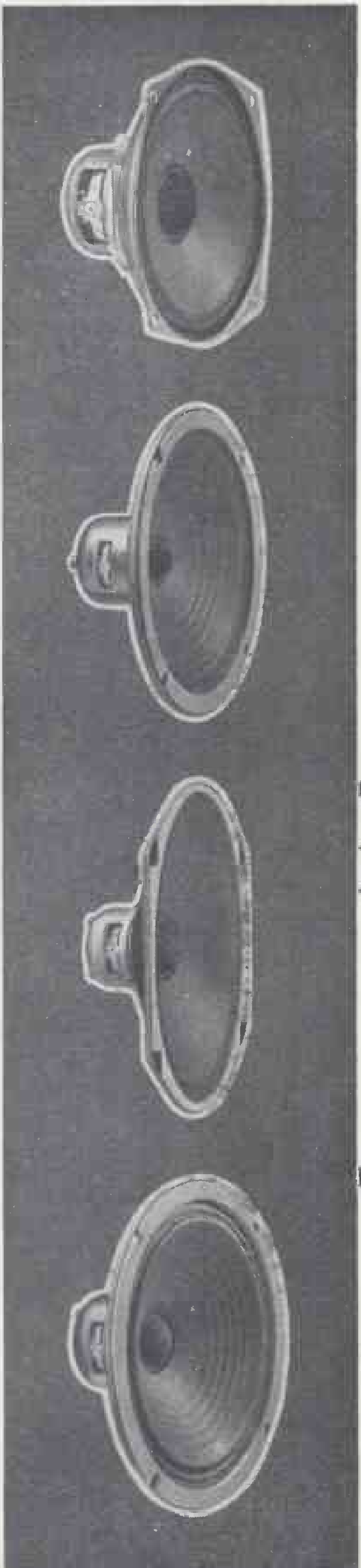

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7 x 3in.	37G	6500 g	20/6	6/7
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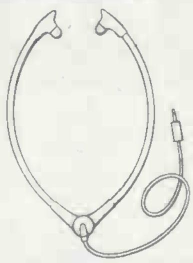
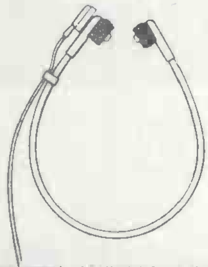
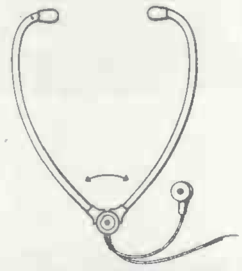


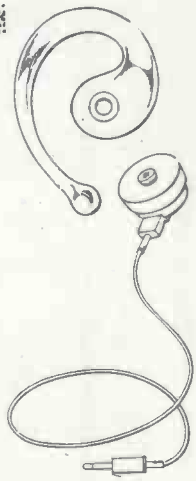
Stetoclip
Featherweight
No. 3530—40



Stetoclip
Junior "60"
No. 3530—35



Stetoclip
Senior
No. 3530—02



Plastic Earset No. 3512—83, Magnetic Earphone available in impedances from 15-8,000 Ohms, and cord with plug-combination and length according to individual requirements.

Straight Jackplug
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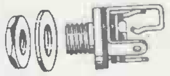
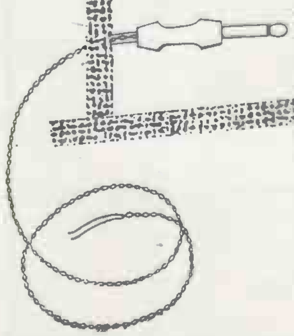
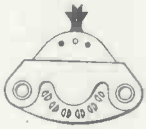


Jacksocket
with breaker
No. 7314—08

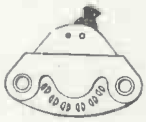


Moulded Straight or Angle Jackplug, only available with cord.



3-pos. Switch
No. 2030—08

2-pos. Switch
No. 2030—16



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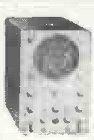

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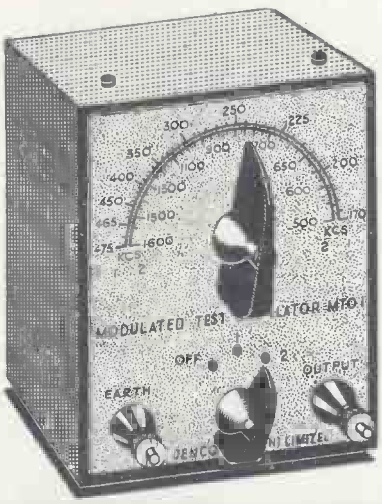

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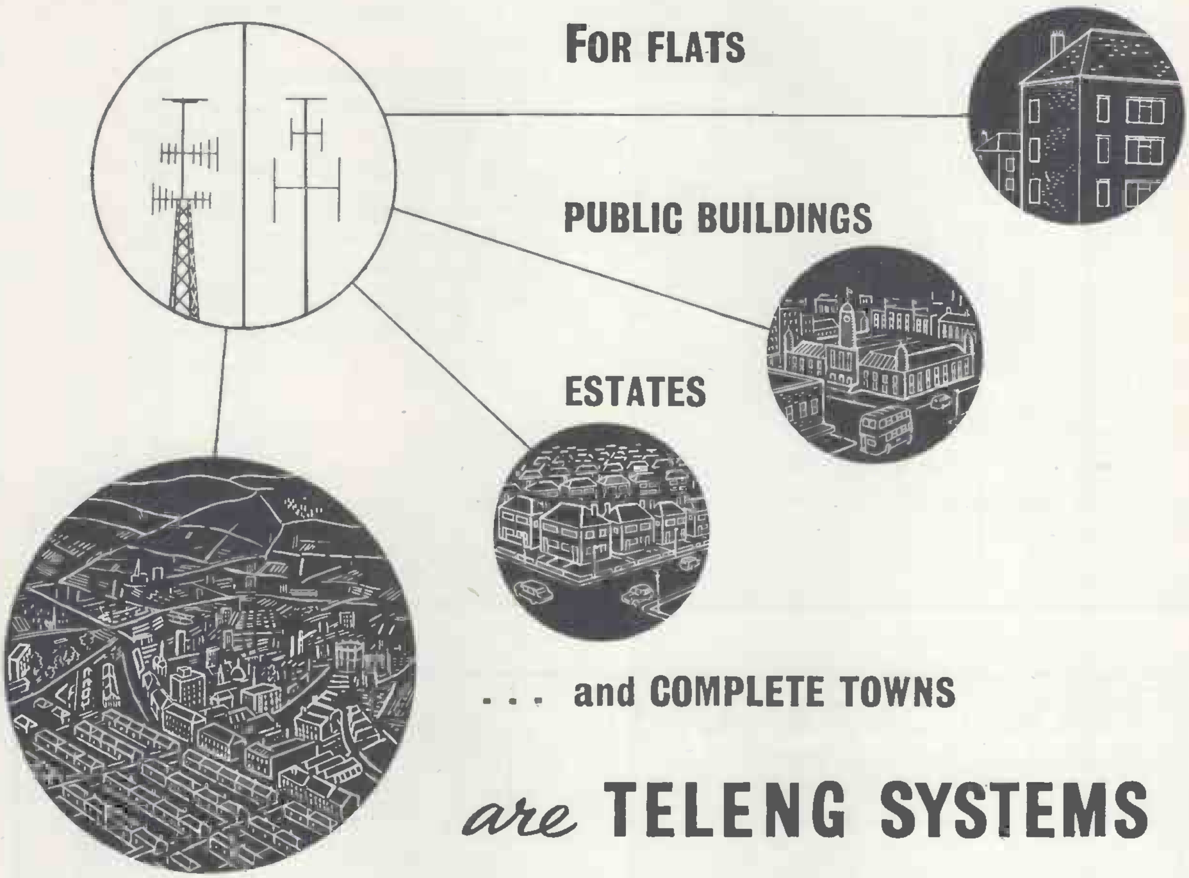

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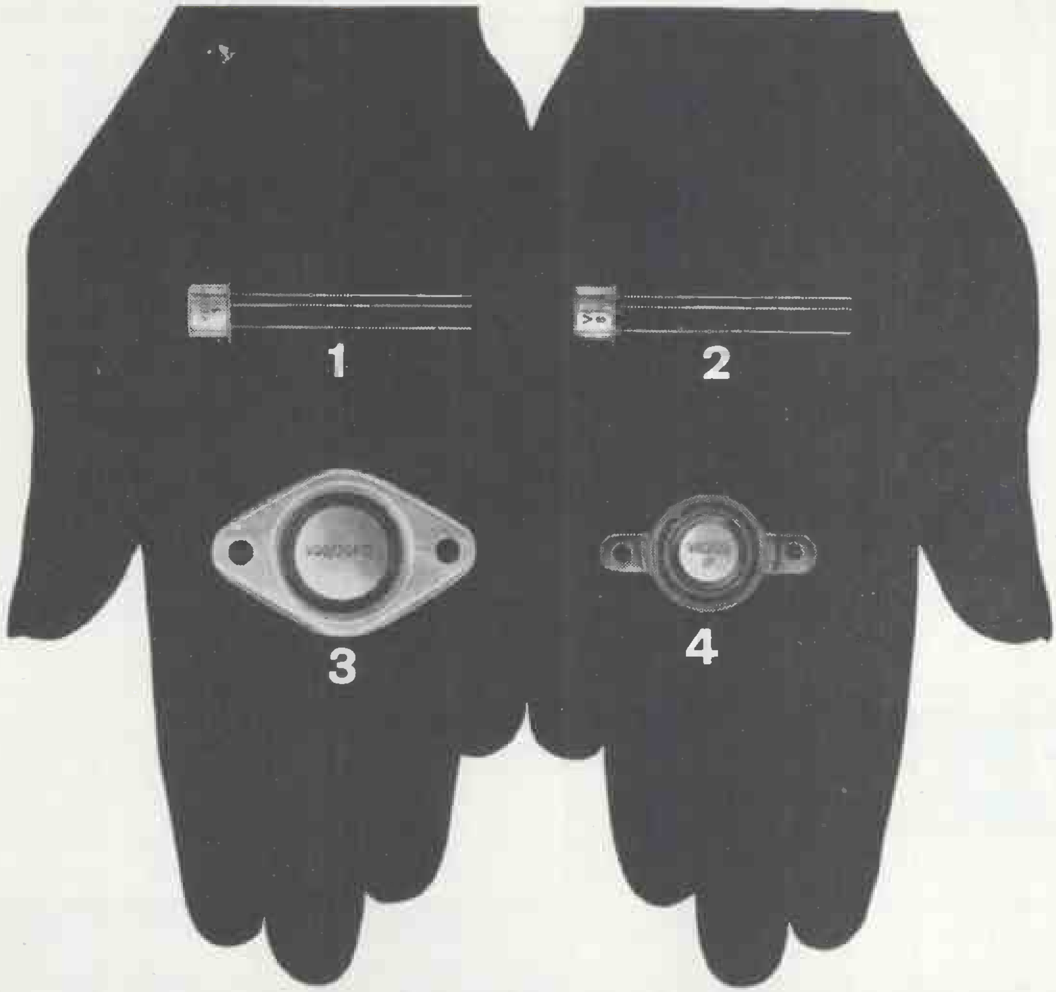

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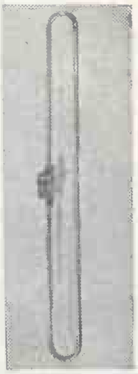

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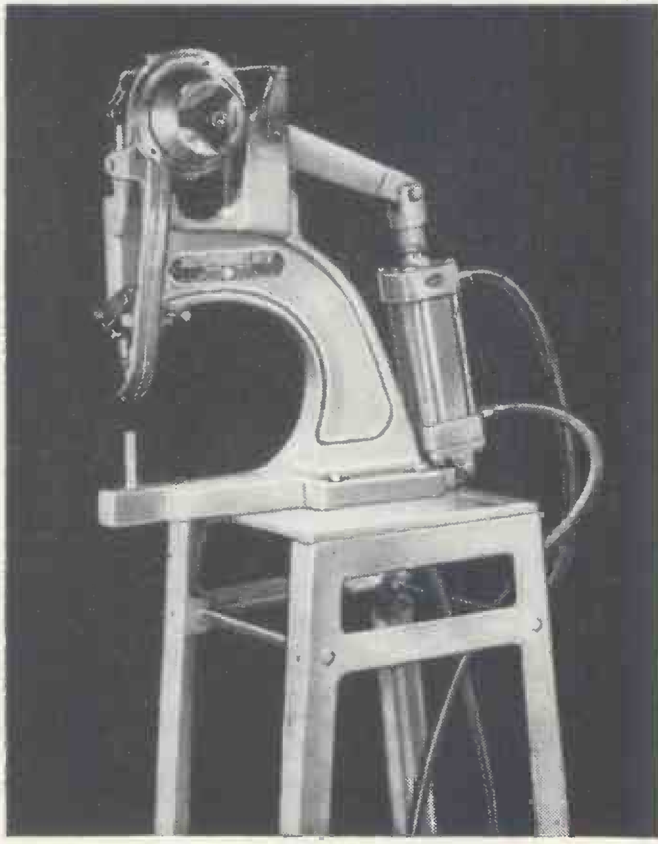

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FIG. 1. DERATING CURVE

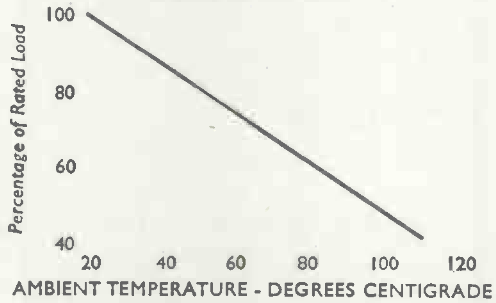
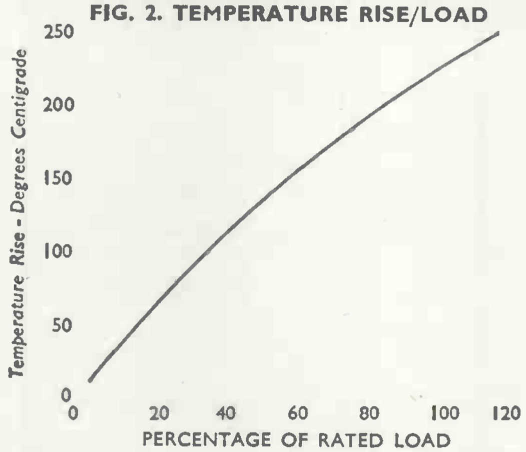


FIG. 2. TEMPERATURE RISE/LOAD



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* Resistance change less than 5% after 100 hours at 40°C. ambient temperature and 95% relative humidity.
* Resistance change less than 2% after three times normal load for 5 seconds.
* Resistance change less than 5% after 500 hours at full load in 25°C. ambient temperature.
* Resistance change less than 1% and no physical effects due to soldering.

MAXIMUM TEMPERATURE COEFFICIENT BETWEEN – 55 and +275°C.

TYPE	0.05%/°C.	0.03%/°C.
PW5	0.5Ω to 2.5Ω	2.5Ω to 2.0kΩ
PW7	0.5Ω to 8.0Ω	8.0Ω to 6.5kΩ
PW10	1.0Ω to 10Ω	10Ω to 10kΩ

TYPE	PW5	PW7	PW10
Wattage	5.0	7.0	10.0
Min. Value	0.5Ω	0.5Ω	1.0Ω
Max. Value	2.0kΩ	6.5kΩ	10kΩ
Length	7/8"	1 25/64"	1 7/8"

Width and height of all three types are 3/8" and 11/32" respectively.

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SPECIFICATION

	BATTERY	CHARGER	
Dimension	25x16x49mm	31x22x66mm	38x24x80mm
Weight	TR—9 37g.	TRC—9—2A1 23g.	TRC—9—2B1 35g. TRC—9—2B24 40g. TRC—9—2B25 42g. TRC—9—3B1 43g.
Voltage		A—Type A.C. 100—130V	B—Type A.C. 200—240V

KIND OF PLUGS

TRC—9—2A1 2 flat pins
TRC—9—2B1 2 flat pins
TRC—9—2B24 2 round pins (4mm)
TRC—9—2B25 2 round pins (5mm)
TRC—9—3B1 3 flat pins

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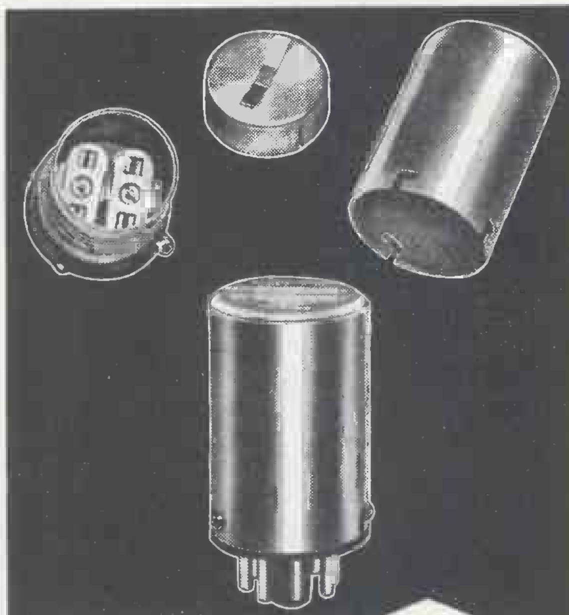

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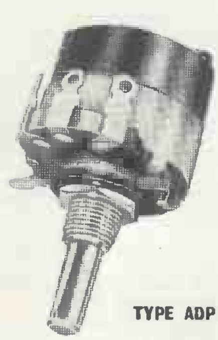
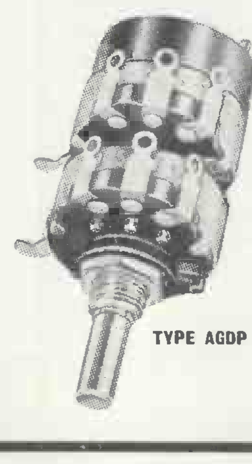


TYPE ADP



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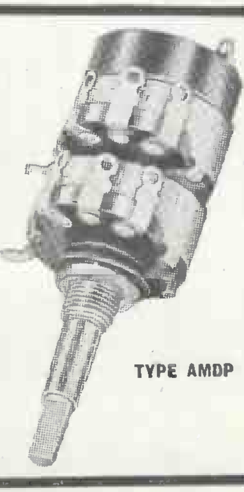

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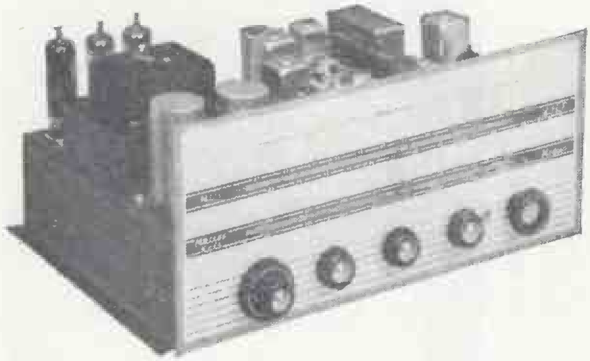

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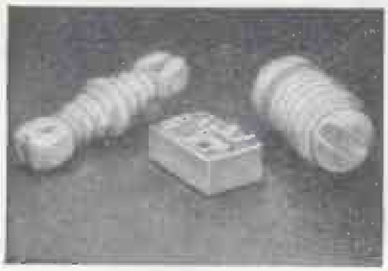

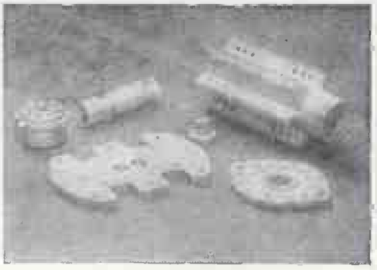

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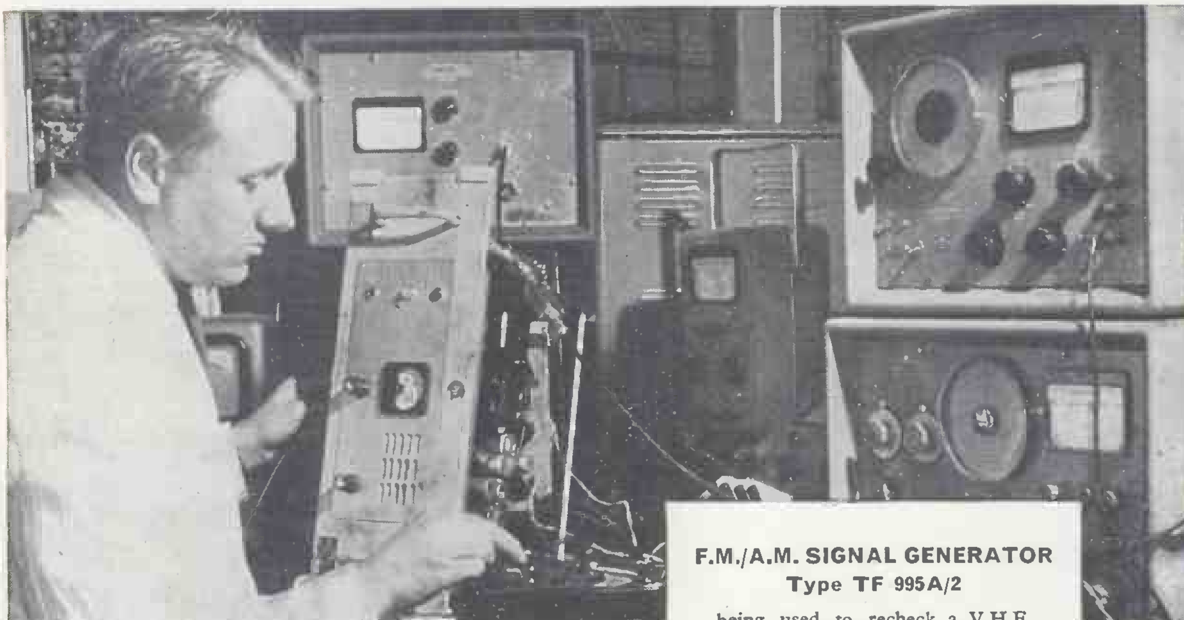

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Type TF 995A/2

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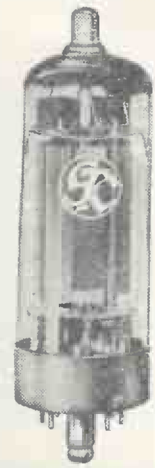
FOR THE 807



These STC valves are loctal-based, indirectly-heated, beam-power amplifiers electrically similar to the U.S.A. type 807 but with extra advantages. Little more than half the size of the 807 the electrode assemblies are more compact . . . stronger and more rigid . . . and the glass bulbs less vulnerable. Shorter grid and anode leads, and glass base with miniature-type pins reduce inter-electrode capacitance and improve performance at the higher frequencies. Thus, both mechanically and electrically, they offer a high standard of reliability, which, together with their small size, makes them particularly suitable for use in mobile equipment.

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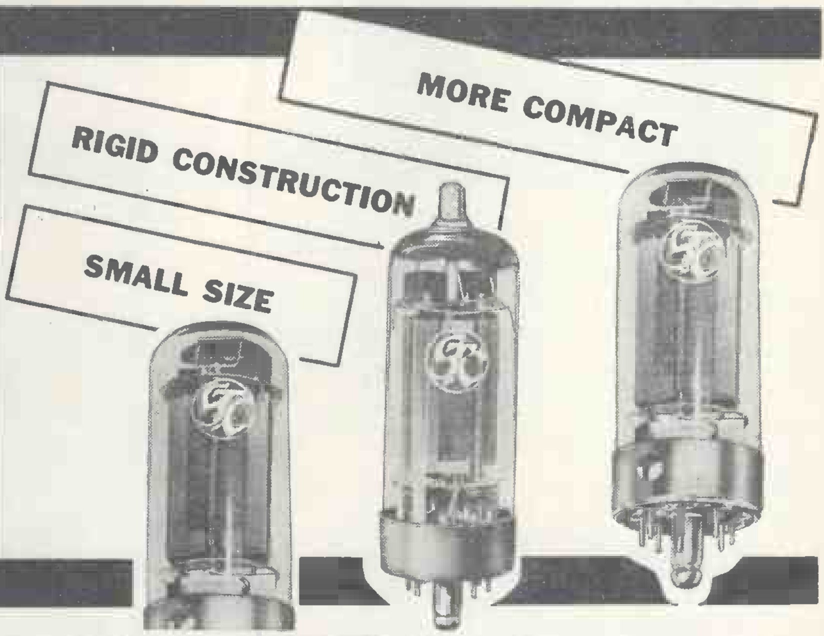

The range of four valves offers a choice of heater voltage:

5B/254M double-ended	5B/255M single-ended	5B/257M single-ended	5B/258M double-ended
6·3V	6·3V	12V	19V
0·9A	0·9A	0·47A	0·3A

Where the overall seated height must be kept as low as possible, the single-ended type 5B/255M may be used, but under conditions of high altitude or anode modulation the double-ended type 5B/254M is to be preferred because of insulation considerations at the valve base. A flying lead version is available under the code 5B/254G.

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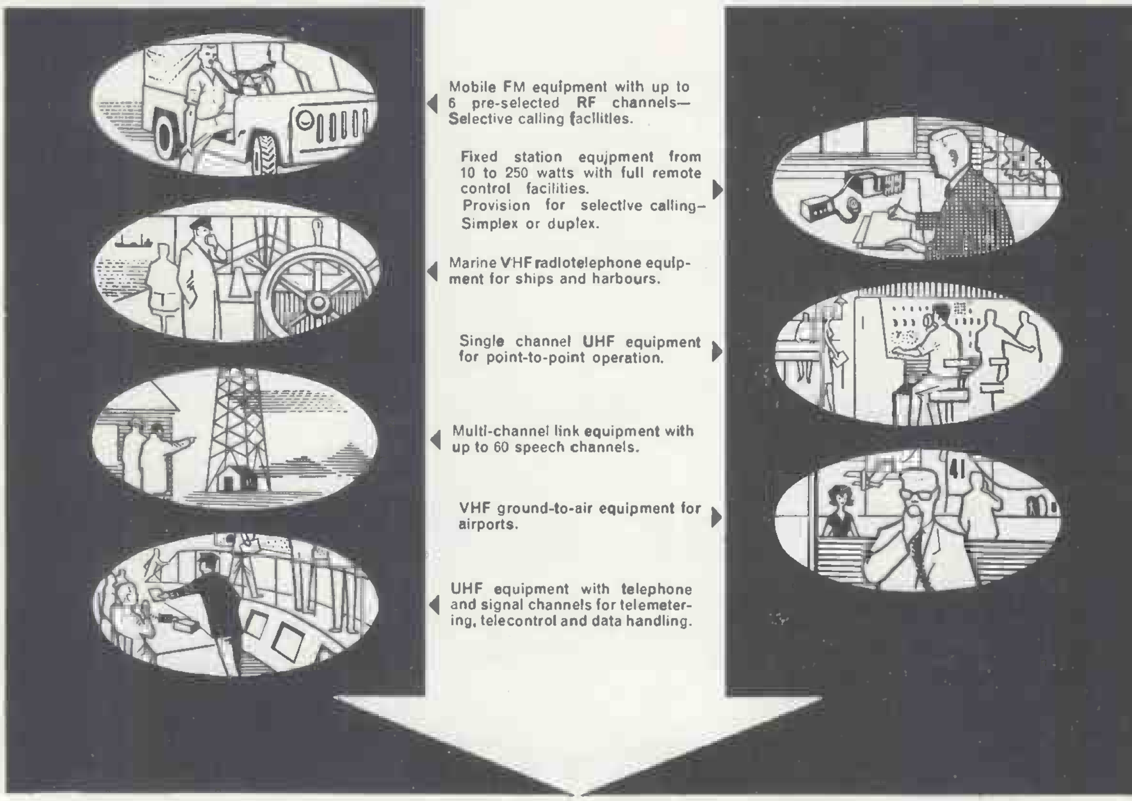

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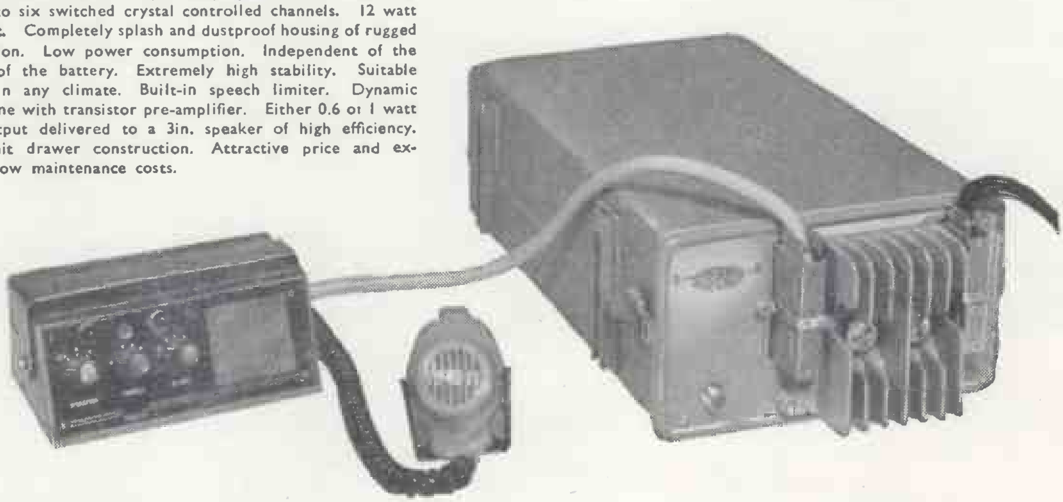

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No. 1 IN THE SERIES

Technical Information for the Transistor Circuit Designer

Switching Performance of Alloy Junction Transistors

There are several possible ways of specifying the switching performance of a transistor, but the most elegant of these involves the parameters τ_C and τ_S. τ_C is a measure of the charge, or quantity of minority carriers, stored on the base of a transistor when it is operated in the active region; τ_S is a measure of the charge stored when the transistor is operated in the saturated, or bottomed, condition.

For example, if τ_C is 0·03 μs, the collector current I_C is 10 mA, and the transistor is being operated in the active region, the charge stored is:

$$\tau_C I_C = 0{\cdot}03 \times 10^{-8} = 0{\cdot}3 \times 10^{-9} \text{ coulombs.}$$

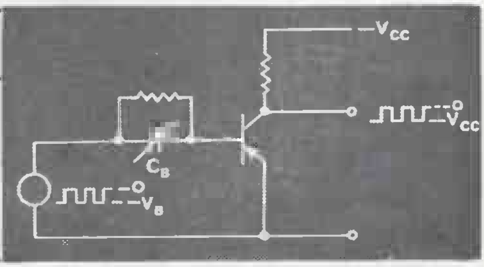
If $I_C = 10$ mA, $\tau_C = 0{\cdot}03$ μs, $h_{FE} = 40$, $\tau_S = 1{\cdot}5$ μs and $I_B = 0{\cdot}5$ mA, there is an excess base current equal to $I_B - \frac{I_C}{h_{FE}} = I_B' = 0{\cdot}5 - 0{\cdot}25 = 0{\cdot}25$ mA. This excess base current acts to drive the transistor into the saturation region and the charge stored is then:

$$I_B' \tau_S + I_C \tau_C = 0{\cdot}92 \times 10^{-9} \text{ coulombs.}$$

With a knowledge of τ_C, τ_S and the collector junction capacitance, the total charge stored in the base region and depletion layer of the transistor can be calculated. Comparisons can then be made between the relative merits of different types of transistors when operated in a specific circuit.

For further details see STC application report No. MK/146, "The Junction Transistor as a Charge Controlled Device" by R. Beaufoy and J. J. Sparkes, A.T.E. Journal, Vol. 13, No. 4, October 1957, and "Transistor Switching Circuit Design using the Charge-Control Parameters" by R. Beaufoy, Proc.I.E.E., Paper No. 2970, May 1959, Vol. 106, Part B.

	Type	τ_C (μs)	τ_S (μs)	$C_{b'c}$ (pF)	h_{FE} range	f_{hb} (Mc/s)
STC Switching Transistors	TK28C	0·03	1·5	18	25-54	—
	TK30C	0·053	1·6	20	15-95	6
	TK31C	0·025	1·3	18	25-125	11



C_B Adjusted to give 'Best' Square Wave Output at the Collector.

Basic circuit for measurement of τ_C and τ_S

With optimum* positive going edge at the collector the charge required to switch on the transistor is

$$Q_{ON} = V_B C_{B1} \simeq I_C \tau_C + 1{\cdot}7\, C_{b'c} V_{CC}$$

With optimum* negative going edge at the collector the charge required to switch off the transistor is

$$Q_{OFF} = V_B C_{B2} \simeq I_C \tau_C + I_B' \tau_S + 1{\cdot}7\, C_{b'c} V_{CC} = Q_{ON} + I_B' \tau_S$$

*Adjusted for minimum rise or fall time with no overshoot.

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61/1MK

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EDISWAN MAZDA 30F27

The 30F27 is a frame grid VHF tetrode having a mutual conductance of 15 mA/V at an anode current of 13.5 mA and a screen current of 1.7 mA with variable-mu characteristics to reduce cross-modulation effects at high signal levels.

This tetrode used in the RF stage of a television tuner offers certain advantages over the more conventional double triode cascode arrangement. For instance, the number of circuit components required is smaller, the layout is simpler and for valves having comparable slopes the single cathode type valve can be manufactured more economically.

Normally the noise performance of a tetrode is inferior to that of a triode due to the presence of partition noise arising from the screen current. However the 30F27 has been specially designed to provide a low ratio of screen to anode current to minimise the effect of partition noise while still retaining good screening between control grid and anode. When this is used in conjunction with frame-grid techniques a high slope per milliamp of anode current can be obtained resulting in a high gain RF valve with a noise performance much superior to that of a conventional pentode and equal to that of a double triode cascode amplifier such as the 30L1.

Heater Current (amps)	I_h	0.3
Heater Voltage (volts)	V_h	3.7

TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

Anode Dissipation (watts)	$p_{a(max)}$	2.5
Screen Dissipation (watts)	$p_{g2(max)}$	0.4
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Voltage (volts)	$V_{g2(max)}$	230
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)}$ rms	90*
Cathode Current (mA)	$I_{k(max)}$	18

* From cathode to higher potential heater pin.

Inter-electrode Capacitances (pF)†

Input Capacitance	c_{in}	6.3
Output Capacitance	c_{out}	1.8
Grid 1 to Anode	c_{g1-a}	0.027
Grid 1 to Grid 2	c_{g1-g2}	2.0
Grid 1 to Cathode	c_{g1-k}	4.0

† Measured in fully shielded socket, without can.

Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

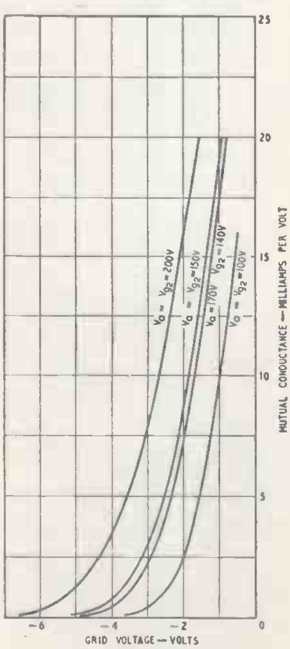
TYPICAL OPERATION

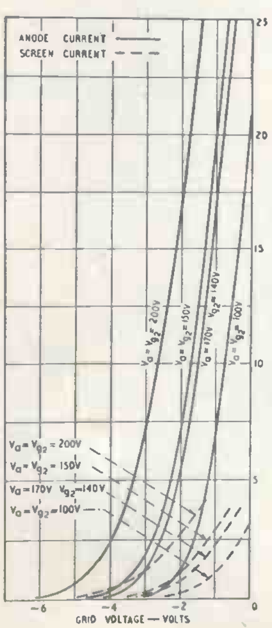
		Cathode Self Bias Circuit	Grid Current Bias Circuit
Supply Voltage (volts)	V_b	200	200
Anode Voltage (volts)	V_a	170	150
Screen Voltage (Initial) (volts)	V_{g2}	140	105
Anode & Screen Common Decoupling Resistor (kΩ)		—	3.3
Anode Decoupling Resistor (kΩ)		2.2	—
Screen Decoupling Resistor (kΩ)		33	33
Cathode Bias Resistor (Ω)	R_k	82	—
Grid Current Bias Resistor (kΩ)	R_{g1}	—	330
Grid Bias Voltage approx. (volts)	V_{g1}	−1.25	—
Anode Current (mA)	I_a	13.5	14
Screen Current (mA)	I_{g2}	1.7	1.4
Mutual Conductance (mA/V)	g_m	15	15.5
Inner Amplification Factor (g_1 to g_2)	μ_{g1-g2}	60	—
Equivalent Grid Noise Resistance (Ω)	R_{eq}	450	—
Input Loss at 50 Mc/s (kΩ)	$r_{g1-k(w)}$	6.8¶	—
Input Capacity Working (pF)	$c_{in(w)}$	10.3¶§	—
Change in Input Capacity produced by biasing valve to cut-off (pF)	$\triangle c_{in(w)}$	2.9¶	—

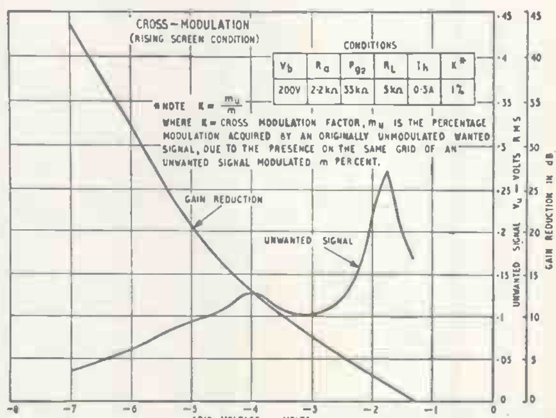
¶ Measured at 50 Mc/s with the three cathodes strapped and taken directly to earth.

§ Inter-electrode capacity with holder capacity balanced out.

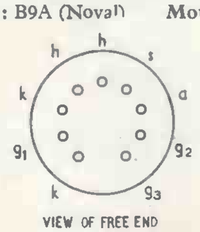
Tentative Characteristic Curves of Ediswan Mazda Valve Type 30F27

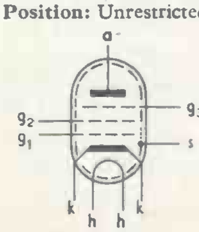






Base: B9A (Noval) **Mounting Position:** Unrestricted





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NEW B9A EFFICIENCY DIODE

EDISWAN MAZDA U193

The U193 is a new Efficiency Diode, designed for use in line deflection stages of television receivers using 110° and 114° cathode ray tubes and has a maximum peak heater to cathode voltage rating of 5.5 kV as compared with 5 kV for the U191.

The valve is mounted on a B9A (noval) base with the cathode brought out to a top cap connection.

MAXIMUM DIMENSIONS (mm)

Diameter	22.2
Seated Height	75
Overall Length	82

TENTATIVE RATINGS AND DATA

Heater Current (amps) I_h	0.3
Heater Voltage (volts) V_h	19

Maximum Design Centre Ratings

Mean Anode Current (mA)	$I_{a(av)max}$	150
Peak Anode Current (mA)	$i_{a(pk)max}$	450
Peak Inverse Voltage (kV)	$PIV_{(max)}$	5.5*
Peak Heater to Cathode Voltage (heater negative) (kV)	$v_{h-k(max)}$	5.5*

*Rated for TV line scan where the duty cycle does not exceed 15% and the pulse duration does not exceed 15μs. An absolute rating of 6.6 kV must not be exceeded.

Inter-Electrode Capacitances (pF)

Anode to Heater and Cathode	$c_{a-h,k}$	6.6
Cathode to Heater and Anode	$c_{k-h,a}$	7.9

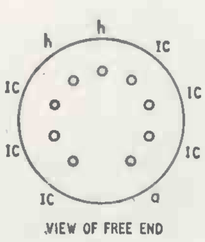
APPLICATION NOTES

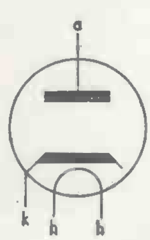
The Ediswan Mazda U193 is designed specifically for use as the efficiency diode in line defletion stages of television receivers using 110° and 114° cathode ray tubes. It would normally be used in conjunction with line scanning output valves such as the 30P4 and 30P19 in energy recovery types of line scanning circuits in a.c./d.c. television receivers. The heater may be directly connected in the normal series chain as the insulation between heater and cathode is adequate to withstand the pulse voltages encountered in auto-transformer scanning circuits. This high voltage insulation generally results in high thermal inertia of the cathode, giving a much longer heating time than the remaining valves in a television receiver. In the U193, however, the thermal inertia, has been reduced considerably so that there is only a delay of a few seconds between the warm-up of other valves in a receiver and the start of operation of the line scanning circuits. Besides reducing the waiting time for a picture to appear, this factor also alleviates problems of protection of valves where a line-gated system of automatic gain control is used.

See "Aspects of Design No. 20 ('Wireless World' March 1960)—Efficiency Diodes for TV Line Output Stages" for notes on circuit considerations and limiting ratings.

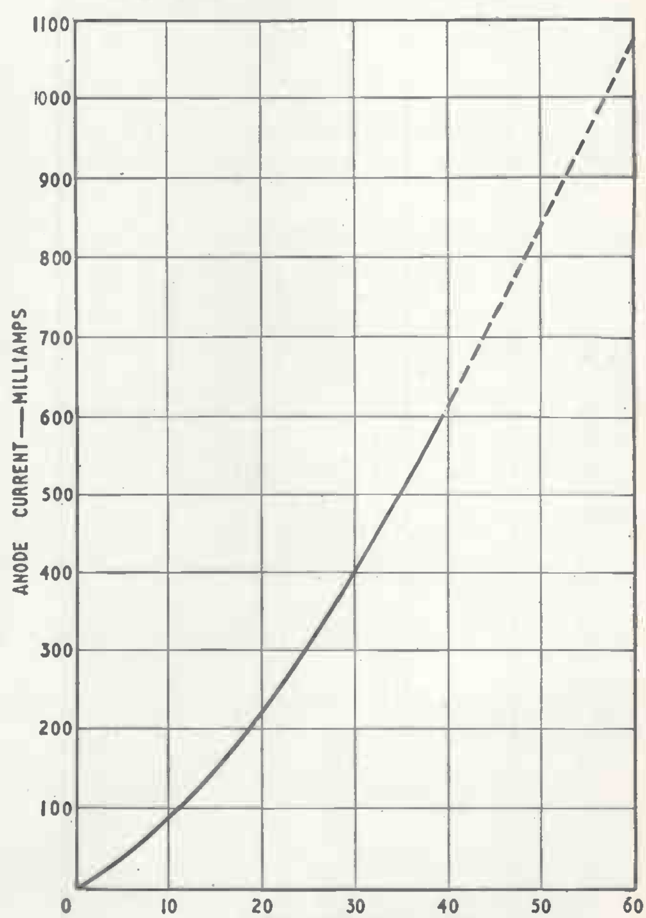
Mounting Position: Unrestricted

Base: B9A (Noval) **Top Cap:** CT1—Cathode Connection





Characteristic Curve of Average Ediswan Mazda Valve Type U193



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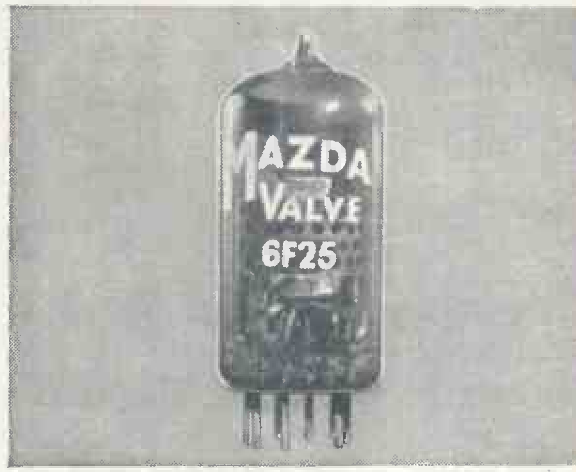
NEW VERY HIGH SLOPE VARIABLE-MU HF PENTODE

EDISWAN MAZDA 6F25

The 6F25 is a frame grid variable-mu HF pentode having a mutual conductance of 12.5mA/V at 11.5mA anode current. This valve is capable of handling large input signals without cross-modulation and is therefore very suitable as the common IF amplifier in a.c. or a.c./d.c. television receivers.

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3



TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

Anode Dissipation (watts)	$p_{a(max)}$	2.5
Screen Dissipation (watts)	$p_{g2(max)}$	0.5
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Voltage (volts)	$V_{g2(max)}$	250
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)rms}$	150*
Resistance Control Grid to Cathode (megohms)	$R_{g-k(max)}$	1

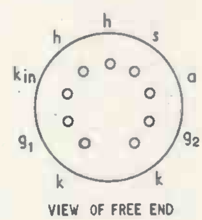
*From cathode to higher potential heater pin.

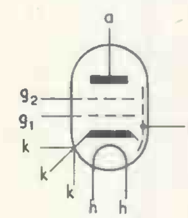
Inter-Electrode Capacitances† (pF)

Input Capacitance	c_{in}	8.5
Output Capacitance	c_{out}	2.7
Grid 1 to Anode	c_{g1-a}	0.006
Grid 1 to Grid 3	c_{g1-g3}	0.1
Grid 1 to Grid 2	c_{g1-g2}	1.8
Grid 1 to Cathode	c_{g1-k}	6.0
Grid 2 to Anode	c_{g2-a}	0.19
Grid 3 to Anode	c_{g3-a}	0.45

†Measured in fully shielded socket, without can.

Base: B9A (Noval) **Mounting Position:** Unrestricted





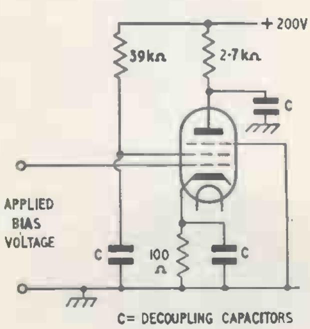
TYPICAL OPERATION

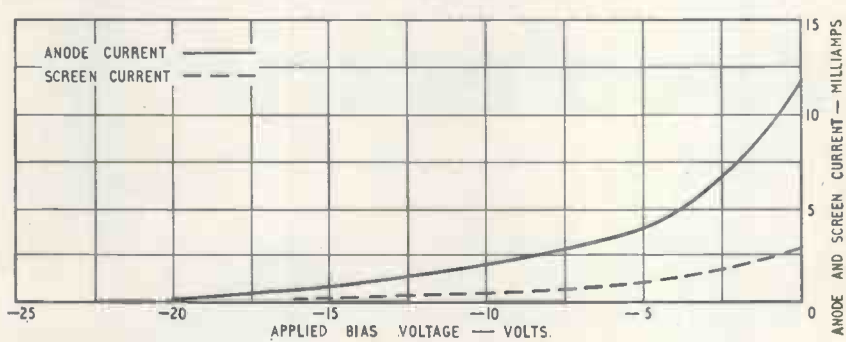
Supply Voltage (volts)	V_b	200
Anode Voltage (volts)	V_a	170
Screen Voltage-Initial (volts)	V_{g2}	90
Screen Resistor (kΩ)	R_{g2}	39
Cathode Bias Resistor (ohms)	R_k	100
Anode Current (mA)	I_a	11.5
Screen Current (mA)	I_{g2}	2.8
Inner Amplification Factor (g_1 to g_2)	μ_{g1-g2}	35
Mutual Conductance (mA/V)	g_m	12.5
Grid Voltage for Mutual Conductance = 1.25 mA/V (volts)	—	—5.5

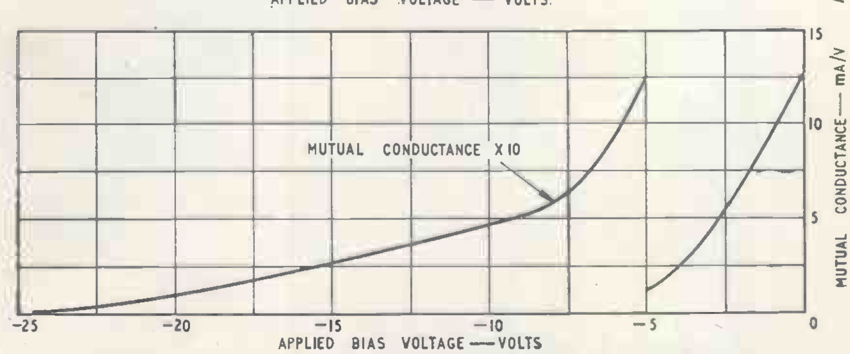
Tentative Characteristic Curves of Ediswan Mazda Valve Type 6F25

RISING SCREEN CHARACTERISTICS

TEST CIRCUIT







Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

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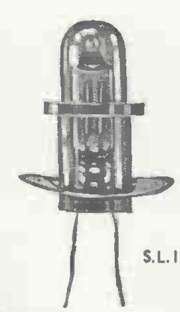
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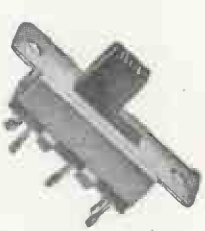
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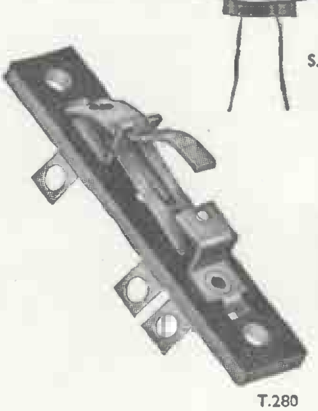
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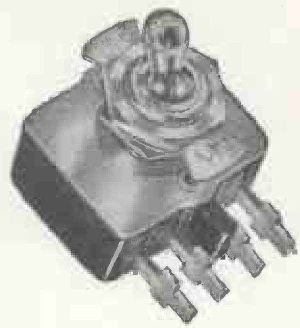
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P_f	**Filament Power (watts)**	**1.15**
$V_{a(max)}$	**Anode Voltage, maximum (volts)**	**150**
$V_{g2(max)}$	**Screen Voltage, maximum (volts)**	**150**
g_m	**Mutual Conductance (mA/V)**	**4.3**
$P_{a(max)}$	**Anode Dissipation, maximum (watts)**	**5.0**

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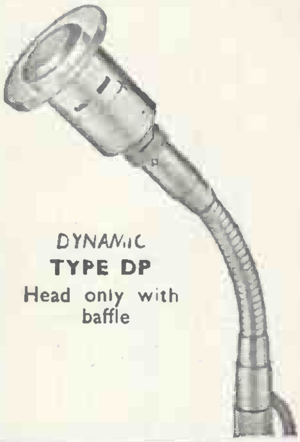

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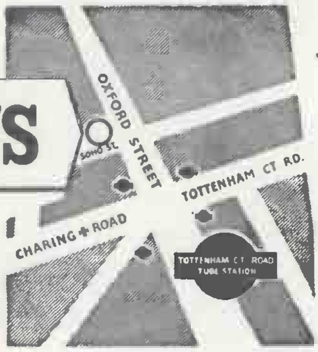

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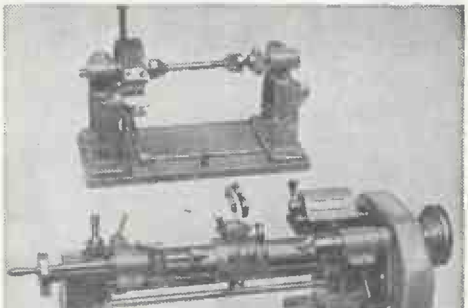

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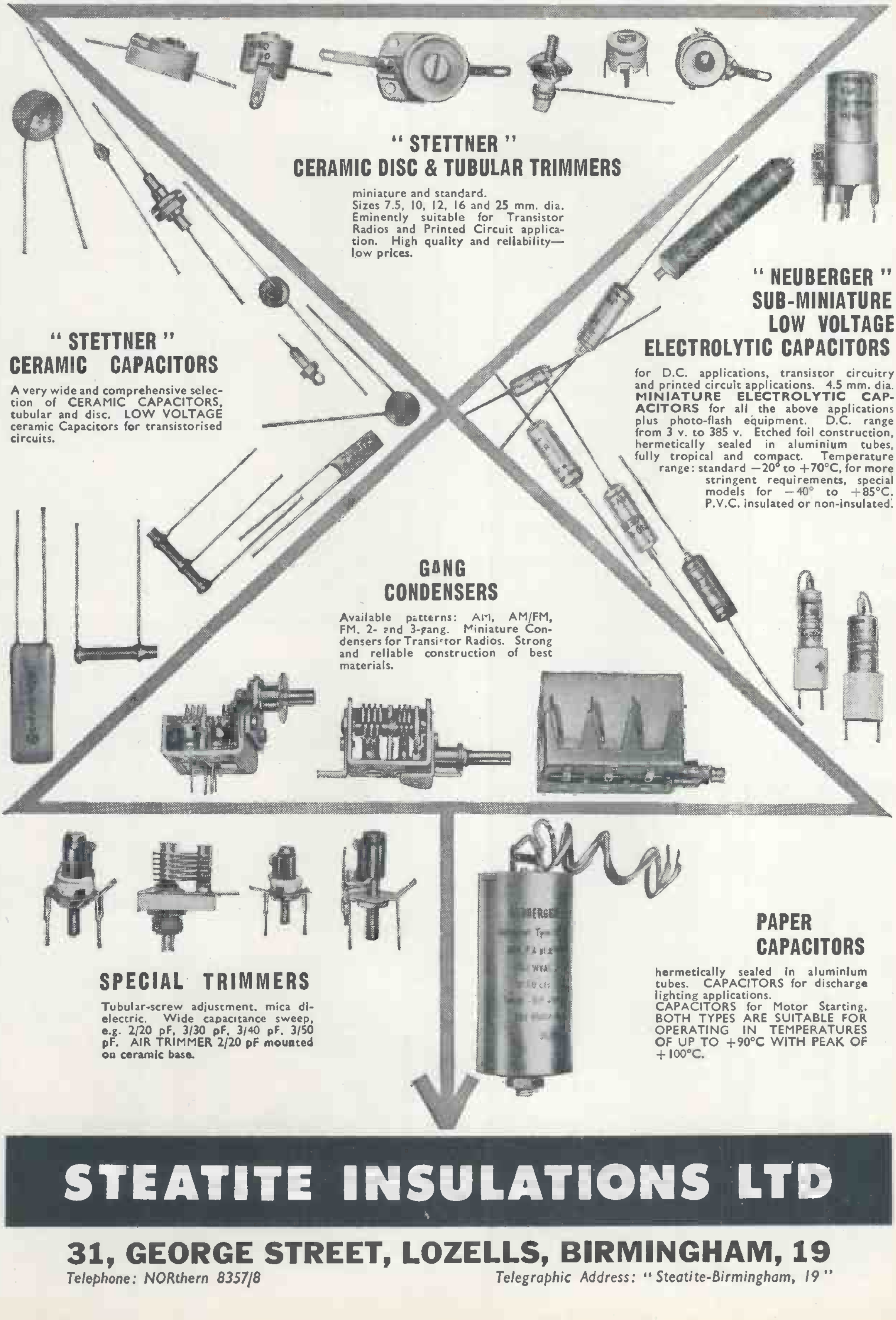

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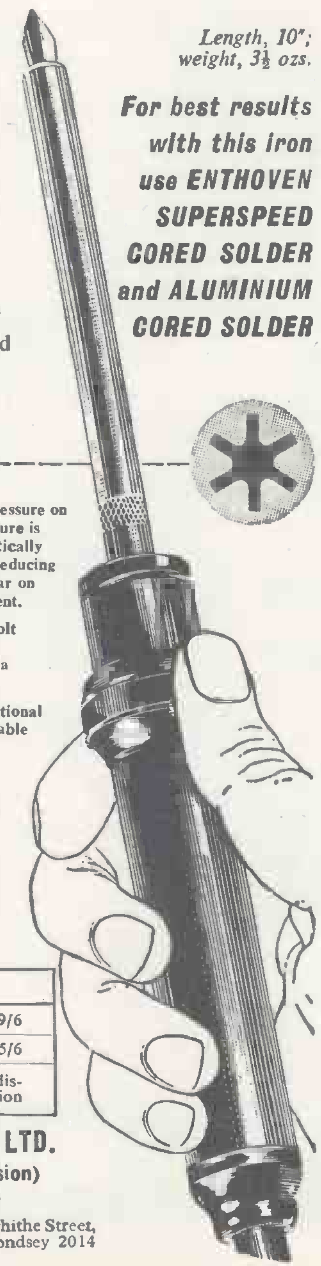

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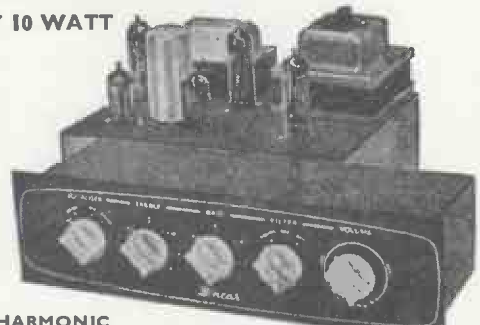

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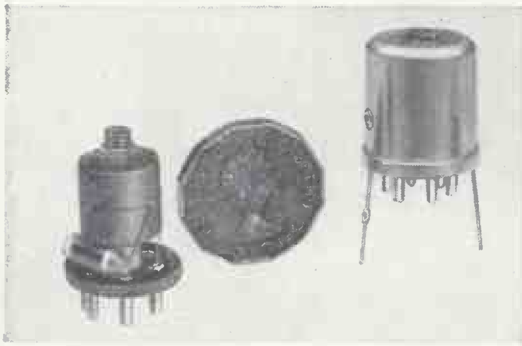

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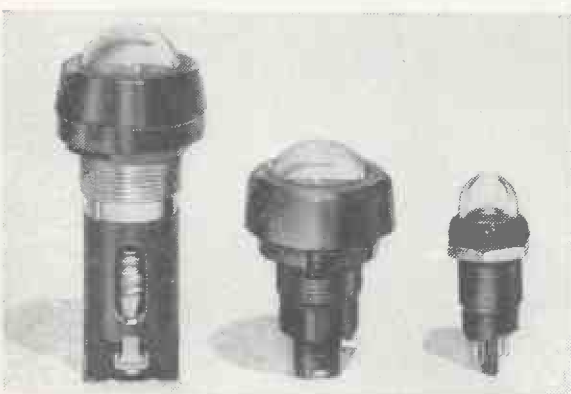

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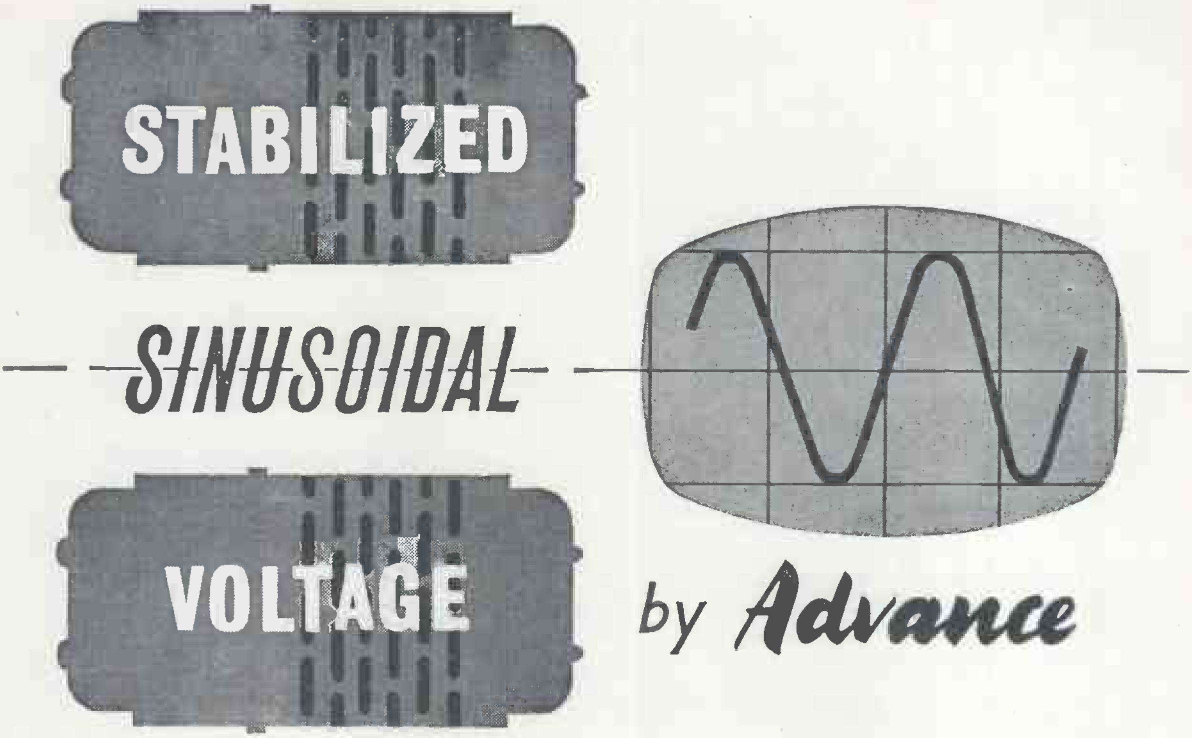

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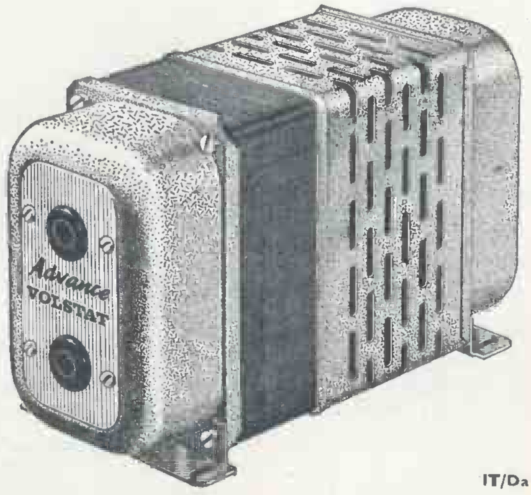

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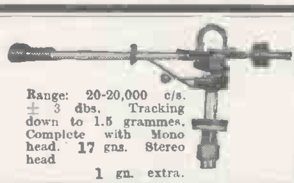

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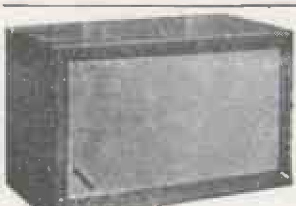

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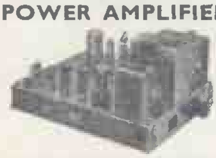

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Aspects of design

This is the thirtieth of a series of special features dealing with advanced problems in circuit design to be published by The Ediswan Mazda Applications Laboratory. We will be pleased to deal with any questions arising from this or other articles, the thirty-first of which will appear in the February 1961 issue.

30 CHOICE OF DECOUPLING COMPONENTS for TELEVISION IF STAGES

The performance of television IF stages is governed to a great extent by considerations of stability, and it is possible to design such stages with the highest gain consistent with adequate stability by careful choice of decoupling capacitors. Although the method to be described is not directly applicable to every type of IF amplifier design, the underlying principles are useful and will therefore be dealt with in some detail.

INPUT CONDUCTANCE

The input conductance of an IF amplifier stage is profoundly influenced by admittance in the cathode circuit and to a smaller extent by regeneration from g_2. For typical values found in a sound IF stage, the cathode admittance produces an input conductance $G_{in} \approx -\frac{g_k B_{gk}}{B_k}$ where g_k is the cathode current mutual conductance and B_{gk} and B_k are susceptances from grid to cathode and cathode to chassis respectively. By using a sufficiently large value of cathode bypass capacitance C_k the cathode admittance might be expected to approach infinity at television IF, but in practice the inductance of the internal connection from the cathode itself to the cathode pin on the valve button cannot be bypassed, and results in degeneration, equivalent to some finite value of input conductance. All Ediswan Mazda television IF valves, including the 6F23, 6F24 and 6F25, have the cathode brought out to two separate pins on the valve button, and if these are strapped externally the unavoidable un-bypassed inductance is effectively halved, resulting in reduced degeneration.

There is, however, another way of reducing the degeneration, for whereas an inductive cathode load produces degeneration, a capacitive load produces regeneration (i.e. in the above expression G_{in} becomes negative). By reducing the value of C_k from that required to fully bypass the cathode resistor, the degeneration due to the unavoidable cathode lead inductance is opposed by the regeneration due to C_k, and for a particular value of C_k the two effects cancel, giving zero input conductance. The unwanted inductance has been "tuned out" by C_k. Further reduction in C_k provides a net regeneration; thus by varying C_k, a whole range of positive and negative input conductances can be provided. This can be seen in Fig. 1 which shows both the case of a single cathode connection (curve a) and strapped cathode connection (curve b) for the 6F24. The effect of strapping the cathode is to shift the curve along the C_k axis so that a larger value of C_k is required to give the same input conductance.

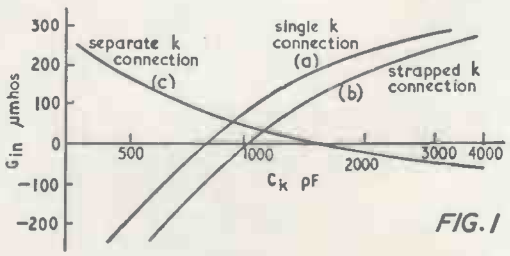

FIG. 1

The fact that some regeneration may be provided by the cathode circuit does not necessarily mean that the stage will oscillate; this will only occur if the negative input conductance due to the cathode circuit exceeds in magnitude the conductance of the external grid circuit.

From the curves (a) and (b) in Fig. 1 it can be seen that the input conductance depends rather critically upon the value of C_k. However, by using the separate cathode connection, in which the earthy end of the grid tuned circuit is decoupled to one cathode pin whilst the other cathode pin is reserved for the cathode components, the input conductance is controlled principally by feedback via g_2 and this circuit has been found to provide a more gradual control of input conductance with change in the value of C_k. This is shown in curve (c) of Fig. 1.

NEUTRALISATION

An earlier article in the series "Aspects of Design" (No. 14 "Wireless World" September, 1959) described how the unwanted feedback from output to input of an IF stage may be neutralised by means of a bridge circuit. Exact neutralisation by adjusting the neutralising component to suit each receiver will enable very high gain to be achieved, but individual adjustment is not usually possible in production receivers, so that in practice a fixed neutralising component must be used and a certain misneutralisation accepted.

The effect of errors in neutralising can be determined directly by plotting IF gain against the value of the neutralising component. The result of varying the neutralising component (in this case a capacitor common to the anode and g_2 circuit of a 6F24 sound IF (38 Mc/s) amplifier) is shown in Fig. 2. The correct value of C_n corresponds to the minimum of each curve, and in this case is 1200pF. The separate cathode connection circuit has been used here. Increasing the value of C_k lowers the input conductance and increases the IF gain, but at the same time it makes the choice of C_n very critical.

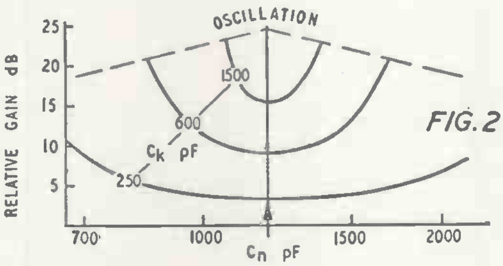

FIG. 2

CHOICE OF C_n AND C_k

It is obvious that in the choice of C_n and C_k a compromise must be made between high gain and security against instability and it is perhaps easier to choose the most suitable values if the information in Fig. 2 is redrawn in the form shown in Fig. 3, where the parameter is the error in the neutralising capacitor C_n.

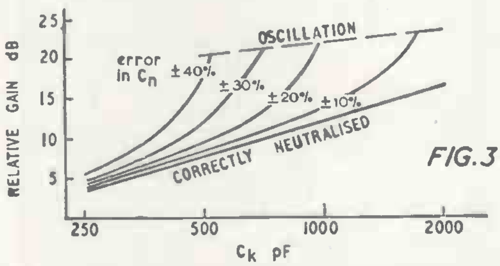

FIG. 3

It will be seen that it is advantageous to keep the error as low as possible by using $\pm 10\%$ tolerance capacitors for C_n and C_k. Stable Hi-k ceramic types are now available which can be recommended for this application. An allowance must be made for the spread of valve parameters and circuit strays. These can be regarded as having the same effect on the circuit as widening the tolerance of the neutralising component C_n and cathode component C_k, and the final choice of suitable values of C_n and C_k must be made with this in mind.

For the Ediswan Mazda frame grid 6F24 used in a typical sound IF circuit, suitable values of C_n and C_k are:—

$$C_n = 1200\text{ pF} \pm 10\%$$
$$C_k = 470\text{ pF} \pm 10\%$$

These values may require adjustment to suit individual circuit design and layout.

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Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3

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Maximum Design Centre Ratings

Anode Dissipation (watts)	$p_{a(max)}$	2.5*
Screen Dissipation (watts)	$p_{g2(max)}$	0.8*
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Voltage (volts)	$V_{g2(max)}$	250
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)rms}$	150†
Control Grid to Cathode Resistance (megohms)	$R_{g1-k(max)}$	0.6‡

*With grid to cathode resistance not exceeding 10 kΩ.
†From cathode to higher potential heater pin.
‡With $p_{a(max)} = 2$ W; $p_{g2(max)} = 0.5$ W; and assuming a common anode and screen decoupling resistance < 2.2 kΩ ±10%.

Inter-Electrode Capacitances (pF)§

Input Capacitance	c_{in}	8.8
Output Capacitance	c_{out}	2.6
Grid 1 to Anode	c_{g1-a}	0.006
Grid 1 to Grid 3	c_{g1-g3}	0.1
Grid 1 to Grid 2	c_{g1-g2}	2.0
Grid 1 to Cathode	c_{g1-k}	6.2
Grid 2 to Anode	c_{g2-a}	0.15
Grid 3 to Anode	c_{g3-a}	0.47

§Measured in fully shielded socket, without can.

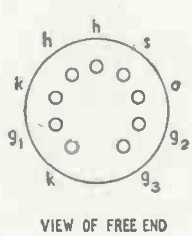
TYPICAL OPERATION

Anode Voltage (volts)	V_a	170
Screen Voltage (volts)	V_{g2}	170
Self Bias Resistance (ohms)	R_k	150
Anode Current (mA)	I_a	10
Screen Current (mA)	I_{g2}	2.7
Mutual Conductance (mA/V)	g_m	15
Inner Amplification Factor (g_1 to g_2)	μ_{g1-g2}	65
Equivalent Grid Noise Resistance (ohms)	R_{eq}	370
Input Loss at 38 Mc/s (Pins 1 and 3 strapped) (kΩ)	$r_{g1-k(w)}$	8.5
Working Input Capacity** Measured at 38 Mc/s (pF)	$c_{in(w)}$	13.7
Change in Input Capacity produced by biasing valve to cut-off. Measured at 38 Mc/s (pF)	$\Delta c_{in(w)}$	3.4
Figure of Merit†† (Valve only) (Mc/s)		375
Effective Figure of Merit (Valve and Circuit) (Mc/s)		220

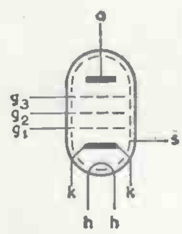
**Inter-electrode capacity with holder capacity balanced out.

††Given by $\dfrac{g_m \times 10^3}{2\pi\sqrt{c_{in(w)}\, c_{out}}}$ see "Aspects of Design" No. 1 for further details. (Wireless World July 1958.)

Base: B9A (Noval) **Mounting Position:** Unrestricted



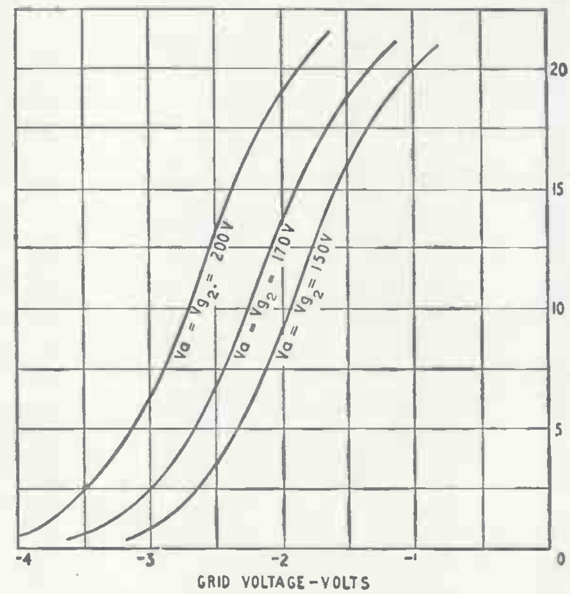
VIEW OF FREE END

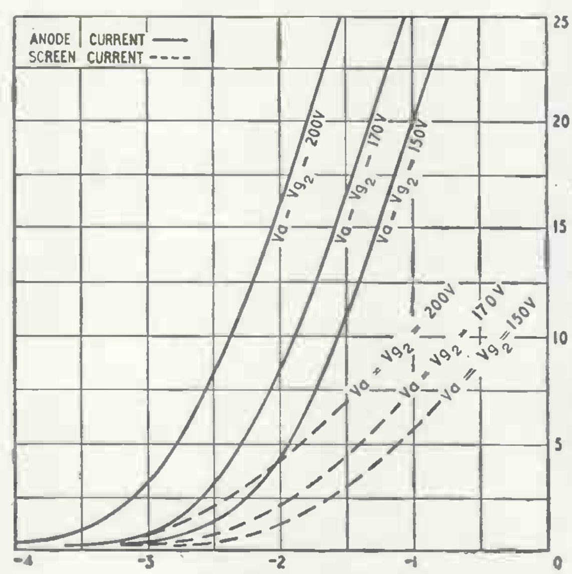


Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

Tentative Characteristic Curves of Ediswan Mazda Valve Type 6F24





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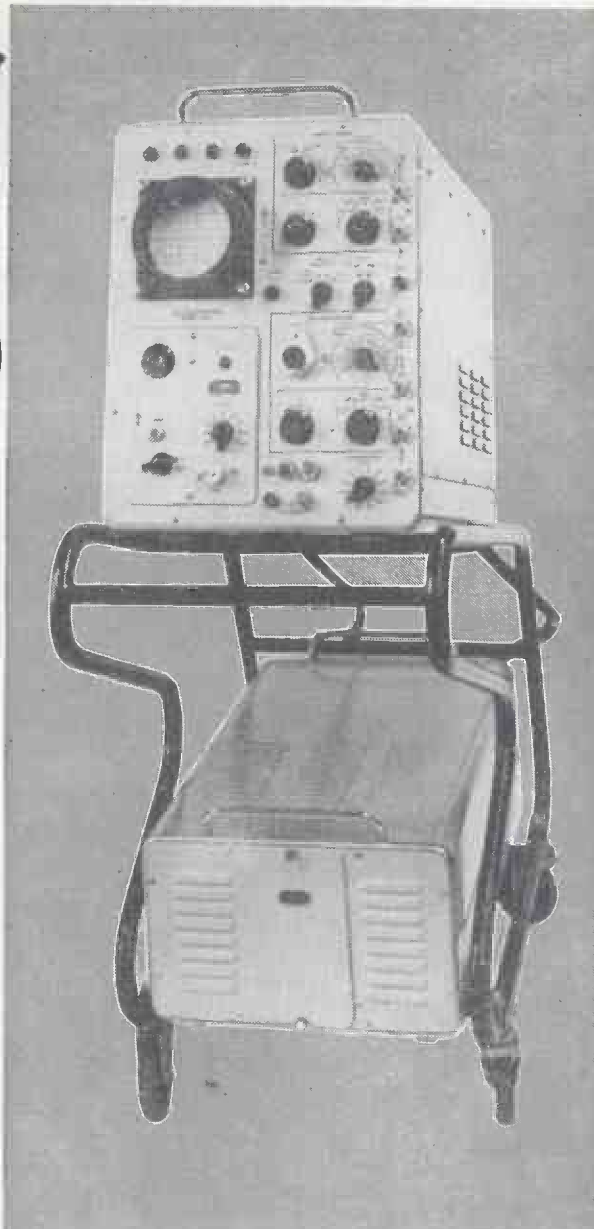

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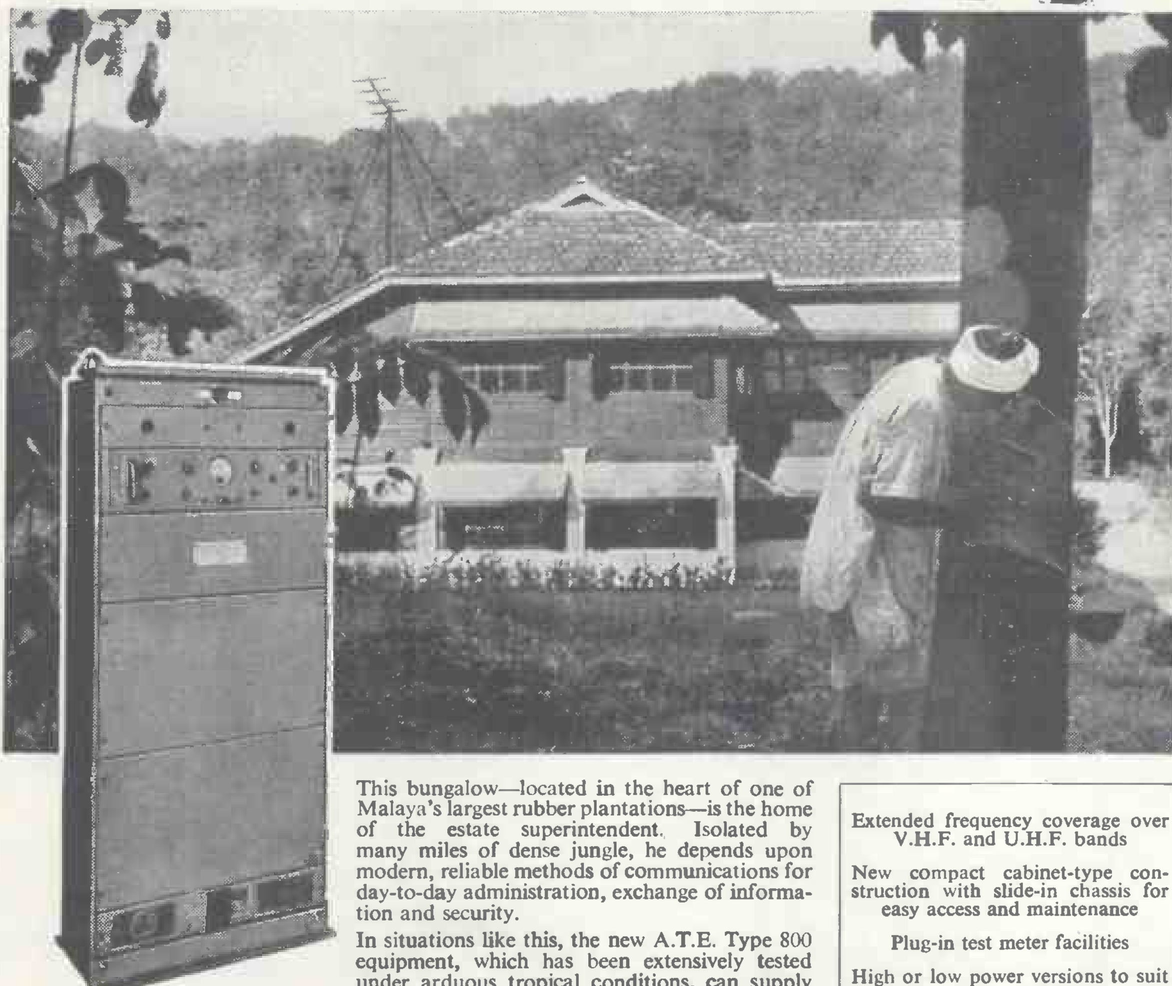

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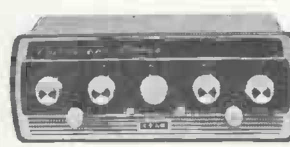

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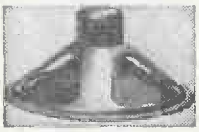

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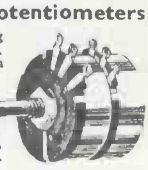

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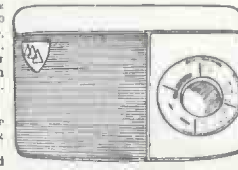

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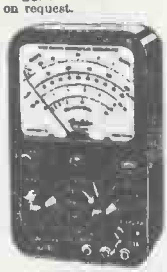

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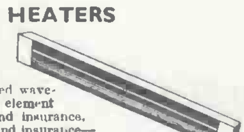

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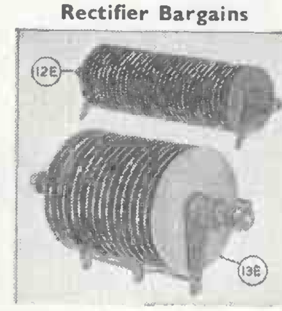

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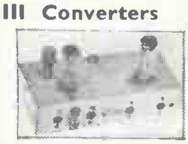

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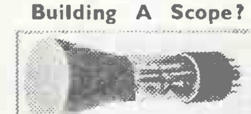

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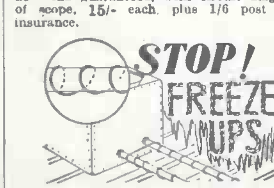

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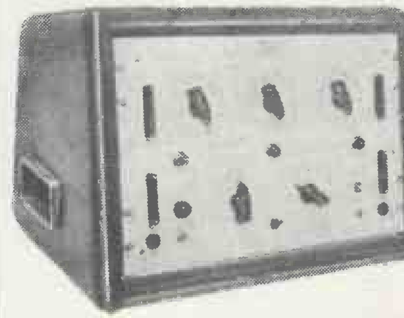

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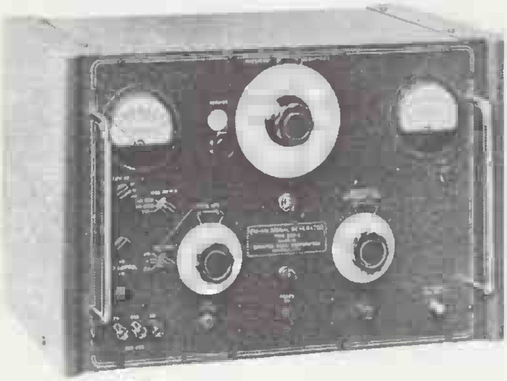

Q Meters	Type 260 AP 190 AP	Freq. Range 50 KC to 50 MC 20 to 260 MC	Q Range 10 to 625 5 to 1200	Tuning Cap. Range 30 to 460 $\mu\mu$f 7.5 to 100 $\mu\mu$f	Q Accuracy 5% to 30 MC 7% to 100 MC		Price £ 349.–.– £ 359.–.–
Q Comparators	Type 265 A	Freq. Range 200 KC to 70 MC	Q Range 30 to 500	L Range 0.15 μh to 15 mh	C Range 5 $\mu\mu$f to .01 μf	R Range 500 Ω to 20 MΩ	Price £ 326.–.–
FM-AM Signal Generators	Type 202 E 202 G 225 AP	Freq. Range 54 to 216 MC 195 to 270 MC 10 to 500 MC	Output Range 0.1 μV to 0.2 V 0.1 μV to 0.2 V 0.1 μV to 0.1 V	FM Mod. 0 to 240 KC 0 to 240 KC 0 to 60 KC	AM Mod. 0 to 50% 0 to 100% 0 to 30%		Price £ 461.–.– £ 451.–.– £ 388.–.–
Sweep Signal Generators	Type 240 AP	Freq. Range 4.5 to 120 MC	Output Range 1 μV to 0.3 V Sweep 1 μV to 0.1 V CW & AM	Sweep Range ±1% to ±30% of center freq.	AM Mod. 30%	Markers crystal and pip.	Price £ 746.–.–
Transistor Test Set	Type 275 A	α-Range 0.100 to 0.9999	β-Range 7 to 200	H_{ib} Range 0.30 to 3000Ω			Price £ 383.–.–
RX Meters	Type 250 A	Freq. Range 500 KC to 250 MC	R Range 15Ω to 100 000Ω	C Range 0 to 20 $\mu\mu$f	L Range 0.001 μh to 100 mh		Price £ 625.–.–
Signal Generator Calibrators	Type 245 C 245 D	Freq. Range 500 KC to 1000 MC 500 KC to 1000 MC	Calibrated Input 0.025, 0.05, 0.1 V 0.025, 0.05, 0.1 V	Calibrated Output 5, 10 or 20 μV 0.5, 1.0 or 2.0 μV	% AM Range 10–100% 10–100%		Price £ 160.–.– £ 158.–.–
Univerters	Type 207 EP 207 GP 203 B	Freq. Range 100 KC to 55 MC 100 KC to 55 MC 100 KC to 25 MC	Output Range 1 μV to 0.1 V 1 μV to 0.1 V 1 μV to 0.1 V	FM Mod. 0 to 240 KC 0 to 240 KC 0 to 15 MC	AM Mod. 0 to 50% 0 to 100% 30%	Accessory to 202 E 202 G 240 AP	Price £ 177.–.– £ 214.–.– £ 173.–.–

BRC Precision Test Equipment is engineered and manufactured to the highest standards of the industry – standards that have made the BRC trademark a recognised symbol of precision and dependability throughout the world.

Prices delivered U. K. exclusive of duty where payable. Continuous progress in design may affect the above specifications which are therefore subject to change without notice. For information, technical sales and engineering help, or a demonstration please write or call

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● SPECIAL OFFER ● 6 EDISWAN TRANSISTORS AND TWO DIODES		● SPECIAL OFFER ● 6 MULLARD TRANSISTORS AND TWO DIODES	
1—XA102 2—XA101 1—XB103 2—XC101 and 2 Diodes	ONLY **57/6** PER SET P.P. 1/-.	1—OC44 2—OC45 1—OC71 2—OC72 and 2—OA81	ONLY **62/6** PER SET P.P. 1/-.

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9.72 Mc/s IF STRIP

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- 3-EF91 Valves
- 1-EB91 Valve

32/6 P.P. 1/6

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"STEREO 3-D"

STEREO RECORD PLAYER AMPLIFIER

New high-gain circuit with full tone, balance and volume controls. Can be used with all types of records as well as stereo.

★ 2 WATTS PEAK PER CHANNEL
★ ECC83; 2-ECL82 VALVES
★ MAINS 110/250V A.C.

Complete with speaker sockets, calibrated dials, etc. **BUILT and TESTED** **£5.7.6** P.P. 2/-

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No 2. GADGETS, AMPLIFIERS, TRANSMITTERS, RECEIVERS, TEST UNITS. **All transistor**

Now contains 40 Easy to Build Transistor Circuits for the home constructor with diagrams and prices. **3/6** POST FREE

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(CV 2696)

PHOTO MULTIPLIER

Brand new, original cartons. **60/-** P.P. 1/-. Base 2/-.

Also: Special purpose 931A-CV337 **80/-** each. Base 2/-.

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As supplied in the well-known Deccamatic III. Uses ECL82 valves, full range tone and volume controls. Size 8¾ x 3½ x 3in. P.P. 2/6. **59/6**

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8 x 6in. CELESTION SPEAKER for use with above. 25/-. P.P. 1/-.

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FOR TRANSMITTING RADIO CONTROL OSCILLATORS, ETC.

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STANDARD AND MINIATURE COMPONENTS

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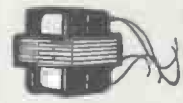

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Two transistor push-pull output stage. For use with Ranger-3 or similar. Includes Elac 3in. speaker.
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Crystal controlled oscillator. Uses fundamental crystals of FT243, 10X, R76, etc.
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Ideal for frequency check or BFO.

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For coupling a low impedance mic. or P.U. to a valve amplifier. Works from 150 to 250 volts D.C. taken from amplifier. HIGH GAIN—NO HUM.
All parts 12/6. P.P. 1/-.

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SPECIFICATION

- 425mW Push-Pull Output
- 6 "Top Grade" Ediswan Transistors
- New Type Printed Circuit with all Components Marked
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- High "Q" Internal Ferrite Aerial
- Car Radio Adaptation and AVC
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- "Hi-Fi" Quality Speaker
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All components available separately

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EQUALLY SENSITIVE ON MEDIUM AND LONG WAVE BANDS

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including Cabinet, Battery, Transistors, Car Radio, AVC and all necessary items.

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★ Full Station Separation
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★ Built-in Ferrite Aerial
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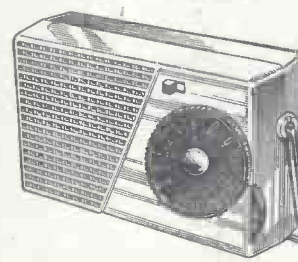

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COLLARO STUDIO TAPE TRANSCRIPTOR
3 motors, 3 speeds 1⅞, 3¾, 7½. Push button controls. LIST PRICE 16 GNS.
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One dozen 35/- post free
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AT ALMOST HALF LIST PRICE WHILE EXISTING STOCKS LAST. BRAND NEW IN MAKER'S CARTONS—100—250 VOLTS—SMALL DEPOSIT SECURES.

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5 Inputs. Size 14½in. wide, 9in. deep, 4in. high. LIST PRICE £29-8-0
19 GNS. CARR. & INS. 7/6.

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Twin 10 watts output, 3-dimensional Monaural reproduction by combining both channels, 3 inputs for each channel. Size 14½in. wide, 4in. high, 8⅞in. deep. LIST PRICE £29-8-0
19 GNS. CARR. & INS. 7/6

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54 watt peak output. Freq. response 5 c/s-30 Kc/s ± 0dB. Two of these can be used in conjunction with SP21/2 Pre-Amp. Control Unit for stereophonic reproduction. Size 14½in. long, 9in. wide, 8½in. high.
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SPECIAL OFFER TO ALL OUR CUSTOMERS
Two DL7-35 Power Amplifiers and one SP21/2 Stereo Control Unit at a special price of **47 GNS.**
Ideal for use in clubs, halls, public performances, etc.

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Twin channel. Designed primarily for use with two DL7 35 Power Amplifiers. Six inputs for each channel. LIST PRICE £28-10-0
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5V4	11/6	6F1	14/-	6X4	7/6	12K8M	13/-	142BT	3/6
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SPECIAL MAINS DROPPER RESISTORS

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3 POLE, 4 WAY	3/- ea.
4 POLE, 3 WAY	3/- ea.
1 POLE, 4 WAY	2/- ea.
1 POLE, 12 WAY	3/- ea.
2 POLE, 6 WAY	3/- ea.
4 POLE, 4 WAY	4/6 ea.
3 POLE, 3 WAY	3/- ea.
3 POLE, 3 WAY, 3 BANK	2/3 ea.

BEST QUALITY RECORDING TAPE

1,200ft. on 7in. spool	21/-
850ft. on 5¾in. spool	18/6
600ft. on 5in. spool	13/9
200ft. on 3¼in. spool	5/3

COLLARO JUNIOR SINGLE 4-SPEED RECORD PLAYER UNIT IN CREAM, COMPLETE WITH PICK-UP FITTED TURNOVER, CARTRIDGE. Special Price 75/- each. Post 3/6.

Garrard GC2 Crystal Cartridge. Black moulded case complete with Standard and LP styli. Price 15/6.

4BA TERMINALS, RED AND BLACK, SUITABLE FOR BATTERY CHARGERS, etc., 1/6 each.

PANL—air drying Paint Black Crackle (Crystalline Black), 3/- tin.

TUNING INDICATOR ESCUTCHEON SUITABLE FOR EM80 TYPE OF VALVES, 2/- each.

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MW31/74, £5/10/-; CRM152B, £6; MW36/24, £5/10/-; CRM141 £5/10/-; CRM123, £5/10/-; MW43/69, £6; CRM171, £6. Carriage and insurance 10/- extra. Allowance on old tube if returned.

SVB MINIATURE M/C. L.S. L.P. 45 F. 1¾in. x ¾in. deep.

9,000 GAVS., Ferrite magnet, MAX loading 2.3 watts. 25/-.

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Alpha Range of Guaranteed Bridge Rectifiers suitable for Battery Chargers 6 and 12 volt output:

2 amp.	7/-
4 amp.	12/6
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BSR Monarch UA8, Record Changer £6/19/6.

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High Resistance Headphones 4000 ohms, 13/6.

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Standard Model B. Frequency coverage 75 kc/s to 1,500 kc/s and 3 mc/s to 18 mc/s on 5 bands. New improved geared slow-motion drive fitted. All receivers overhauled, aligned and tested. £8/19/6 ea. P/P 7/6. Combined A.C. mains power pack and audio output stage supplied 85/- extra.

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2½in.	Perdio	3 ohm	17/6
2½in.	Perdio	15 ohm	17/6
3in.	Plessey	5 ohm	15/6
3in.	Rola	3 ohm	17/6
4½in.	Plessey	3 ohm	15/6
5in.	Goodmans	3 ohm	15/6
6½in.	Plessey	3 ohm	17/6
8in.	Elac	3 ohm	19/6
10in.	R.A.	3 ohm	27/6
12in.	Plessey	3 ohm	29/6
6 x 4in.	Plessey wafer	3 ohm	12/6
7 x 4in.	Plessey	3 ohm	15/6
8 x 6in.	Rola	3 ohm	17/6
10 x 7in.	Plessey	3 ohm	27/6
12 x 8in.	Plessey	3 ohm	49/6
8 x 2¾in.	Goodmans	3 ohm	17/6

All brand new. Please add postage.

AMPHENAL 15 PIN UNITERS. Brand new 3/6 pr., ditto 18 pin, 3/6 pr. P/P 6d.

4 POLE 11 WAY METER SWITCHES. 4 bank 6/6 ea. P/P 9d.

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PORTABLE PRECISION VOLTMETERS

Brand new moving iron instruments by famous manufacturer. Housed in polished teak case, 8in. mirror scale. 2 ranges, A.C. or D.C. 0 to 160 v. or 0 to 320 v. Accuracy within 2%, £5/19/6 ea. P/P 3/6.

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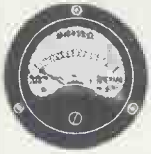

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PARMEKO MAINS TRANSFORMER. Fine heavy duty job. Primary 0/110/230 volts. Sec. 350/0/350 volts 150 ma. 6.3 v. 4 amps, 5 volts 4 amps. New, boxed, 32/6. P/P. 2/-.

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HEAVY "C" CORE TRANSFORMERS. 230 volt primary. 725/700/675/0/675/700/725 volt 500 ma. 6.3 v. 6 amp. 6.3 v. 1 amp. 5 v. 6 amp. New, boxed, 72/6 ea. P/P. 5/-.

FERRITE CORED LOOP AERIALS. Operative up to 2mc/s. New boxed, 22/6 ea. P/P. 2/6.

ADMIRALTY SLOW MOTION DRIVES. 180°, scaled 0 to 100. Fast and slow knob with lock and also flick mechanism for setting to fixed frequencies, new 7/6 ea. P/P. 1/3.

24 AMP. VARIAC TRANSFORMERS. Primary 230 volts. Adjustable sec. from 185 to 250 volts. 24 amps, £12/10/- each. P/P. 10/-.

"C" CORE POTTED L.T. TRANSFORMERS. Primaries all 230 volts.
1. 6.3 v. 3 amp. 6.3 v. 3 amp., 6.3 v. 3 amp., 6.3 v. 1.5 amp., 21/- ea. P/P. 2/-.
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HIGH FIDELITY P.V.C. BASE RECORDING TAPES

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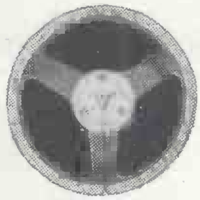

3in. spool 225ft. L.P. 6/-. 5in. spool 600ft. std. 12/-. 5in. spool 900ft. L.P. 17/-. 5¾in. spool 1200ft. L.P. 19/6. 7in. spool 1200ft. std. 19/-. 7in. spool 1800ft. L.P. 29/-.

SPARE PLASTIC SPOOLS, 5¾in. 2/3; 7in. 3/6. New, Boxed, Guaranteed. Post extra.

HALLICRAFTER 6 VOLT VIBRATOR POWER SUPPLIES. Magnificent units housed in grey metal case and supplied with all necessary connectors, etc. Made for SX28, S27, S36 receivers, etc. Output 300 volts 170 ma., fully smoothed. Supplied new boxed, 29/6 each. P/P. 3/6.

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FIELD TELEPHONES TYPES L.
Ideal for all intercom systems. House, office or building site. Generator bell ringing. Two line connection. Supplied complete with batteries, fully tested. As new, 59/6 ea. P/P. 3/6.

8 RANGE SUB-STANDARD D.C. AMMETERS
Ranges 1.5, 3, 7.5, 15, 30, 60, 300 and 450 amps. 8in. mirror scale. Housed in polished teak case. Supplied complete with all shunts and leather carrying case, £15 each. P/P. 7/6.

PHOTO VOLTAGE AMPLIFIERS
These special units contain a 1 microamp. Tinsley mirror galvonometer and a double selenium photo electric cell. Brand new, £9/19/6 ea. P/P. 7/6.

RECORD CHANGERS/PLAYERS
Bargin prices, all new and guaranteed.
COLLARO CONQUEST. 4 SPEED AUTO CHANGERS. £6/15/- ea. P/P. 3/6.
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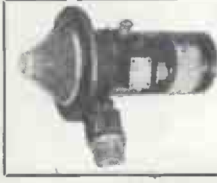
COLLARO JUNIOR 4 SPEED SINGLE PLAYERS. 79/6 ea. P/P. 2/6.



24 VOLT D.C. FUEL PUMPS.
Perfect condition, 15/6 ea. P/P. 2/6.

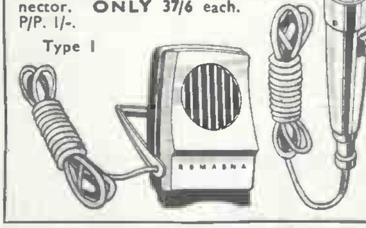
HALLICRAFTER S-36A U.H.F. COMMUNICATION RECEIVERS. This is the later version of the S-27. Frequency coverage 27 to 143 mc/s split on 3 bands, capable of receiving F.M. or A.M. signals. Circuit incorporates calibrated S meter, B.F.O., noise limiter, etc. Operation 110/230 v. A.C. Output for phone or speaker. Supplied reconditioned and in superb condition. Price £27/10/- each. P/P. £1.

NEW BLOCK PAPER CONDENSERS. Nitrogol, Visconol types. .25 mfd. 4 kv. 3/6; .25 mfd. 7.5 kv. 10/6; .25 mfd. 10 kv. 15/-; 1 mfd. 600 v. 1/9; 1 mfd. 1 kv. 3/6; 1 mfd. 2.5 kv. 6/6; 1 mfd. 5 kv. 15/-; 2 mfd. 400 v. 2/6; 2 mfd. 600 v. 4/6; 4 mfd. 400 v. 3/6; 4 mfd. 600 v. 4/6; 4 mfd. 1,000 v. 6/6; 4 mfd. 1.5 k. 8/6; 8 mfd. 400 v. 6/6; 8 mfd. 800 v. 8/6; 8 mfd. 1.5 kv. 15/-; 10 mfd. 1.5 kv. 17/6; 32 mfd. 500 v. 17/6. Post extra.

CRYSTAL MICROPHONES
Brand new and guaranteed.
Type 1. Hand or desk type with screened lead. ONLY 15/6 each. P/P. 1/-.
Type 2. High fidelity stick type, metal cased and fitted with switch.
Supplied with screened lead and screened 2-pin connector. ONLY 37/6 each. P/P. 1/-.

Type 2

Type 1



POTTED TRANSFORMERS. 230 v. primary Secondary 350/310/0/310/350 v. 220 ma. Total of 6.3 v. 13 amps.; 5 v. 4 amps., 49/6 ea. P/P. 3/-.

110/230 VOLT AUTO TRANSFORMERS. 20 watt 9/-; 50 w. 12/6; 150 w. 18/6. Post extra.

100 AMP. A.C. MOVING IRON METERS. 6in. scale. Modern type, flush mounting ideal for switchboards, etc., new, boxed, 65/-. P/P. 3/6.

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JOHNSON VARIABLE INDUCTANCES. Large type 8in. x 2½in. Supplied brand new boxed, 22/6 each. P/P. 2/-.

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20 microamp D.C. M/C flush rd. 2½in.	69/6
25 microamp D.C. M/C proj. rd. 2½in.	59/6
50 microamp. D.C. M/C proj. rd. 2½in.	49/6
100 microamp D.C. M/C flush rd. 2½in.	42/6
100 microamp D.C. M/C flush rd. 3½in.	62/6
200 microamp D.C. M/C proj. rd. 2½in.	29/6
300 microamp D.C. M/C flush rd. 2½in.	29/6
1 milliamp. D.C. M/C flush sq. 2in.	22/6
1 milliamp. D.C. M/C flush rd. 2½in.	25/–
1 milliamp. D.C. M/C flush sq. 4in.	69/6
30/0/30 milliamp. D.C. M/C flush 2½in. rd.	9/6
15 amp. D.C. M/C proj. rd. 2in.	8/6
120 volt D.C. M/C flush rd. 3½in.	32/6
300 volt A.C. M/C rectifier flush rd. 2½in.	25/–
300 volt A.C. M/I flush rd. 2½in.	25/–
500 volt A.C. M/I flush rd. 2½in.	25/–
1,500 volts electrostatic proj. rd. 2½in.	25/–

Postage extra.

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G.W. SMITH & CO (RADIO) LIMITED

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39/6

CARRIAGE U.K. 10/6

SPECIAL OFFER
MINE DETECTORS No. 4A

For detecting Ferrous or Non-Ferrous Metals:— Underground Pipes—Cables—or any hidden metallic objects to a depth of 24in. at full signal. Or greater depths can be obtained at a lower signal strength.

Complete equipment comprises: Search Head, Amplifier, Headset, Control Box, Telescopic Rods for Search Head, Search Head Test Unit, Test Depth Measure and Holdall Haversack.

Complete equipment supplied in original transit cases, with circuit and operating instructions.
Batteries if required 8s 0d extra, 67½ volt/1.5 volt.

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THE INSTRUMENTATION PEOPLE

VARIABLE VOLTAGE TRANSFORMERS

TYPE B5
5 amp. 260 v. output, as illustrated £8 10 0
TYPE B10
10 Amp. 260 v. output £17 15 0
TYPE B20
20 Amp. 260 v. output £32 0 0

Large easily read Dial calibrated 0-260 v. Totally enclosed with Input and Output Terminals. Ideally suited for Laboratory experimental work and Schools.

TRANSFORMERS & SATURABLE REACTORS

Iva-30Kva to Specification.

COMPLETE INSTRUMENTATION INSTALLATIONS FOR INDUSTRIAL PROCESS CONTROL.

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EXPORT ONLY
PROMPT deliveries Mobile V.H.F. Radio Telephones. Frequency ranges on five bands (1) 36–44 Mc/s, (2) 65–78 Mc/s, (3) 78–100 Mc/s, (4) 118–132 Mc/s, (5) 156–174 Mc/s. R.F output 10 watts. A.M. Single Channel, crystal controlled. To operate from 6 v., 12 v. or Mains supply sources. Reconditioned with same as new guarantee. Prices from £55 per complete station FOB U.K. Port, as illustrated.

GENERALLY AVAILABLE
H.F. Radio Transmitters 300 watts Modulated R.F. Output.
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Military Wireless Sets of very many types including Handy-Talkies.
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The oldest Component Specialists in the Trade

Telephone: MUSEUM 9188
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FOLLOWING THE STUPENDOUS SUCCESS OF THE "MIRACLE"

WE NOW INTRODUCE FOR 1961

THE "CONTESSA"

A really remarkable 2-Band 6-Transistor Superhet Kit as displayed at the Radio Hobbies Exhibition.

Study these brilliant features which cannot be found in any other kit—the Contessa is the professional looking set with the professional performance.

- Waveband coverage of 530 kc/s to 1,620 kc/s and 160 kc/s to 270 kc/s.
- Assured reception of at least a dozen stations in daylight!
- Large clearly-calibrated station-named dial.
- Internal high-gain Ferrox aerial.
- 5 : 1 ratio slow motion tuning.
- Fitted with the latest 1200 line high-flux loudspeaker.
- Power of 410 milliwatts from the single-ended push-pull final stage.
- Specially designed aerial matching coil for use in a CAR.
- Only first grade fully-guaranteed Mazda matched transistors and diodes are used.
- Double tuned IF transformers for maximum gain and knife-edged selectivity.
- Fully drilled printed circuit panel marked with component numbers.
- The two-colour case measures 10 x 7½ x 3½in. and weighs approx. 4 lbs. when assembled.
- Battery lasts 4 months with normal usage.
- Book supplied with detailed assembly instructions, diagrams and circuitry.
- Anyone can build this set—everything supplied—just a soldering iron required.

Inclusive price for all associated components, cabinet and battery, complete in every detail.
(or our BUY AS YOU BUILD SCHEME, any parts sold separately.
Send for comprehensive descriptive Manual and Parts List, 3/6 post free.)

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Plus 3/6 Regd. P.P.

MOULDED TROPICAL PAPER CONDENSERS

Small, non-inductive, insulated, high-grade Capacitors. 150 v. Wkg., ·15 Mfd. 5% 10d. .22 Mfd. 10% 9d. 2 Mfd. 10% 1/10. 250 v. Wkg., .068 Mfd 9d. 1 Mfd 1/1. .22 Mfd. 2% 1/4. 1 Mfd 10% 1/7. 500 v. Wkg., 680 pF. 1,000 pF. 1,500 pF., 2,200 pF 7d. each. 3,300 pF., 8d. 5,000 pF., 6,800 pF., 01 Mfd. 9d. each. 8,200 pF., 1/-. .022 Mfd. .03 Mfd. 10d. each. 047 Mfd. 2% .05 Mfd. 11d. each. .1 Mfd. 11d. .25 Mfd 1/7. .5 Mfd 1/3. 750 v. Wkg., 470 pF., 10% 820 pF., 1,500 pF., 2,000 pF 8d. each. 5,000 pF., 6,800 pF., 9d. each. .022 Mfd. 10d. 1,000 v. Wkg., 1,500 pF. 9d. 6,800 pF 10d. .01 Mfd., 1,500 v. 1/-. .12 Mfd., ·15 Mfd., 1/1 each.

VALVE HOLDERS

4 pin UX, 7d. 7 pin Brit. Pax. 3d. 7 pin Brit. Porc. 4d. Int. Octal Pax. 3d. Internat. Octal McMurdo 6d. Mazda Octal Pax. 3d. Loctals Amp. 6d. B7G Pax 6d. B7G P.T.F.E. 8d. B7G Cer. with saddle and valve retaining spring 1/-. B8A Pax. 4d. B8A Amp. 6d. B8A Cer. 8d. B9A Pax. 6d. B9A Cer. 10d. B9A Cer with saddle and valve retaining spring 1/-. B9A Cer. skirted 1/-. B9A Cans. 6d. B9A printed circuit 10d. B7G Valve cans 6d. EY86 High Voltage holders 1/3.

VARIABLE GANG CONDENSERS

Twin Gang .0005 MFD. 2⅜in. × 2in. × 1⅝in. Spindle 5/16 in 4/-.
Min. Twin Gang .0005 MFD. 2⅜in. × 1½in. × 1⅝in. Spindle ¼in. 5/6 with Trimmers 6/6 and Dust cover 7/6.
AM/FM 2-Gang Condensers. 500 + 20 pF., 3/6.

DISC CERAMIC CONDENSERS 500 v. Wkg.

8.2 pF., 470 pF., 500 pF., .001 Mfd., .002 Mfd., .0025 Mfd. 003 Mfd., .005 Mfd. 6d. each. .01 Mfd 9d.

TRANSISTOR COMPONENTS

SUB-MINIATURE ELECTROLYTIC CONDENSERS

Most with sleeves, all at 2/3 each.
.1 mfd. 30 v., .25 mfd. 15 v., .5 mfd. 50 v., 1 mfd. 10 v. 25 v., 2 mfd., 6 v 15 v 70 v., 4 mfd., 12 v. 5 mfd. 25 v., 6 mfd. 3 v. 6 v., 8 mfd. 3 v. 6 v. 15 v 30 v., 10 mfd. 6 v. 25 v., 16 mfd. 3 v. 6 v. 30 v., 20 mfd. 15 v., 25 mfd. 12 v., 30 mfd. 3 v. 6 v. 12 v., 50 mfd. 6 v.

SUB MINIATURE TRANSISTOR COILS

Set of 3 I.F. Transformers 470 Kc/s plus Oscillator coil.
As specified for Mazda Circuits 23/6 complete.
As specified for Mullard Circuits 23/6 complete.
WTC oscillator Coils for Jackson or Plessey Gang 4/6 each. WTC 470 kc/s. I.F. Transformers 4/- each. 7/6 pair.

SUB MINIATURE CARBON POTS

5K., 50K., 220K., 330K., 1M. 2/-. 5M with switch. 4/6. 5K., 1/6. 500K preset 1/-. 1M Transistor Pots 2/-. 5K Transistor Pots 1/6.

FULLY MOULDED TRACK POTS

(Diameter ⅝in. SHORT SPINDLES) 2/6 each.
100Ω. 250Ω. 400Ω. 500Ω. 1k., 2k., 2.5k., 5k., 10k., 25k., 50k. 100k., 250k. 500k., 1M.

SUB MINIATURE METALLISED PAPER CONDENSERS ⅜in. × ¼in. 100 v. working.

.005 MFD., .0022 MFD., .002 MFD., .001 MFD., 8d. each. .02 MFD., .04 MFD. Price 9d. each.

MIN. POLYSTYRENE CONDENSERS

10 pF., 50 pF., 59 pF., 75 pF., 82 pF., 100 pF., 125 v. wkg. 6d. each. 300 pF., 350 pF., 390 pF., 470 pF., 560 pF., 1,000 pF., 1,200 pF., 4,000 pF., 9d. each.

TV PRESET CONTROLS

Knurled knob and 4BA fixing holes. Diam. 1in. 100Ω 5K. 10K., 25K. 50K 100K. 200K., 250K., 500K., 1.5M., 2M. 1/3 each. 25K wirewound 1/6.

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Size 1 5/16in. dia. 2in. spindles. Price 2/11 each.
1 pole 10 way. 1 pole 12 way. 2 pole 2 way. 2 pole 3 way. 2 pole 4 way. 2 pole 5 way. 2 pole 6 way. 3 pole 3 way. 3 pole 4 way. 4 pole 3 way.

POTMETERS CARBON—HI-GRADE

Moulded Tracks. Diam. 1¼in., 2¼in. spindles. 5K, 10K., 25K. Linear only. 50K., 100K., 250K., 500K., 1M. 2M. Log or Linear, less switch, 2/6 each. With switch 4/6

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Audio Output Types 5,000Ω to 3Ω 3/9. 30,000Ω to 3Ω 4/6. Universal CRT Boosters with tapped primaries 2 v. 6.3 v. 13 v. 25% boost all taps. 10/6. Filament Transformers, centre tapped. 6.3 v. 1.5 amps., output, 5/9; 3 amps. 9/6. Charging Transformers, tapped all voltages 2 amp., 14/3. 4 amp. 16/6.

MODERN TV COMPONENTS

Ferrox Line O/P Transformers. 16 kV. U25 10/6. (90° Types 12/6) Frame O/P transformers to match 4/6. Scanning Coils to match 10/6. (90° types 12/6). Panel containing 6 preset pots 5/-. Smoothing Chokes: 2 Hy. 250 mA. 3/11. 1.9 Hy. 250 mA. 2/11. 1.3 Hy. 250 mA. 2/6.
G.E.C. Metal Rectifier 250 v. 250 mA. 10/-. 34 Meg. I.F.T. 1/6 ea. 38 Meg. I.F.T. (link) 2/- ea. Masks 14in., 17in. and 21in. 2/6, 3/6, 4/6 (plus 2/6 p.p.).

MISCELLANEOUS

Crocodile clips 4d. Coax. Plugs and Sockets 2/2 per pair. Condenser clips 1in., 1⅛in., 1⅜in., and 1¾in. 6d. ea. Parmeko Smoothing Choke 8/9 Hy. 100 mA. 6/6, 500 pF. 15 Kv. moulded Condensers 2/6. WX2s Westector 6d. Transistor Twin gang condensers 387 + 166 pF. ex equip., 4/6. Vibrator Hash Chokes 1/-. Ext. Loudspeaker panel with switch 1/-.

We have an extensive range of Waxed Paper Condensers (average price 5d. each). Metallised Paper Condensers (average price 11d. each) and Wirewound resistors 5/6/7-watt types (average price 1/- each).

All Electrolytic Condensers as advertised in May 1960 issue still available.

STAMPED AND ADDRESSED ENVELOPE with any enquiry please

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LASKY'S RADIO

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL

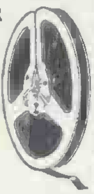
3-SPD. TAPE RECORDER
Complete with Microphone, Tape & Spool
Carr. & Ins., 25/-
29 GNS.

A complete Tape Recorder using Collaro Studio 3-speed Deck, 1⅞, 3¾, 7½ i.p.s. Twin track, with pause control, rev. counter, latest type electronic recording indicator. Superimposing switch, volume and tone controls, 7 × 4 loudspeaker, 4 watts output. Takes 7in. spools. In contemporary design carrying case, 9½ × 16 × 16in. Brand new, fully assembled ready for use.

TAPE RECORDERS
Largest stocks in London.

BRENELL, CLARION, COSSOR, ELIZABETHAN, ELEKTRON, FIDELITY, FI-CORD, FERGUSON, FERROGRAPH, GRUNDIG, HARTING, KORTING, MINIVOX, PHILIPS, REFLECTOGRAPH, SOUND, SIMON, STEELMAN, STUZZI, TANDBERG, TELEFUNKEN, TRUVOX, TRIX, STELLA, WALTER

SPECIAL OFFER OF TAPE



Famous make. P.V.C base on latest type plastic spools. Brand new, boxed and guaranteed. 1,200ft. on 7in. spool. **20/-**

1,800ft. on 7in. spool 32/6
1,200ft. on 5¾in. spool 21/-
850ft. on 5¾in. spool 16/6

SCOTCH PLASTIC TAPE
1,200ft. on 7in. spool 25/-

M.S.S. LONG PLAY TAPE
1,800ft. on 7in. spool.......... 39/6
1,200ft. on 5¾in. spool 29/6
850ft. on 5in. spool 25/6
220ft. on 3in. spool 7/11

Post: 1 spool 1/6
Orders over 60/- post free.

ALL MAKES OF TAPE. Long Play, Double Play and American "MYLAR."

HIGH FIDELITY TAPE RECORDER HEADS

Leading make, new and unused. Upper or lower track. RECORD/PLAYBACK, high impedance. Double wound and will reproduce up to 12,000 c.p.c. at 7½ i.p.s. Azimuth adjustments. Output 5 millivolts at 1 Kc. at 7½ i.p.s. ERASE, low impedance. LIST £4 PAIR.
LASKY'S PRICE, per pair **29/6**
Post free
Please specify upper or lower track.

MICROPHONE BARGAINS

The "Diana," High impedance moving coil mike with unique magnetised table base. Response 30-15,000 c.p.s. Ideal for tape recorders. List 4 Gns.
Lasky's Price 55/- Post free.

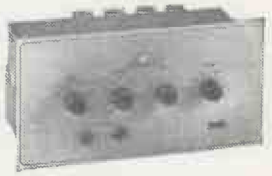
ACOS CRYSTAL STICK MIKE Type M.C.39/1, complete with cable. Listed at £5/5/-.
Lasky's Price 39/6 Post free.

MINIATURE moving coil dynamic microphone, incorporating switch and complete with pocket clip. As used for the "Fi-Cord," **35/-** Post 1/6.

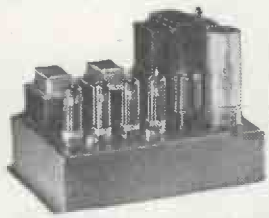
ALL TYPES OF CHASSIS
ARMSTRONG, DULCI, EMPRESS,
etc. A.M. (1, m., s.) from ... 7 Gns.
A.M./F.M. from .... 14 Gns.
A.M./F.M. STEREO from 22 Gns.

Saville HI-FI EQUIPMENT
(STEREO & MONAURAL)
AT GREAT REDUCTIONS

For mains 200-250 v., 50-60 c/s. New and fully guaranteed, only slightly soiled. Very limited quantity.

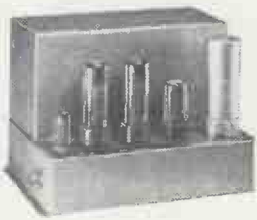


SAVILLE STEREO SEVEN
Pre-Amplifier and Control Unit. Uses two EF86 and two ECC81 valves. Separate controls, bass and treble, balance and switched selector for various inputs.
List £15. **Lasky's Price £9/19/6**
Post 3/6.



POWER UNIT. Twin push-pull Amplifiers of 7 watts each. Freq. range 45 c/s to 28,000 c/s ± 1 dB. Distortion at 1,000 c/s and 7 watts <0.2%. Extra power supplies for Tuner. Five valves: four ECL82, one GZ34. List £33.
Lasky's Price £13/19/6
Post 7/6.

SPECIAL COMBINED OFFER
The Saville Stereo Seven Pre-Amp. and Power Unit, if purchased at the same time, **£23** Carr. 10/-.



SAVILLE TWENTY
Main Amplifier and Power Unit. 20 watts nominal, 30 watts peak from "C" core distributed load stage. Freq. range: 34 c/s to 30,000 c/s ± 1 dB at 20 watts. Distortion at 1,000 c/s and 20 watts <0.1%. Mains transformer will sustain 100% overload continuously. Power supplies for Tuner: 300 v. 50 mA. 6.3 v. 2.5 amp. 4 valves: 2 EL34 push-pull, ECC81, GZ34. List £27
Lasky's Price £14/19/6
Carr. 9/6

SPECIAL COMBINED OFFER
Two Saville Twenty Amplifiers and one Saville Pre-Amplifier (as illustrated), if purchased at same time. **£36** Carr. 12/6.

LAST FEW! AVANTIC
STEREOPHONIC HI-FIDELITY EQUIPMENT
For 200-250 v. A.C. mains. New and fully guaranteed.

SP21/2. Stereo Pre-Amp. Control Unit **£16/19/6.** Carr. & Ins. 7/6.

DLT-35. Power Amplifier. **£16/19/6.** Carr. & Ins. 12/6.

Special Offer. One SP21/2 and two DL7-35, 47 gns., Carr. & Ins. 21/-.

PL6/21. 20 watt Monaural Amp. and combined control unit, **19 gns.** Carr. & Ins. 7/6.

STEP 11. Stereo P.U. Pre-Amplifier Unit, **84/-.** Carr. & Ins. 7/6.

HI-FI SPEAKER SYSTEM

Special Offer. Limited quantity ELAC Hi-Fi Speaker system comprising 10in. bass unit (woofer), 8 × 6in. enclosed middle range unit, and 4in. tweeter. **LASKY'S PRICE,** complete **49/6** Post 3/6.

TWO MATCHED SETS FOR STEREO £5 post paid.
Units available separately:

10in. Bass Unit 27/6. Post 2/6.
8 × 6 Middle Unit, 15/6. Post 1/6.
4in. Tweeter 12/6. Post 1/6.

NEW YEAR TAPE DECK SCOOP

The well-known MOTEK K10 Deck with push-button controls, 3 motors, 3-speed (1⅞, 3¾, 7½ i.p.s.), rev. counter. Freq. response better than 40-12,000 c/s. at 7½ i.p.s. 2-tone grey finish. Listed at £22.
LASKY'S PRICE Carr. and Ins. 7/6. **£9.19.6**
SUITABLE CASE AVAILABLE, 39/6.

COLLARO STUDIO TAPE TRANSCRIPTOR. 3 motors, 3 speed 1⅞, 3¾, 7½ i.p.s., takes 7in. spools. Push - button controls. **Lasky's Price complete with Tape and Spool £12/19/6.** Carr. & Ins. 12/6.

COLLARO TAPE TRANSCRIPTOR Mk. IV, fitted digital counter. List £25. **Lasky's Price £16/19/6.** Carr. & Ins. 12/6. Tape extra.

TAPE RECORDER AMPLIFIER
for use with Collaro Studio Transcriptor. Uses 3 valves, magic eye, contact cooled metal rectifier. Incorporates mike/gram/radio inputs, ext. l.s. jack, superimposing switch. Complete with gold/black knobs. **12 Gns.** Post 3/6.

PLASTIC TAPE SPOOLS

3in.	5in.	5¾in.	7in.	8¼in.
2/9	2/9	2/9	2/9	5/6

7in. Metal Spools, 1/9 each. Post extra.

"INSTANT" BULK TAPE ERASER
and Head Demagnetiser. Erases a complete reel of magnetic Tape in few seconds, 27/6. Post free.

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LONDON'S LEADING Hi-Fi SPECIALISTS

Visit either of our addresses for selective Demonstrations of the latest Hi-Fi Equipment, or send for our 100-PAGE HI-FI CATALOGUE, 3s. 6d., part post 6d
Fully refunded on making your first hi-fi purchase

7-valve AM/FM RADIOGRAM CHASSIS

Famous make. For 200-250 v. A.C. Output 4 watts matched to 3 ohms speaker. 7 valves: ECC85, ECH81, EF89 EABC80, EL84, EZ80, EM81, magic eye tuning indicator. Covers medium, long and FM bands. Length 12in., height 7½in., front to back 8½in.

LISTED AT 22 GNS.
LASKY'S PRICE **£16/19/6**

Carr. and Ins. 12/6.
Available on H.P. terms.

4-SPD. AUTO-CHANGERS

New and Unused in Maker's Cartons

B.S.R. type UA8	£6 19 6
B.S.R. UA8, stereo	£7 19 6
B.S.R. UA12, stereo	£8 19 6
B.S.R. type UA14	£7 19 6
COLLARO Conquest, wired for stereo, with monaural p.u.	£6 19 6
As above, Stereo	£7 19 6

Post on all above 5/-.

GARRARD

Model 120	£8 8 0
Model 121	£9 9 0
Model 209	£9 19 6
Mdl. 210, Stereo	£11 11 0
Mdl. 210 with monaural and stereo heads	£12 10 0
RC.88	£12 19 6
RC.88 STEREO	£13 19 6
RC.98	£14 19 6

SINGLE PLAYERS

Auto start and stop. Complete with pick-up and crystal cartridge.

GARRARD 4SP	£6 19 6
GARRARD TA Mk. II, wired for STEREO, plug-in head	£8 9 0
E.M.I. 4-spd., wired for STEREO and fitted Acos stereo T.O. cartridge	£6 19 6

Post on all above 5/-.

B.S.R. TU9, non-auto Turntable and separate Pick-up ... 79/6

COLLARO JUNIOR 4-speed motor and separate pick-up ... 75/-
Post free.

PICK-UP CARTRIDGES

ACOS HGP.59 or HGP.37 turnover crystal cartridge with L.P. and standard styli. List 39/7.
Lasky's Price 18/- post free

ACOS 73-1A STEREO. List 52/6.
Lasky's Price 29/6 post free.

20,000 VALVES IN STOCK
Mullard, Brimar, G.E.C., Mazda, Cossor, E.M.I., Philips, Pinnacle, Telefunken, etc. Send for our latest Valve List.

STEREO AMPLIFIER KIT

Twin 4 watt (or 8 watt monaural), employing two ECL82 and EZ80 rect., double-wound mains transformer, etc. Separate panel with bass, treble and volume controls. Indkcator lamp, push-button on/off switch, elegant gold/cream knobs. Kit comprises two Amplifier Units and Power Unit, all 5in. × 2in. in size, fully assembled ready to be wired together. Kit is priced without Loudspeaker so that you can choose the type and size required.

LASKY'S PRICE for the Kit with 3 new Mullard valves Post 5/-. **56/-**

Full data, circuit diagram, assembly instructions and suggested layout supplied.

SPECIAL OFFER OF SPEAKERS WITH THIS KIT

Two 5in. for 20/-. Two 6×4, 25/-.

CABINET. For an ideal cabinet see our offer at 69/6 on page 128.

TRANSISTOR RECORD PLAYER

CAN BE BUILT FOR £9.19.6
Carr. free

6 v. operation. For all L.P. and standard records. All components available separately.

AMPLIFIER
300 milliwatts push-pull output, using two OC71 and two OC72 transistors. Fully assembled, 79/6. Knobs, 3/6 extra.

LOUDSPEAKER
30 ohms, 7×4in. elliptical, matched to Amplifier, 25/-.

3-SPD. TURNTABLE
6 v., with rubber mat and speed adjustment, complete with t.o. crystal cartridge and two sapphire styli. 79/6.

CARRYING CASE
As illustrated, handsome two-tone finish. 17in. deep, 14in. wide, 5¾in. high. Well made and finished. 49/6.

Batteries extra.

STEREO ADAPTOR

CONVERTS ANY RADIOGRAM TO GIVE STEREOPHONIC REPRODUCTION

2-valve Amplifier using EF80X and EL84 metal rectifier (full-wave bridge). Mains voltage 195-250, 50/60 c.p.s. Ganged volume control and ganged tone control.

CAN ALSO BE USED AS A SINGLE-END AMPLIFIER.

LASKY'S PRICE complete with printed circuit, circuit diagram, full service data and 2 new valves. Post & Pkg. 3/6. **59/6**

SPECIAL OFFER. The above, plus Acos 73-1a Stereo Cartridge and 6in. or 8in. Loudspeaker, 95/-. Post 5/-.

LASKY'S F.M. TUNER

PRINTED CIRCUIT VERSION OF G.E.C. 912 "F.M. PLUS" TUNER FOR HOME CONSTRUCTION

Uses 5 valves, 2 germanium diodes and brand new T.C.C. condensers. The PRINTED CIRCUIT ensures that the I.F. R.F. and amplifiers are extremely stable at maximum gain and results are consistent on all tuners.

CAN BE BUILT FOR 7 GNS. (including valves)
Post free.

ALIGNMENT SERVICE available.

TRANSFORMERS
Complete ranges in stock, mains and output by Partridge, Gilson, Parmeko, Ellison, Elstone, Douglas, etc., etc. Let us quote you.

STOP PRESS! AMPLIFIER BARGAIN

6 watt, employing 4 valves: EX80 rect., ECC83, feeding two EL84 in push-pull. Separate control unit with bass, treble and volume controls. Size of chassis: 4½×4½×12in. Complete with 4 new Mullard valves. **LASKY'S PRICE 85/-**
Post 4/6.

TRANSCRIPTION MOTORS

GARRARD 4HF, stereo and monaural, complete with two plug-in heads ... £18 9 0
Carr. & Ins. 12/6.

GARRARD 301	£22 7 3
GARRARD 301 (Strobe)	£23 18 4
GARRARD type A	£21 7 8
PHILIPS	£10 10 0

Also Lenco, Connoisseur, etc.

"LINEAR" AMPLIFIERS

"DIATONIC" 10-14 watts	12 Gns.
"CONCHORD" 30 watt	15 Gns.
L45 4-5 watt Amplifier	£5/19/6
LT45 Tape Deck Amplifier	12 Gns.
L50 50 watt Amplifier	19 Gns.
L10 10-12 watt with pre-amplifier	15 Gns.
L3/3 Stereo Amplifier	7 Gns.

All other types in stock.

PRINTED CIRCUIT GRAM AMPLIFIER

Uses two valves, ECL82 and EZ80 and separate mains transformer to minimise hum. Incorporates Elac 8 × 5in. loudspeaker with output transformer mounted. Concentric volume and tone controls. Size of printed circuit: 4×3×2½in.
Lasky's Price 59/6 Post 3/6

P.M. SPEAKERS

ROUND

3½in.	4in.	5in.	6½in.	8in.	10in.	12in.
17/6	19/6	14/6	16/-	16/6	25/-	27/6

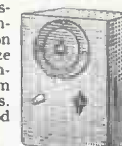
ELLIPTICAL:—

7×4	9×6	10×2½	10×6	10×7
14/6	22/6	25/-	25/-	25/-

Post extra.

THE 'VANCOUVER'

3-TRANSISTOR POCKET RADIO



Employs 3 transistors plus germanium diode, on printed circuit size 3¼×4×⅞in. Tunable over medium and long waves. Built-in Ferrite rod aerial.

CAN BE BUILT FOR 39/6 Post 1/6.

Circuit diagram and step-by-step instructions, 1/6 (free with parcel).

'EASY-SIX' 6-TRANSISTOR PORTABLE RADIO

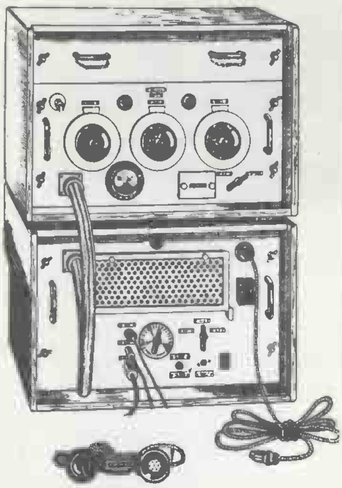
CAN BE BUILT FOR £9/15/- Post 3/-.

500 milliwatts p.p. output. Full medium and long wave coverage. Uses six first-grade Mullard transistors, 5in. loudspeaker, internal ferrite rod aerial with provision for car radio aerial. The printed circuit with component positions clearly shown, plus pre-assembled dial makes construction very simple. Smart blue/cream Vynide covered cabinet 8¼×6¼×3in. Uses PP7 battery (3/3 extra).

CIRCUIT DIAGRAM and full step-by-step instructions 1/6 (free with parcel).

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO



TRANSMITTER TYPE 36. A complete 50 watt TX for phone or CW. Covers 10-40 Mc/s. (10-15-20m.). Crystal or stabilised VFO. Push-pull 807's plate and screen modulate parallel 807's. Tested and ready to plug into AC mains. Complete with 16 valves, handset, operating instructions and circuit. Wooden cabinets may be somewhat damaged. £15 Carr. England and Wales £2.

MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. 19/6. Post 1/6.
MATCHING TRANSFORMER (for Hi impedance) i.e. for HRO, CR100, etc., with standard jack plug, 4/6.

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RMS. D.C., output 30 v. 10 amps. BRAND NEW. Boxed. 45/-. Post 3/6.

MARCONI IMPEDANCE BRIDGE. Type TF373. Measures, L, C & R at 1,000 Cycles. Accuracy 1%. 0-100H; 0-100μF; 0-1MΩ each in 5 ranges. Power Factor and "Q." Guaranteed **£35.**

ADMIRALTY HT TRANSFORMERS Pri. 230 v. 50 c/s. Secs 620-550-375-0 375-550-620 v. (620 and 550 v. 200 m/amps., 375 v. 250 m/amps.), plus two 5 v. 3 amp. rectifier windings. Total rating 278 VA. Upright mtg. Wt. 25lb. Made 1953. **BRAND NEW.** Original boxes. 45/-. Carr. 5/-.

INSTRUMENT TRANSFORMERS. 230 v. A.C. input. Outputs 0-65-130-195 v. 85 m/amps., 6.3 v. 5 amps., 6.3 v. 0.3 amps. Shrouded. Size 3¼ x 3¾ x 3¾in. high. 15/-.

HALLICRAFTER VIBRAPACK. Input 6 v. output 300 v. at 170 mA. Designed for SX28 or S27. Size 6½ x 7 x 7in. **BRAND NEW, BOXED.** 29/6. Carr. 3/6.

AR88D MAINS TRANSFORMERS. Input 110-240 v. Output 345-0-345 v. 125 m/amps., 6.4 v., 4.5 amps., 5 v. 2 amps. 4¾ x 4½ x 5½in. high. Wt. 12lb. Potted. Tag ends. RCA BRAND NEW. Boxed. **29/6.** post 3/6.

TRIPLETT METER MOVEMENT
This article consists of a basic 400 microamp meter movement mounted on a Bakelite panel 5¾ x 2⅞. The dial is scaled as a 15 range Testmeter. A circuit and parts list of the original instrument is supplied.
BRAND NEW. Boxed. **35/-,** post paid.

QQV06-40 37/6

PV1-35 **32/6,** 2D21 **7/6,** OC3 **6/-,** PT15 **12/6,** CV51(Y65) **5/-,** 6F33 **5/-,** BRAND NEW in individual cartons. Bulk enquiries invited.

CANADIAN RECEIVER No. 52

1.75-16 Mc/s (19-170 m.) in three wavebands R.F., Mixer, Sep. Osc., 2 I.F.'s, Det/A.V.C., 1st Audio, Output, BFO (10 valves), plus a 3-valve dual Crystal Calibrator. Controls: R.F. Gain, L.F. Gain, Crash Limiter, C.W. Filter, Variable Selectivity, slow and Fast Tuning and Osc. Vernier Tuning. Man. or A.V.C. BFO pitch control. Internal 3in. speaker and valve check meter. Power supply required 160 v. H.T., 12 v. L.T. Data and Circuit supplied. A really excellent receiver, **£8/19/6,** carr. 15/6. Power supply Unit, **59/6,** carr. 5/6.

SEARCH RECEIVER

Type AN/APR4. Covers 38 to 1000 Mc/s. with 3 Plug-in R.F. Heads. TN 16 (38-95 Mc/s.) TN 17 (74-320 Mc/s.) and TN 18 (300-1000 Mc/s.). Self-contained power supply for 115v. 50-2,600 c.p.s. Thoroughly reconditioned as new. In absolutely 100 per cent mechanical and operational order. **£100.**

MARCONI CR100

Completely overhauled. In perfect working order. LOOK LIKE NEW. **£21.**
Later model with Noise Limiter, **£25.**
Carr. England Wales **30/-.** Send S.A.E. for full details.

RECEIVERS R-1155B

A first-class 10-valve Communications receiver, covering 75 Kc/s. to 18 Mc/s. (16.2-4,000 m.) in 5 bands. The large scale and superior dual ratio slow-motion drive make tuning easy and the R.F. stage and 2 I.F. stages ensure world-wide reception. All the receivers we sell have been thoroughly overhauled. completely realigned and are in first-class working order. ONLY **£9/19/6.**

A.C. MAINS POWER PACK OUTPUT STAGE. In handsome black crackled steel cabinet to match the R-1155. Fitted with RCA 8in. speaker. Just PLUG IN and switch on! Only the finest quality components are used and we guarantee OUR power packs for 6 months. ONLY **£6/10/-.** Deduct 10/- when purchasing receiver and power unit together. Send S.A.E. for further details or 1/3 for 10-page Illustrated booklet giving technical data and circuits etc. (Free with each receiver). Add 10/6 carriage for receiver, 5/- for power unit.

RCA AR-88 SPEAKERS

A high quality 3 ohm unit fitted into heavy gauge black crackled steel cabinet, size 10½ x 11½ x 6in. Fitted with rubber feet and 6ft. lead. Ideal for extension speaker. CR 100. etc. In original cartons. BRAND NEW. 45/-. Post 3/6.

MINIATURE 373 IF STRIPS. For FM tuner described in "Practical Wireless." Complete with 3 of EF91, 2 of EF92 and 1 of EB91. A fresh release enables us to offer these once again. BRAND NEW. Complete reprint of conversion instructions and circuit supplied free. **35/-.** OR less valves **12/6.** Post, either, 2/6.

LOUD-HAILER EQUIPMENT

IDEAL FOR CROWD CONTROL, FACTORIES, FETES, ETC. CONSISTS OF 4 SPEAKER UNITS AND CONTROL UNIT. COMPLETE WITH MICROPHONE, HEADPHONE AND SPARES. OPERATES FROM 12 VOLTS D.C. (OR 6 VOLTS A.C. WITH SLIGHTLY REDUCED OUTPUT) CONSUMING ONLY 3 AMPS. OUTPUT POWER 8 WATTS. ALL TESTED AND WORKING, BUT SLIGHTLY SOILED. A GENUINE BARGAIN. £4/19/6. CARRIAGE 25/6.

T.C.C. VISCONAL CONDENSERS. 8 mfd. 800 v. D.C. wkg. at 71 deg. C. CP152V. Size 3 x 1¾ x 5in. high. **BRAND NEW.** Boxed 8/6 each, post paid.
4 mfd. 600 v. wkg. CP 130T. 4/6 each, post paid.

MINIATURE RELAYS (ALL BRAND NEW and BOXED)

G.E.C., sealed, wire ends, 670 2M2B H/D M1095.........	**8/6**
G.E.C., sealed, wire ends, 670 Ω, 2 H/D makes, M1099......	**15/-**
G.E.C., sealed, wire ends, 5,000 Ω 2 c/o., plat., M1052	**17/6**
Siemens High Speed, 1K+1K Ω, 1 c/over.....................	**10/6**

GIANT COMPONENT PARCEL

Contains 100 ½ and 1 watt resistors, 50 Hi Stab resistors, wire wound resistors, carbon and W/W pots, 100 capacitors (mica, paper, Sprague, bias, variable, etc.), valveholders, tag strips, metal rectifiers, sleeving etc. All components are unused. GUARANTEED VALUE. 25/- plus 2/6 post.

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE LONDON, W.C.2 *TEMple Bar 0545*
Near Leicester Sq. Station. (Opposite Thorn House)
Shop Hours: 9-6 p.m. (9-1 p.m. Thursdays). Open all day Saturday

CRYSTAL CALIBRATOR No. 10
A crystal controlled heterodyne wavemeter covering 500 Kc/s. to 10 Mc/s. (Harmonics up to 30 Mc/s.) Requires 300 V. 15 mA. and 12 V. 0.3 a. D.C., but can be easily modified for 120 V. and 1.4 V. working. Size 7 x 7½ x 4in. Good condition, complete with valves, crystal, instruction manual and circuit. ONLY **59/6.** Post 3/6. This item available complete as above. **BRAND NEW** and with spare set of valves. **£4/10/-,** post 3/6.

CANADIAN CRYSTAL CALIBRATOR. Uses double crystal and multivibrator circuit to give "pips" at 1 Mc/s., 100 Kc/s. and 10 Kc/s. Incorporates Modulator Handbook supplied. **79/6,** post 2/6.

PHILIPS RADIATION MONITOR. Type 1092C. A portable self-contained instrument for measuring radio-activity, uses the Mullard MX-115 Geiger counter tube, and is scaled 0-10 milli-Rontgens per hour. Supplied complete with carrying haversack. BRAND NEW. **£17/10/0.** Carr. 5/-. *Other types of radiation monitoring equipment in stock*

SANGAMO WESTON ANALYSER E772. A useful multi-range meter. Thoroughly overhauled and in perfect working order. For full details see previous adverts. **£7/10/-.** Carr. 4/6.

MARCONI TF987/1 NOISE GENERATORS. Range 100 Kc/s. to 200 Mc/s. Determines noise factor of AM and FM receivers. Fully stabilised H.T. supply A.C. mains operation. Brand new and in original boxes. **£15.** Carr. 7/6.

HEAVY DUTY SLIDER RESISTORS. 1.25 Ω 20 A., **12/6,** post 3/6 1 Ω 12 A., **8/6.**
PRECISION RESISTORS. 1 Megohm. 1% 1 watt wire wound, Ex-U.S.A. BRAND NEW. **10/6** per dozen.

D.C./A.C. CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0-300 v. A.C. 2½in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. **£9/19/6.** Carr. 10/6.
24 v. Input 230 v. A.C. 50 c/s. 100 watts output. In grey metal case. BRAND NEW. **92/6.** Carr. 7/6

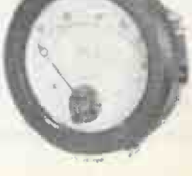
FIELD TELEPHONES. Army type D, Mk. 5. Buzzer calling. Ideal for building sites, farms, workshops, etc. Complete with handset and batteries. Tested. **32/6.**

MICROAMMETERS

R.C.A. 0-500 microamps. 2½in. circular flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the No. 19 set BRAND NEW. Boxed **15/-.**

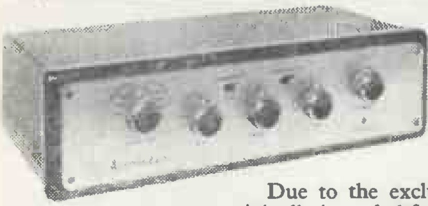
American 0-100 microamps. 2½in. square flush panel mounting. BRAND NEW. Boxed. **42/6.**

FERRANTI VOLTMETERS N.5.
0-300 volts, 25-100 c/s. Moving iron. 6in. scale. Fl. mtg. Hermetically sealed, grade IN. Made 1955. BRAND NEW. Boxed. **79/6.** Post 3/6



PROOPS Walk-around Store
and MAIL ORDER SERVICE

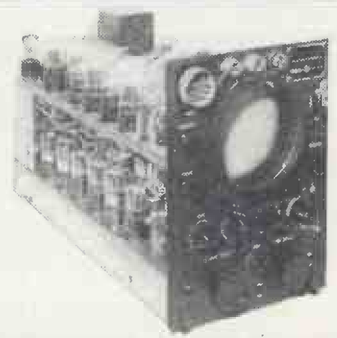
52 Tottenham Court Rd., London, W.1 ● *Open 9-6, including Sats., Thurs. 9-1* ● LANgham 0141



KIT OF BEAM-ECHO AVANTIC PARTS

Due to the exclusive purchase of a large stock of parts originally intended for the Beam-Echo Avantic combined stereo control unit and power amplifier SPA.11 we are able to offer a kit of all the parts necessary to build this superb piece of equipment—complete to the last nut and bolt, with specially prepared assembly instructions, full circuitry and wiring diagrams, plus a full copy of the handbook—at the BARGAIN PRICE of **£11 plus 7/6 carriage.**

Abridged Specification. Two 7 watt channels switchable for either stereo or 14 watt monaural. Wide-range bass and treble controls, channel and phase reversal. Main and pick-up balance controls. Separate output on each channel for tape. 100-245v mains. Mains outlet socket and tuner power supply provided. Two p.u. and two tape and tuner inputs. 4, 8, and 16 ohms output. Six valves and bridge circuit metal rectifiers. 2xECC83 and 4xECL 82. Less than 1% total distortion at 7 watts. Hum and noise 70 dB.



TELEVISION OSCILLOSCOPE

Release of a small quantity of the latest version of the well known APN-4 Indicator Unit from the American Loran Airborne radio navigation system. This provides a golden opportunity to make a serious television servicing and development tool as described in the *Wireless World*.

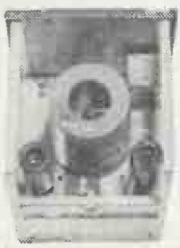
This is a nice looking piece of equipment with a really businesslike inside. Steel, double-decked chassis with fully screened 5CP1 tube in the centre, all high-grade capacitors and resistors, separate tag boards and layout diagrams for individual sections, etc. Modern circuit technique centred around one type of valve (15 of 6SN7 double-triodes and 8 of 6H6, plus three 6S7 and one 6SJ7), and RCA. 100 kcs Crystal.

Brand New, with Wireless World article, carriage paid **£6:10.**

RF EHT POWER UNIT 846

A small, very neat, lightweight unit of most modern construction providing 1000 volt DC from rectification of self-generated AC. Unit employs a 6C4 oscillator and an EY51 EHT rectifier and incorporates its own HT and EHT smoothing. Requires only 12 or 24v DC for filaments and 250 volts of raw AC to provide the EHT for an oscilloscope etc. Unit also contains a 6J6 arranged as an independent multivibrator with its inputs and outputs connected to a Breeze multi-socket on front panel. Size: 4½ x 5½ x 5½in.

Brand New, complete with valves and circuit . . . SNIP . . . **25/-** *post paid.*



WALKIE-TALKIES Type 46

This is a later type than those previously available. A really serious job of sound design, crystal controlled, 10 mile range, transmitter and receiver covering any one frequency between 4125 and 7100 kcs in 25 kcs steps with standard crystal supplied—or any spot frequency between 3600 and 9000 kcs with special crystal supplied to order. Brand new, complete with headphones, throat mic., whip-antenna, plugs and leads. Size: 12 x 4 x 6½in. Weight 8½lb.

Price, with standard crystal .... **£3/10/0** *carriage paid*

with chosen spot frequency crystal .... **£7/15/0** *carriage paid*

Batteries required: 150, 15, and 3 volts. Transistorised converter to operate from 6v. or 12v. D.C. .... **£8/10/0** *extra*

ART13 TRANSMITTERS. 100 watt **£18/0/0** *carriage paid*

CARPENTER POLARISED RELAYS

Type 5C9. Two 1685 ohm coils .... **19/6** each
Type 519. Two 68 ohm coils .... **15/-** each

G.E.C. SEALED RELAYS

5,000 ohm double-pole changeover **12/6**
670 ohm four-pole changeover **10/-**

TRANSISTOR AMPLIFIER KIT

Printed circuit, 500 milliwatt push-pull output. Input and output transformers of 3 ohms impedance with two OC.71 and two OC.72. Supplied complete with all condensers, resistors, volume control, etc. Input 9 volts. for only **52/6** post paid

SCR 522 TRANSMITTER RECEIVER

Well known American airborne equipment covering 100 to 156 Mc/s. BC625 transmitter has a 6G6 Crystal oscillator with the 2nd harmonic fed to a 12A6 and an 832 tripler stage and finally to an 832 power amplifier giving 8 watts. The BC624 superhet receiver has a 9003 RF and Mixer, three 12SG7 12 Mc/s IF's, 12C8 Detector, 12J5 Audio, and 12AH7 oscillator using 8 to 8.72 Mc/s crystals. AVC, Noise Limiter, and Squelch provided. Output transformer provides 50, 300 and 4,000 ohms. Successful conversion to 2 metres was fully described in CQ. Circuit diagram (unmodified) supplied. In good used condition.

Receiver, less valves, post paid. **10/-** *Transmitter, less valves, but including modulation transformer, post paid.* **15/-**

MAINS TRANSFORMERS

200-250 volt 50 c/s. post paid

Type 1. 250–0–250 at 70mA.	6.3v at 2A. 4v at 2A.	....	9/-
2. 300–0–300 at 70mA.	6.3v at 2.5A. 5v. at 2A.	....	10/-
3. 350–0–350 at 120mA.	6.3v at 3.5A. 5v at 2A.	....	16/6
4. 350–0–350 at 300mA.	6.3v at 8A. 5v at 2A plus 4v at 2A and 6.3v at 2A.	....	27/6
5. Filament only:	6.3v at 4A.	....	8/-

CRYSTALS Type FT. 243

Set of 80 covering 5706.667 to 8340 kcs in 33.333 kcs steps.
Complete set .... £4/3/6 post paid
Any one between 7006.667 & 7173 kcs, or above 7973 kcs ... 6/6 each
Any Three others .... 10/- post paid
Set of 120 covering 5675 to 8650 kcs in 25 kcs steps.
Complete set.................................. £6/4/0 post paid
Any one between 7000 to 7300, or 8000 to 8300 kcs ...... 6/6 each
Any Three others .... 10/- post paid

POST PAID VALVE BARGAINS

7Z4, EY91, 6AM5, 6AM6, 6C4, 6AL5, CV71 (neon stabiliser).............................. any 4 for **10/-**
6SN7 ... 4 for 12/6; TT15 ... 32/6; QVO.4/7 .... **9/6**
Brand New CV.139A CRT. **£1**
STC Miniature Silicon Diodes, 50 volt Peak Inverse. Output 15v. 0.5A, DC **3/6**

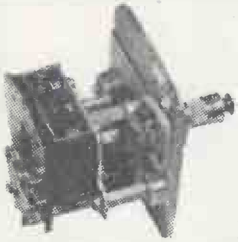
POST PAID TRANSISTOR BARGAINS

OC.170 **27/6**; OC.16 **37/6**; Goldtop V30/10DP... **21/-**
Also leading make of 3v transistors .... 4 for **10/-**

AMERICAN 400 CYCLES INVERTER.

30/- post paid.

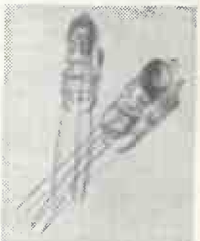
Very neat unit indeed, only 2½ dia. by 4in. long on 1½ in. high pedestal base containing suppressor. Ball bearings. 24 volt D.C., input for 26 volt single phase A.C. 6VA output. Instrument quality — as used with Bendix Magnesyn compass system.



LOW INERTIA INTEGRATING MOTORS

Precision made, high-efficiency, permanent magnet DC motors employing jewelled bearings and gold brushes that sufficiently eliminate brush-contact voltage-drop and friction and iron losses to provide a linear voltage/speed response that enables very small voltages to be integrated over time. Made by Electro-Methods, of Stevenage, these units are assembled to a robust aluminium faceplate which forms a type 1000 gearbox with a 5 : 1 ratio through fibre and brass reducing gears to a double ball-bearing spindle terminating in a small bevel gear. Low inertia motors are suitable for use in instrument-type servo-mechanisms for driving light loads, operating mechanical counters, or as small power generators. Nominally of 2,000 r.p.m. at 24 v., they have an off-load starting voltage of 79 millivolts at 95 microamps. With an armature moment of inertia of 1.8 gram. cm. squared they are so sensitive that they will operate directly from a photo-cell or thermo-couple. **£4-10** *post paid.*
Brand New, in original wrappings.

Cold Cathode Trigger Tubes



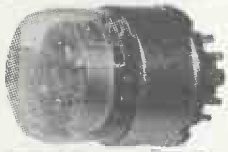
A sub-miniature cold cathode valve developed by Ericsson primarily for computor work, these GTR.120W tubes have great possibilities in a number of experimental electronic automatic control circuits. They have an Anode-Cathode running voltage of 95 to 140 at 4.5 mA, and at 290 anode volts require a trigger current of only 250 microamps to cause the anode to take over the discharge. Typical ionization time = 90 microseconds. They will withstand up to 310 v. with zero trigger voltage without self-igniting.
Supplied complete with full performance data in original packs of 100 at the Special Price of **£5** *per 100 post paid.*

CHROMEL/ALUMEL THERMOCOUPLE LEADS

7, 10 and 21 foot lengths of flat twin lead—90% nickel, 10% chrome and 95% nickel, 5% aluminium. Total resistance 0.875 ohms. For use with millivoltmeter to read 0 to 1,000°C. Sheathed in heat resisting silicon rubber that will stand 200°C. Price, post paid, 7/6, 10/6 and 21/- respecitvely.

BC.929 SCOPE UNIT

Neat, modern indicator unit especially suitable for quick conversion to attractive general servicing scope. **(Suitable circuit diagram and all component values supplied.)** Contains fully mumetal screned 3BP1 tube, intensity and focus controls, 3-position rotary switch and 8 pre-set, potentiometers, plus 2×6SH7, 2×6H6, 6G6, 6X5 and 2X2 valves. Designed for 24 v. D.C. or 400 c/s A.C. input. Size 14 × 8½in. square. Well known and deservedly popular buy. Offered new, less (unwanted) motor driven aerial switching unit, for post paid. **50/-**



NOMOTRON DECADE COUNTER TUBES

STC Type G10/241 latest type cold cathode, gas-filled, single pulse, uni-directional decade counter which illuminates numerals on tube face. Operating range—20 kc/s. Cathode output 40 volts, 3.7 mA. HT supply 310 v. plus. Applications include: tachometers, counting and batching, frequency and time measurement, direct operation of electro-magnetic relays, sequential monitoring of up to 10 different waveforms, etc. Brand New, complete with special base and instructions. **32/6** post paid.

ROTARY RELAY. Superb, fast acting, brand new precision unit made by Price for RCA. Nominally 12 volt, but mighty lively on 6-volt supply. Two heavy duty single pole changeover contacts and one low current for external circuits, plus one break set that extends coil winding to reduce initial energising current to 50 mA. (at 6 v.) for holding. Solid milled armature, laminated steel frame, 2¼ × 2⅛in. $\frac{1}{16}$in. thick, moulded inset dielectric block.
A highly recommended spares box buy at 7/6 each, *post free.*

200/220v. D.C. to 200/250v. A.C.

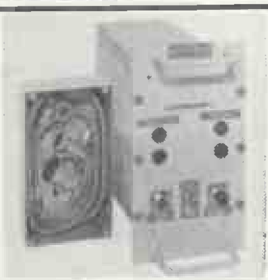
New 200-watt D.C. to A.C. rotary inverters in sound-proof cabinet. £9/10/- *carriage paid.*

VENNER TIME SWITCHES

Type T.S.2, first grade precision time switches as supplied to G.P.O. Comprises absolutely silent, self starting, 250 volt 50 c/s synchronous clock mechanism totally enclosed in heavy gauge brass case. Central drive takes detachable dial that revolves to operate sensitive on and off trips for external mains operated circuit. Self contained clock is easily detachable from rear mounting panel (self starting down to 80 v. and keeps running down to 15 v.).
Brand new, in original packings, and with dial and adjustable stops, post paid. **37/6**

400 CYCLE CHOPPER

Latest version of U.S.A. Servomechanisms 400 c/s chopper. High quality 6 v. vibrator oscillating between twin contacts for chopping external circuit. Hermetically sealed in octal based can.
Brand New **£2** *post paid.*



HIGH QUALITY POWER PACK

Admiralty Rectifier Unit Design 95, totally enclosed in heavy gauge attractive light grey case size 11¼in. high × 6in. wide × 14in. deep. Admiralty ratings: transformer 400–0–400 at 50mA, 6.3 v. at 1 Amp, 5 v. at 3 Amp for 5U4G. Insulation tested to 3 kV. Two 350 ohm 20 henry 80 mA chokes; Two 4 μF at 600 v. ceramic terminal square canned paper smoothing capacitors. Double pole mains switch, two 2A fuses and two spares all in screw-in holders on front panel. 3-pin 250 v. 50 c/s mains input, and 3-pin output with matching plug on short screened cable providing 650 v. D.C. and 6.3 v. A.C. with common earth. An unusually neat, attractive, high quality unit. Brand New, still boxed for only **50/-** carriage paid.

Brand New, Individually Tested, Fully Guaranteed

LOW-VOLTAGE, HALOGEN-QUENCHED, GEIGER-MUELLER TUBES 25/- *post free*

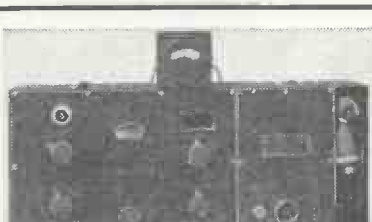
Working voltage 400–450. Highly sensitive. Effective length 11.8 cm Background count 90/minute. Response 30,000 counts/minute. 80-volt plateau. Standard British 4-pin base, stainless iron electrode. Ideal for basic experimentation and instructional demonstration. Circuits of simple all transistor and conventional valve counter circuits supplied on request with each tube.

I-30-A SIGNAL GENERATOR 100-156 Mc/s

Modern, portable, battery operated, 5 valve Signal Generator with alternative crystal or master oscillator, either optionally modulated by 1,000 c/s Hartley oscillator. Large directly calibrated dial with precision slow motion drive. Five step and variable attenuator. Supplied with matching black crackle carrying case for 6 and 135 volt batteries with 10ft. supply cable, and metal cased 1 mA. test meter for checking crystal resonance, etc. Brand new. £2/17/6 *plus 7/6 packing and carriage.*

I-95-A FIELD STRENGTH METER 100-156 Mc/s

Self-contained, tunable-input, valve-voltmeter with telescopic aerial and battery-fed diode rectifier and pentode amplifier for measuring field strength, presence of modulation, and approximate frequency of transmitter. Compensating circuit for state of 1½ and 45 volt batteries. In attractive black crackle case. Brand new.
£2/5/- plus 5/- packing and carriage.



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POST FREE SNIPS

Double pole knife changeover switch on porcelain base. 2 for 5/-
G.P.O. 230 volt mains, twin six inch gong, outdoor bells...... 33/6
Siemens high-speed relays. 1,000–0–1,000 ohm coils.......... 8/6
Pyrex Aerial Insulators. Four 3in. OR one 8in.............. 7/6
U.S.A./British co-ax. adaptors. Four for.................. 5/-
Neons. Ten 115 volt for 12/6; Six 80 volt for.............. 7/6
G.P.O. mechanical counters. 0-9999 .... 7/6

RECEIVER TYPE 88 (R1475)

Highly stable, specially accurately calibrated, Marconi design, RAF communications receiver covering 2-20 Mc/s in 4 bands with built-in 600 kcs Xtal reference oscillator for checking dial which can be reset by special panel trimmer control. 11 Valves: 3x6K7, 6K8, 6J5, 3x6Q7, 6H6, Y63 tuning indicator and VR150-30 voltage regulator. Two stage IF with 8 tuned circuits, Xtal controlled B.F.O. Four position selectivity with audio filters for narrow band-width C.W. Fast and slow AVC, high and low noise suppression. A plug-in unit with additional mixer provides a "listening through" guard channel of either 2-4 or 4-7½ Mc/s. Receiver 16½ × 9 × 11in. Power pack 8 × 9 × 11in. Complete with 200-250 volt AC (or 12v. DC) power pack type 360, and operating and alignment instructions. Used, but in very good condition. Guaranteed serviceable. A sound buy indeed at **£13.10.0** carriage paid.

ETCH-YOUR-OWN PRINTED CIRCUIT KITS 21/- Post Free

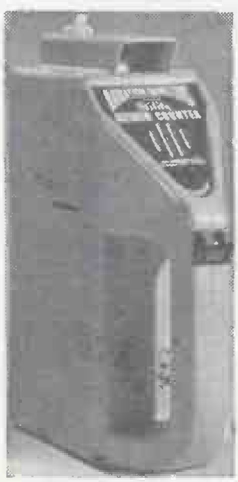
Each contains over 60 sq. in. of laminated board and sufficient chemicals to make dozens of printed circuits, plus comprehensive instruction book giving advice and examples on translating theoretical circuits into layouts ready for etching. High-quality materials—completely safe to handle—carefully prepared to ensure fine definition and uniform results without laboratory control.

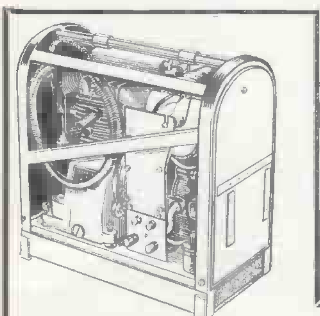
£10 GEIGER COUNTER

Circuit embodies U.K.A.E.A. patent. Specially moulded case. Currently being supplied throughout the world. Three ranges—highly sensitive—light—portable—visual and audible response—plus output socket. Ideal for introduction to radiation measurement and nucleonic circuitry. Specially written 40-page instruction manual supplied. Batteries £2/15/3 extra.

KIT OF PARTS £4/17/6

Identical parts. Guaranteed performance. Manual and printed circuit plates for battery pack supplied (assembled pack £2/15/3 extra). Fully illustrated assembly instructions. Spares and service permanently available.





PORTABLE A.C./D.C. GENERATING SET

Self-contained 80 watt unit on compact chassis delivering 12 to 18 volts D.C. Size only 14 × 15 × 8in. Weight 46lb. Spring mounted air cooled petrol engine with fuel tank in base driving integral generator that has heavy duty bridge rectifier feeding D.C. terminal board. Miniature sparking plug. Filtered air intake.

Guaranteed serviceable. **£9** plus 10/- carriage.

PROOPS BROTHERS LTD.

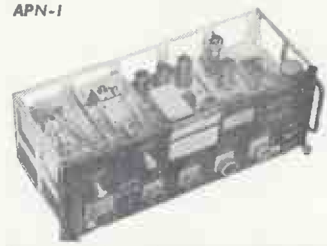
D.C. GYRO & SERVO MOTOR—CI AUTO PILOT

Beautifully engineered Minneapolis-Honeywell precision gyro, totally enclosed in sealed light-alloy housing about 8½in. cube. Automatic erection and precession correction. Large diameter Dessyn type transmitting potentiometers provide signals corresponding to the magnitude of the deviation of gimbal arms. Powerful D.C. motor coupled through a differential reduction gear to a 4in. spur driving gear integral with a 3in. dia. spiral groove cable driving drum. Two powerful solenoid clutches and corresponding brakes hold drum rigidly in position or set free for "neutral." Nominally for 26-volt operation, but operates at 12 volts. Size 10 × 6 × 8in.

£10 each unit or £17/10/- pair, carriage paid.

TRANSMITTER/RECEIVER APN-1

This is the attractive lightweight American Radio Altimeter that superseded the British version. A complete 14-valve radar set covering 420-460 Mc/s it is ideal for conversion to radio control of models or 70 cm. work. It embodies three self-contained sub-units in separate detachable aluminium cases, as follows:



TRANSMITTER
A push-pull feed-back oscillator tuneable either side of 445 Mc/s., frequency modulated at 100 c/s by a particularly robust moving coil transducer. Two 955 high frequency acorn valves. Case size only 3½ × 6½ × 2in. plus 2 × 2½in. dia. for transducer.

RECEIVER
Tuneable to transmitter frequency. Size 3½ × 6½ × 2in. Two 9004 acorn valves.

AUDIO AMPLIFIER
Self-contained RC coupled 12SH7, 12SH7 and 12SJ7. Size 3 × 5 × 1½in. Amplifies the received signal which is passed to detector circuit giving a D.C. voltage proportional to the difference between the transmitted and received (reflected) signal to operate internal relays which pass appropriate correction signals to autopilot and supply external indicator (5 mA meter).

MAIN CHASSIS
The main chassis carries the 3 sub-units and has a further three 12SH7 one 12SJ7, two 12H6 and one VR150 regulator, three 1% wire-wound resistors, one 4-pole changeover relay, two SPCO relays, three twin-ganged pre-set potentiometers, trimmers, fuses, etc.
Power supply is derived from a 27-volt dynamotor (charging rate for 24 v. supply) delivering 285 volts at 75 mA.

BRAND NEW, a very useful buy indeed at only **£2** plus 7/6 carriage.

200 AMP D.C. GENERATORS

These relatively small but really heavy duty generators were designed for a continuous output of 200 amps at 29 volts and are very successfully employed as a portable welding plant when driven from a tractor take-off pulley or separate engine as required.

Guaranteed fully serviceable. Only **£6.15** carriage paid.

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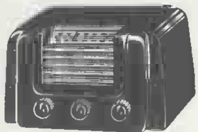
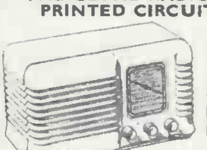
" FAMILY FOUR " (5)



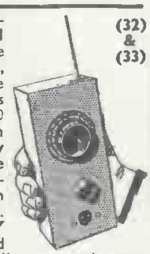
Our supersensitive T.R.F. Receiver for home construction. Covers Long and Medium Wavebands, is housed in very smart plastic table cabinet in Brown or Black. For A.C. mains 200/250 v. Comprehensive assembly instructions provided, including practical and theoretical diagrams, which are easy to follow and will enable you to complete this receiver which will be the envy of your friends. ALL NECESSARY COMPONENTS ARE BEING OFFERED FOR LIMITED PERIOD ONLY AT THE REMARKABLE PRICE OF ONLY 79/6, plus 2/6 P. & P. Instruction book available separately if you wish to study before purchase at 1/6 post free.

THE CLYNE RADIO " DE LUXE " PRINTED CIRCUIT SUPERHET



A new two-wave band (L and M) Superhet using the latest miniature valves: ECH81, EF85 and ECL80, plus contact cooled Rectifier. Incorporates Ferrite Rod Aerial and is of unit construction. Exceptional sensitivity and selectivity. Outstanding performance and quality T.C.C. condensers throughout. Easily constructed in one evening. Brown or ivory Bakelite or wooden Walnut finish cabinet. A.C. mains 200/250 v. All necessary components at special inclusive price of £7/19/6 plus 3/6 P. & P. Instruction Book with itemised price list available separately at 1/6 post free. Also available in De Luxe Cabinet (as " Economy Four " at 5/- extra).

SUPER PERSONAL PORTABLE. (32) & (33)



A wonderful little set that you can take anywhere. Ideal for camping, picnics, etc. Detachable aerial rod supplied. Covers Medium waveband 200-500 metres. Can be built in approx. 1 hour. All necessary components available at the following SPECIAL INCLUSIVE PRICES: 1-valve version **ONLY** 35/- plus 2/- P. & P. Super 2-valve version **ONLY** 41/-. Plus 2/- P. & P. Send for point-to-point wiring diagram and parts price list 2/- post free. Extra for use with the above DLR5 balanced armature headphones, 7/6 pair.

NEW ! " PAGEBOY " 2-TRANSISTOR POCKET PORTABLE

Completely portable—NO EXTERNAL AERIAL OR EARTH REQUIRED. This is an amazing little receiver with built-in aerial and small enough to be held in the palm of the hand. Medium wave reception at wonderful volume. No fiddley tuning!—condenser tuned! Supplied with drilled chassis and colour coded components. Easily assembled with the aid of the easy-to-follow assembly instructions provided. Total cost of all necessary components, including transistors, wiring wire and even solder **ONLY** 32/6 plus 1/6 P. & P. Battery 3/- extra. Ardente type deaf-aid earpiece complete with cord and plugs extra at 12/6. Parts price list and Easy Lay-out Plans 2/- post free. Callers welcome to hear this set demonstrated at any of our branches. Our reputation is your guarantee.

(45)

THE "WAVEMASTER" 7-TRANSISTOR LUXURY PORTABLE

400 MILLIWATTS OUTPUT

(43)

To build yourself Medium and Long waves—Push-Pull Superhet A.V.C. Perfect Car Radio reception. Size 10in. x 6¾in. x 4½in. at base tapering to 4in. at top.
Very attractive two-tone grey Vynide covered cabinet with black and gold printed escutcheon plate, cream and gold knobs, handle and cabinet fittings. ★ Weight—complete with long-life 7½ volt battery—4½lb. ★ Mazda high-grade transistors throughout. ★ High-Flux 7in. x 4in. Elliptical Speaker. ★ Slow motion tuning. ★ Co-axial socket at rear for direct connection to Car Radio Aerial. ★ Improved reception by use of seven-section plated telescopic aerial disappearing into Cabinet when closed; 34in. above Cabinet when fully extended.
Construction simplified by Bakelite chassis board with the following components already mounted: I.F. Transformers (3). Oscillator Coil, Trimmer Bank, Output Transformer, Interstage Transformer, Aerial Brackets and Earth Bar. SPECIAL INCLUSIVE PRICE for all required components, full assembly instructions—nothing more to buy—is £10/19/6 plus 3/6 P & P. Alignment service available. Full assembly instructions and individually priced parts list, all of which are available separately, 2/6, post free.

TO BUILD YOURSELF

ALL PARTS AVAILABLE SEPARATELY

" PRACTICAL WIRELESS " POCKET SUPERHET
All required Components for the Pocket Superhet as described in November issue of " Practical Wireless " now available at special inclusive price of £9/15/6 complete, including Printed Circuit. All items available separately, send stamp for list.

	All required components at special inclusive price	P. & P	Instruction Book and itemised price list available separately
(1) New Look " RAMBLER all dry s'het portable. NEW LOW PRICE	£6 19 6	2/6	1/6
(2) " RAMBLER " Mains Unit (suits most portables)	£2 7 6	1/6	9d.
(3) " ECONOMY FOUR " T.R.F. Mains Receiver	£5 5 0	2/6	1/6
(4) " ECONOMY FOUR " with New Look Cabinet	£5 10 0	2/6	1/6
(5) " FAMILY FOUR " (our new T.R.F. Receiver)	£3 19 6	2/6	1/6
(6) " SUPERIOR FOUR " (four valve mains receiver)	£5 15 0	2/6	1/6
(7) Standard JASON F.M. Tuner FMT1	£6 15 0	2/6	2/-
(8) Fringe area JASON F.M. Tuner FMF	£7 15 0	2/6	2/-
(9) JASON " MERCURY 2 " Switched F.M. Tuner plus ITA/B.B.C. Sound	£10 10 0	2/6	3/6
(10) OSRAM 912 Printed circuit F.M. Tuner. NEW LOW PRICE	£5 19 6	2/6	2/6
(11) JASON " ARGONAUT " AM/FM Chassis	£15 5 0	2/6	2/-
(12) JASON " ARGONAUT " AM/FM Tuner	£13 19 6	3/6	2/-
(13) F.M. Power Pack (suitable for most tuners)	£1 17 6	1/6	1/-
(14) R.C. 3/4 watt Amplifier (with Bass, Middle and Treble controls)	£4 5 0	2/6	1/-
(15) 2-amp. Battery Charger	£1 16 6	2/6	3d.
(16) R.C. Transistor/Crystal Receiver ('phones extra)	£1 1 0	1/3	3d.
(17) R.C. Super Transistor/Crystal Rec. (ditto)	£1 7 6	1/3	3d.
(18) R.E.P. 1-valve Battery Receiver	£2 2 0	2/-	9d.
(19) " CRY-BABY " ALARM (Baby Alarm)	£3 12 6	2/6	1/-
(20) MULLARD 510 Amplifier (printed circuit) Ultra Linear Version	£9 9 0	3/6	1/6
(21) MULLARD 510 as above plus input selector and spare power supplies	£11 10 0	3/6	2/6
(22) " DE-LUXE " Printed Circuit Superhet	£7 19 6	3/6	1/6
(23) " DE-LUXE " with New Look Cabinet	£8 4 6	3/6	1/6
(24) JASON J.T.V. 2 Tuner	£13 19 6	3/6	2/6
(25) RADIO JACK	19 6	1/6	6d.
(26) MULLARD TYPE " C " Tape pre-amp.	£12 9 6	3/6	2/6
(27) JASON WII Wobbulator	£14 19 0	3/6	3/6
(28) JASON Valve Voltmeter EM10 (23 ranges)	£18 10 0	3/6	2/6
(29) NEW JASON F.M. TUNER FMT2 with built-in power supplies and cabinet	£8 19 6	3/6	2/6
(30) NEW JASON FRINGE F.M. TUNER FMT3, as above	£10 19 6	3/6	2/6
(31) PULLIN Series 90 TEST METER	£5 19 6	2/6	1/6
(32) R.C. Super Personal Portable 1-valve (phone extra)	£1 15 0	2/6	2/-
(33) R.C. Super Personal Portable 2-valve (phone extra)	£2 1 0	2/6	2/-
(34) R.C. TRANSETTE 2-Transistor Personal Portable	£3 9 6	2/-	2/-
(35) JASON EVEREST 6-Transistor 2-wave Portable	£13 19 9	3/6	3/6
(36) JASON EVEREST 7-Transistor 2-wave Portable	£15 18 9	3/6	3/6
(37) CLYNE Cathode Ray Oscilloscope	£12 19 6	5/-	10/-
(38) Compact Multi-range Test Meter	£2 19 6	1/6	1/6
(39) CAR RADIO, Printed Circuit, 5-valve S'het. NEW LOW PRICE	£11 19 6	3/6	2/6
(40) JASON Audio Generator AG10	£14 5 0	3/6	2/6
(41) JASON Oscilloscope OG10	£22 10 0	5/-	3/6
(42) Super SHORT WAVE RADIO, 1 valve	£1 15 0	2/-	2/-
(43) " WAVEMASTER " 7-Transistor Luxury Portable	£10 19 6	3/6	2/6
(44) " GOLD STAR" De-Luxe 1-valve Portable	£1 17 6	2/6	1/6
(45) " PAGEBOY " 2-Transistor Pocket Portable ('phone extra)	£1 12 6	1/6	2/-

Instruction Books which contain full description easy-to-follow practical wiring diagrams theoretical diagrams itemised price lists, etc., are free of charge with all parcels but may be purchased separately as shown above.

PLEASE NOTE:—A selection of the above items are described more fully in this advertisement!!

PRINTED CIRCUIT CAR RADIO

(39)

(for Home Construction). We are proud to be able to offer this New type Car Radio employing up-to-the-minute circuitry, special 12 volt valves and transistorised out-put stage. The highest degree of sensitivity is assured by the incorporation of Permeability Tuning and a tuned R.F. Stage. Covers Medium and Long Wavebands. NO VIBRATOR PACK IS REQUIRED. This is a really compact receiver that will fit any car. Comprehensive assembly Instructions are provided with all necessary components, including valves and transistor at a Special New Low inclusive Price of Only £11/19/6 plus 3/6 P. & P. Instruction booklet with itemised price list, full description dimensions, etc., available separately at 3/6 post free.

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CABY UNIVERSAL TEST METERS
These pocket-size multi-range test meters are of excellent quality and cover all the most useful ranges (A.C. Volts, D.C. Volts, resistance and current). Supplied complete with test prods, instruction book and batteries. Model A.10 (2,000 ohms per volt) **£4/17/6**
Model B.20 (10,000 ohms per volt) **£6/10/-**. Plus P.&P. 3/6 on ea. Fully detailed and illustrated leaflet available on request

RECORD PLAYERS
Full range at usual competitive prices. Interesting H.P. facilities
E.M.I. 4-SPEED STEREO/MONAURAL SINGLE RECORD UNIT. Complete with Stereo Head and Sapphire Styli. Brand New and Fully Guaranteed. **ONLY £6/19/6** plus 3/6 P. & P.
LATEST GARRARD MODEL 210. Four-speed manual or automatic. 10in. and 12in. records of same speed can be mixed in any order, wired for stereo, attractive white colour scheme. Price **10½** gns. plus 3/6 P. & P.
LATEST B.S.R. UA14. 4-speed. Attractive appearance. Wired for stereo. Fully guaranteed. **£7/19/6.** plus 3/6 P. & P.
B.S.R. UA8 STEREO/MONAURAL. Few only at **£7/19/6**, plus 3/6 P. & P. Brand new Guaranteed.
COLLARO CONQUEST. 4-speed. Wired for stereo. Brand new. **£7/19/6**, plus 3/6 P. & P
CATHODE RAY TUBES. Unrepeatable offer! 17in. MW 43/69 by leading British Manufacturer. Brand new in original cartons. Not regunned. Full 12-month guarantee. Limited quantity at **£7/10/- each** only, plus 10/- P. & P. Send stamp for comprehensive Valve and Tube List.
METERS. Large selection of panel mounting meters at competitive price. Send stamp for new list now ready.
ANOTHER PORTABLE CABINET! Ex leading manufacturer's battery portable attache type case. Attractive two-tone grey rexine finish. Size closed 13¼ in. x 9½ in. x 3¾ in. Complete with fittings and handle. Including Medium and Long Wave frame aerial which fits in lid. Limited quantity only at bargain price of **19/6** plus 2/- P. & P. Brand new.
"PIFCO" INSTRUMENT BIT SOLDERING IRON with integral Stand and built-in Spot-light for illuminating work 200/250 v. **ONLY 22/6.** P. & P. 1/6.
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VIBRATOR PACKS. Limited quantity of both 6 volt and 12 volt types available. Output 300 volt. 100 m/a. Fully smoothed. Brand new ex-Govt. surplus. Price **35/-** ea., plus 2/6 P. & P. Please specify input voltage required.
12 VOLT VIBRATOR PACK. (Mallory). Output 150 v. @ 40 mA. Complete with synchronous vibrator. Brand new. **ONLY 12/6**, plus 2/- P. & P.
12in. BAKERS SELHURST LOUDSPEAKER. 15 ohms, 15 watt 30-14,000 cps. Brand new, **£4/10/-**. P. & P. 3/6.
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SUPER MAGNETIC RECORDING TAPE SPECIAL!!!

Famous American Ferrodynamics **"BRAND FIVE"** An enthusiast's "must." Brand new (NOT SUB-STANDARD) High grade Acetate Base, 5in. 600ft. **16/-**, 5in. 900ft. **18/6**, 5¾in. 1,200ft. **23/6**, 7in. 1,200ft. **25/-**, 7in. 1,800ft. **35/-**. Extra quality Mylar Dupont. 3in. 300ft. **13/-**. 5in. 1,200ft. **37/6.** 7in. 1,800ft. **44/-**. 7in. 2,400ft. **60/-**. Each on plastic spool. All Post free. *Trade enquiries invited.*

EXTRA SPECIAL OFFER!!
A small three-valve **PORTABLE RECORD PLAYER AMPLIFIER** mounted on baffle 12 x 7in., with High Flux 6½in. Loudspeaker. Valve line-up ECC83, EL84, EZ80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high impedance pick-up. Ready to use, **£5/12/6.** P. & P. 3/6.
NEW STYLE CABINET finished in two-tone Leatherette. Will accommodate above Amplifier and Baffle without modification, also most types of Ancillary Equipment. Overall size 18 x 13½ x 8½in. Fitted with carrying handle, **£3/9/6** plus 5/- P. & P.
NOTE. If both items purchased together they will be supplied at a special inclusive price £8/7/6 plus 6/6 P. & P.

★ TAPE RECORDER CONSTRUCTORS ★
★ *FOR THE CONNOISSEUR* ★
COLLARO TAPE PRE-AMPLIFIER AND BIAS OSCILLATOR. Complete with power pack for use with Collaro Mk. IV deck. 4 valve plus EM81 magic eye. 110-240 v. A.C. Input sensitivity: microphone socket 5 m/v., auxillary socket 500 m/v. Speed equalisation switch gives compensation at all 3 speeds. Full wiring instructions included. List price £21. Limited quantity only at **£15/19/6.** P. & P. 5/-.
LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. 3 motors, 3 speeds, 1⅞, 3¾, 7½ i.p.s. takes 7in. spools. Push-button controls, **£12/19/6** plus 5/- P. & P. Usual H.P. facilities.
LATEST B.S.R. "MONARDECK." Single speed Tape Deck. Takes 5¾in. spools—3¾ i.p.s. At only **£8/19/6** plus 5/- P. & P.
NEW! NEW! NEW!
TAPE RECORDER AMPLIFIER Suitable for use with either of the above Tape Decks, and most other types. For A.C. mains, 4 watts output. 40-12,000 CPS at 7½ i.p.s. ± 3 db. Facilities for superimpose. Valves: 6BW6, ECL82, 12AX7, EM84, and contact cooled metal rectifier. Radiogram input, microphone input, monitor facilities (can be used as straight through amplifier), volume control and separate treble and bass controls. Chassis measurement 11½ x 3 x 4⅞in. Supplied complete with attractive grey/blue escutcheon plate finished in black and gold. Circuit diagram and connecting instructions included. Price **£11/5/-** only, plus 3/6 P. & P. If purchased with either of the above decks, both items post free!
ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE Suitable for above amplifier and Collaro, Studio deck. Limited quantity only at **72/6** plus 3/6 P. & P.
MIC 45-1 Acos latest flat pistol-grip crystal microphone. Attractive black and gold finish. OUR PRICE **29/6** plus 1/- P. & P.
ACOS MIC 39-1. Crystal stick microphone. List price 5 gns. Our price **39/6** plus 1/6 P. & P.
MIC 40. General purpose crystal microphone with desk stand. Our price **25/-** only plus 1/6 P. & P.
M.C.24. Imported, crystal, attractive streamlined polished metal case, incorporates muting switch. List price 64/-. OUR PRICE **42/-** only. 1/- P. & P.
ANOTHER HAND MIKE BARGAIN! Lightweight crystal with built-in desk stand at only **19/6.** P. & P. 1/-.

LIMITED IMPORT QUOTA ONLY! OUTSTANDING BUY!
MODEL U.1 MULTI-RANGE TEST-METER. Ideal for amateurs and service engineers. Incorporates 3 inch rectangular meter. Ranges: A.C. and D.C. voltage. 0-10-50-250-500-1,000 v. D.C. current 0-100-500 m/a. 0-1 m/a. (used at 0-10 v. range). Resistance 1-2,000 ohms (centre 24 ohms). 100-200,000 ohms (centre 2.4 k.). Sensitivity 1,000 ohms per volt A.C. and D.C. Size: 5in. x 3in. x 2¼in. Weight **22** ozs. only. Fully guaranteed. Supplied complete, and ready to use with test leads, at the very low price of only **79/6** P. & P. 3/6.
(Bona fide trade enquiries invited).

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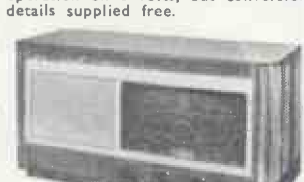
99 Cheapside, London, E.C.2.
ALSO SEE PREVIOUS PAGES

BERNARDS Latest Manual No. 167. "Eleven Tested Transistor Circuits, using Pre-Fabricated Circuit Units." Price **2/6**, post free. Covers the use of the new items listed below.
TSL LP45F MINIATURE LOUDSPEAKER, diameter 1¾in., depth ⅞in. High flux 9,500 guass, 150-15,000 cycles, **25/-**, plus 1/6 P. & P.
TOROTOR TRANSISTORISED FM FRONT END (80-100 m/cs.). Completed with 2-OC171 VHF Transistors. Ready assembled, **79/6.** Plus 26/9 P.T.
Suitable set of 10.7 mc/s. sub-miniature IF TRANSISTOR Transformers (2 IF-1 RDT) **27/6** per set, plus 1/6 P. & P.
SUB-MINIATURE DRIVER and Output Transistor Transformer **12/6** per pair, plus 9d. P. & P.
MINIATURE TRANSISTOR Twin Gangs 196/87 pF. size approx. 1in. x 1in. x ⅝in. **17/6**, plus 9d. P. & P. Set of Miniature Transistor IF and OSC Coils (455 kc/s.). (3 IF and 1 OSC), **21/-**, plus 1/- P. & P.
3 WAVEBAND CONVERTER TA-12401. With OC170 transistor in emitter injected autodyne converter circuit. S.W., 5.9-13 Mc/s.; M.W., 510-1,620 kc/s.; L.W., 150-275 kc/s. Wavechange and on-off by four pushbuttons. Overall size 3.4 x 2.1 x 1.8in. **67/6.** Plus 22/9 P.T.

TRANSISTORS!!!
SURPLUS P.N.P.
RED SPOT (Audio/Experimental Application) .... **3/6** ea.
WHITE SPOT,
R.F. up to 2.5 M/cs. .... **5/-** ea.
OC169 VHF PNP JUNCTION TRANSISTOR. Drift-type, Alpha cut-off frequency 80 Mc/s. **18/-** ea. Attractive discounts for bulk purchases. The above is a selection only. Full range in stock by all leading manufacturers. Let us have your enquiries. (ALL POST FREE).
FRUSTRATED EXPORT. Not repeatable! L., M. and S.W. SUPERHET RECEIVER. Manufactured by McCarthy for export. At present for operation on 6 volts, but conversion details supplied free.



Valve line-up: 6K8G, 6K7G, 6Q7C 6F6G, 6X5G and 6 volt 4-pin non-synchronous vibrator. 8in. P.M. Speaker, 4 watts output, P.U. socket Ext. L.S. socket, etc. Tone control. Fitted in polished wood cabinet, size 21¾in. x 10½in. x 10½in. These cabinets are slightly soiled owing to storage, but each is guaranteed unused, in serviceable condition, tested prior to despatch. Price **£5/19/6** only plus P. & P. 7/6, plus **27/6** for A.C. Mains Conversion Components if required. **OUTSTANDING BUY!**
ACOS GP73-2A: Turnover cartridge for Stereo and Monaural Standard and L.P. Few only at **29/6**, also **GP67-3** Mono at **18/-**. Both plus 9d. P. & P.
LOUDSPEAKERS. EX. CHASSIS. As new guaranteed perfect, by leading manufacturers. 5in. high flux. **9/6**; 6½in. **10/6**; 8in. **13/6**; also 10in. with O/P transformer (5,000 ohms), **17/6.** All 3 ohm speech coil, also 8in. available, in attractive cloth covered cabinet, ideal for extension speaker, **22/6.** Each item plus 1/6 P. & P. Complete list of new speakers on request.

C.R.T. BOOSTER TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit and for C.R. Tubes with falling emission. Full installation instructions supplied.
Type A. Low Leakage windings. Optional Boost 25% and 50%. Tapped mains primaries:

2 volt	12/6 each
4 volt	12/6 each
6.3 volt	12/6 each
10.8 volt	12/6 each
13.3 volt	12/6 each

OUR LATEST SUPERIOR PRODUCT. Type A2. High Quality. Low capacity. 10/15 pf. Optional boost 25%, 50%, 75%. 16/6 each
Type B. Mains input. Low capacity. Multi-Output 2, 4, 6.3, 10 and 13 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes 21/-.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w. 6d.; 1½ w., 8d.; 2 w. 1/-. HIGH STABILITY. ½ w., 1% 2/-. Preferred values 10 ohms to 10 meg. Ditto 5% 9d., 100Ω to 5 meg.
5 watt 1/3, 10 watt 1/6, 15 watt 2/- WIRE-WOUND RESISTORS 25 ohms—10,000 ohms.
12,500 ohms.—50,000 ohms. 10 w. 3/3

WIRE WOUND POTS, 3 w. Pre-set Min. T.V. type Knurled Slotted knob. All values 25 ohms to 25K. 3/- ea., 30 K. 50 K., 4/-. Ditto ½ w. Carbon Track. 30 K. to 2 Meg., 3/-.

WIRE-WOUND POTS. 4 w. Standard size Pots. long Spindle High Grade. All values 50 ohms to 50 K. 6/6; 100 K. 7/6. W/W EXT. SPEAKER CONTROL 10Ω, 3/-.

O/P TRANSFORMERS. Heavy duty 50 mA. 4/6. Multi-ratio push-pull 7/6. Miniature 3V4, etc. 4/6. Hygrade Push-Pull 10 watts, 15/6. Push-pull 20 w. 6 k. or 8 k. 30/-. L.F. CHOKES. 15/10H 60/65 mA. 5/-. 10H 85 mA., 10/6. 10 H 120 mA., 12/6. 10H 150 mA., 14/-.

MAINS TRANSFORMERS 200/250 v. A.C.
STANDARD 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. Ditto 350-0-350 22/6
MINIATURE 220 v. 20 mA., 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA. 6.3 v. 2 a. 15/6
SMALL, 200-0-200 50 mA., 6.3 v. 2 A. 17/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a. 17/6
HEATER TRANS., 6.3 v. 1½ a., 7/6; 3 amp. 10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 A. 22/6
AUTO. TRANS. 150w, 0, 10, 120, 200, 230, 250v 22/6

ALADDIN FORMERS and cores, ¼in. 8d.; ⅜in. 10d. 0.3in. FORMERS 5937 or 8 and Cans TV1 or 2⅛in. sq. × 2⅜in. or ⅝in. sq. × 1⅜in., 2/- with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
SOLON. Midget Soldering Iron, 220/40 v. 25 w., 24/-.
REMPLOY INSTRUMENT IRON. 220/40 v. 25 w., 17/6.
MAINS DROPPERS. 3 × 1½in. Adj. Sliders .3 amp. 1,000 ohms 4/3. .2 amps. 4/3. .1 amp. 2,000 ohms, 5/-.
LINE CORD. .3 amp. 60 ohms per foot .2 amp. 100 ohms per foot, 2-way, 6d. per foot; 3 way 7d. per foot.

CRYSTAL MIKE INSERT by Acos 6/6
Precision engineered. Size only ⅞ × ³⁄₁₆ in.
ACOS CRYSTAL STICK MIKE 39-1. Bargain 35/-.

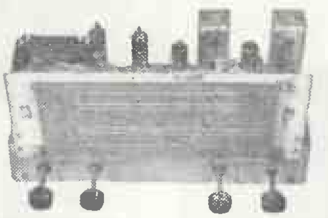
MIKE TRANSF. 50 : 1, 3/9 ea., 100 : 1 Potted 10/6.
LOUDSPEAKERS PM. 3 OHM. 5in. Rola, 17/6. 6in. × 4in. Rola, 18/-. 7in. × 4in. R.A., 21/-. 10in. × 6in. Rola 27/6. 8in. Plessey, 19/6. 6½in. Rola 18/6. 8in. Rola, 21/-. 10in. R.A. 30/-.
HI-FI TWEETERS, 4in. 25/-. 12in. Plessey, 30/-. 12in. Baker 15 wt. 3 ohm. and 15 ohm models, 90/-. 12in. Baker foam suspension 15 w. 15 ohm, £6. 12in. HIGH-FI Master £17/10, 20 c.p.s. to 17 k.c.s.

I.F. TRANSFORMERS 7/6 pair
465 kc/s. slug tuning miniature can 1½ × ¾ × ¾in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.
Weymouth I.F. Standard size 465 kc/s., 12/6 pair.

CRYSTAL DIODE G.E.C., 2/-. GEX34, 4/-. 40 Circuits 3/-.
H.R. HEADPHONES. 4,000 ohms, brand new, 15/- pair.
SWITCH CLEANER Fluid, squirt spout. 4/3 tin.
TWIN GANG CONDENSERS. 365 pf. Miniature, 1⅛in. × 1⅛in. × 1⅛in., 10/-. .0005 Standard with trimmers, 9/-; less trimmers 8/-. Midget 7/6; Single 50 pf. 2/6; 100 pf., 150 pf., 5/6. Solid dielectric 100, 300, 500 pf., 3/6.
VALVE HOLDERS. Pax. int. Oct. 4d. EF50, EA50, 6d. B12A. CRT. 1/3. Eng. and Amer. 4, 5, 6, 7 pin. 1/-. MOULDED Mazda or Int. Oct. 6d. B7G, B8A, B8G, B9A. 9d. B7G with can, 1/6; B12A, 1/3. B9A with can, 1/9. CERAMIC, EF50, B7G, B9A, Oct. 1/-. B7G, B9A Cans, 1/-.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-; 25in. × 35in., 10/-. Tygan 54in. wide, 10/- ft., 27in. wide 5/- ft. Brown, Green or Red. Samples S.A.E.
WAVECHANGE SWITCHES
2 p. 2-way, or 3 p. 2-way; short spindle 2/6
5 p. 4-way, 2 wafer, or 3 p. 11-w. 3 wafer, long spindle 6/6
2 p. 6-way, or 4 p. 2-way, or 4 p. 3-way. long spindle 3/6
3 p. 4-way or 1 p. 12-way long spindle 3/6
Wave change "MAKITS" 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer 16/-; 4 wafer, 19/6; 5 wafer 23/-; 6 wafer 26/6.
TOGGLE SWITCHES. S.P., 2/-; D.P., 3/6; D.P.D.T., 4/-;
MORSE KEYS, good quality 2/6.
SUB-MINIATURE ELECTROLYTICS (15 v.), 1, 2, 4, 5, 8, 25, 50 mfd., 100 mfd., 3/- each.

THE HI-GAIN BAND 3 PRE-AMP
Cascode circuit using Valve ECC84. 17db gain. Kit 29/6 less power; or 49/6 with power pack. Plans only 6d.
Also Band I version same prices.
(PCC84 Valve if preferred)

1961 RADIOGRAM CHASSIS

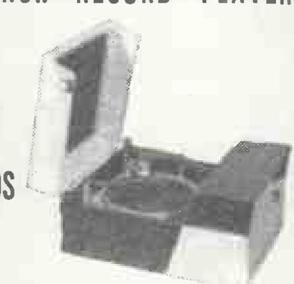


THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.—50 m. — LATEST MULLARD
M.W. 200 m.—500 m. — ECH81, EF89, EBC81,
L.W. 800 m.—2,000 m. — EL84, EZ80
12-month Guarantee. A.C. 200-250 v., 4-way switch. Short-Medium-Long-Gram. A.C.C. and Negative Feedback. 4.2 watts. Chassis 13½in. × 5½in. × 2¼in. Glass Dial Size 10 × 4½in. horizontal or vertical. Two Pilot Lamps. Four Knobs. Walnut or Ivory. Aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9 . 10 . 0 Carr 4/6
MATCHED SPEAKERS 8in. 17/6; 10in. 25/-; 12in. 30/-

MONARCH RECORD PLAYER

SAVE POUNDS



BUILD IT YOURSELF using
BSR MONARCH AUTOCHANGER U.A. 8
READY BUILT 3W. AMPLIFIER
HANDSOME PORTABLE CASE
HIGH FLUX 6" LOUDSPEAKER
FULL INSTRUCTIONS supplied
Total Price Carr. and ins. 5/- **£12 . 10 . 0**

RECORD PLAYER BARGAINS

4 Speed Autochangers, BSR, U.A.8 Stereo or Monaural	£6 15 0
Collaro Model 457	£7 19 6
Garrard Model 210	£10 10 0
4 speed Single Players, EMI Stereo or Monaural	£6 19 6
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Garrard 4 HF Transcription	£17 19 6

Garrard Stereo Heads £2 extra.

AUTOCHANGER ACCESSORIES
Suitable player cabinets (uncut boards) 49/6
Amplifier player cabinets with cut boards 63/-
2-valve amplifier and 6½in. speaker for above 79/6
Ready mounted on baffle 12in. × 7in., 3in. deep.

MINIATURE 2-STAGE Hi-Fi AMPLIFIER. A.C. only. 200-250 v. Valves ECL82 and EZ80. 3 watt quality output. Mullard tone circuits, bass boost, treble and volume controls. Separate engraved perspex front panel with de luxe finish. Heavy duty output transformer, 3 ohm, and shrouded mains transformer. Stove enamelled chassis size 6 × 5 × 3in. Bargain price £4/15/-. Circuit supplied.

CYLDON TURRET TELETUNER

I.F. 33/38 megs, complete with frame-grid valves. 30C1 and 30L15. (LT 16v. .3a.) With coils for channels 1 to 5 & 8 to 11. Latest model. Brand new price. 45/-, operating data & circuit supplied. Ideal for "P.T." Olympic.

VOLUME CONTROLS
Midget size:
Long spindle. Guaranteed 1 year. All values. 5 K. ohms up to 2 Meg.
No switch. 3/- D.P. Sw. 4/6
Linear or Log Tracks.

80 Ohm Cable Coaxial
Semi air spaced, ¼in. dia. Ideal Band III Losses cut 50% 6d. yd.
FRINGE QUALITY AIRSPACED .... 1/- yd.

COAXIAL PLUGS .. 1/- LEAD SOCKETS .. 2/-
PANEL SOCKETS .. 1/- OUTLET BOXES .. 4/6
BALANCED TWIN FEEDER per yd. 6d., 80Ω or 300.
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohm.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled, with 4 sides, riveted corners and lattice fixing holes with 2½in. sides 7 × 4in. 4/6; 9 × 7in., 5/9; 11 × 7in. 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 15 × 14in., 12/6 and 18 × 16 × 3in., 16/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, coloured, single or stranded 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE, 4d. yd., ½lb. 2/6.
PAXOLIN 1/16in. × 8in. × 10in., 1/6. ION TRAPS 5/-.

AMERICAN MAGNETIC RECORDING TAPE FERRODYNAMICS 'BRAND FIVE'

5in. 600 feet	16/-	MYLAR DUPONT	
5in. 900 feet	18/6	Super High Fidelity	
5¾in. 1,200 feet	23/6	Double Play	
7in. 1,200 feet	25/-	5in. 1,200 feet	37/6
7in. 1,800 feet	35/-	7in. 2,400 feet	60/-

Illustrated leaflet S.A.E.
Spare Reels, plastic, all sizes 3/-

RECTIFIERS, RM1, 5/-; RM2, 6/-; RM3, 8/-; RM4, 16/-; RM5, 20/-; FC31, 27/6; 14A86, 17/6; 14A100, 21/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA., 7/6; 60 mA., 8/6; 85 mA., 9/6; 200 mA., 21/-; 300 mA., 27/6; Full Wave 250 v. 120 mA., 15/-.
COILS. Wearite "P" type 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.
TELETRON. L and M. T.R.F. with reaction, 3/6.
FERRITE ROD AERIALS. M.W., 8/9; M. & L. 12/6.
T.R.F. COILS. A/HF, 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET, 29/-. H.F. coil aerial coil. Oscillator coil two I.F. transformers, 10.7 Mc/s. Detector transformer and heater chokes. Circuit and component book, using four 6AM6 2/6. Complete kit FMT1 with Jason Calibrated dial and 4 valves. £6/5/-. With new Jason Cabinet FMT2 £2 extra.

CONDENSERS. New Stock. .001 mfd. 7kV. T.C.C. 5/6. 20 kV., 9/6. .1 mfd. 7kV. 9/6. 100pf. to 500 pf. Micas, 6d. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25. 1/6; 0.5 1/9; 0.1/350 v., 9d.; 0.1/1,000 v., 1/9; 0.1 mfd., 2,000 v., 3/6; 0.001 mfd., 2,000 v., 1/9. 500pf., 20 kV., 9/6.
CERAMIC CONDS. 500 v. 0.3 pf. to 0.01 mfd., 9d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3.
CLOSE TOLERANCE (1± pf.) 1.5 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf., 1/9; 1,000 pf. to 2,000 pf., 2/-.
TRIMMERS. Ceramic 30, 50, 70 pf., 9d.; 100 pf., 150 pf. 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Phillips, 1/- ea.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	50/350 v.	5/6	16/500 v.	4/-
2/350 v.	2/3	100/25 v.	2/-	32/350 v.	4/-
4/450 v.	2/3	250/25 v.	2/6	100/270 v.	5/6
8/450 v.	2/3	500/12 v.	3/-	2,500/3 v.	4/-
8/500 v.	2/9	8+8/450 v.	3/6	5,000/6 v.	5/-
16/450 v.	3/-	8+16/450 v.	3/9	8+16/500 v.	7/-
16/500 v.	4/-	8+16/500 v.	5/6	32+32/450 v.	6/-
32/450 v.	3/9	16+16/450v.	4/3	50+50/350 v.	7/-
25/25 v.	1/9	16+16/500v.	6/-	64+120/350v.	11/6
50/50 v.	2/-	32+32/350v.	4/6	100+200/275v.	12/6

FULL WAVE BRIDGE SELENIUM RECTIFIERS. 2.6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6; 6 a., 22/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6.
Charger circuit free. AMMETERS, 4 a., and 5 a., 13/6.

NEW and boxed **VALVES** 90 day guarantee

1R5	7/6	6L6G	10/6	EA50	1/6	EY51	9/6
1S5	7/6	6N7M	6/6	EABC80	8/6	EY86	10/-
1T4	6/-	6Q7G	7/6	EB91	6/-	HABC80	12/6
2X2	3/6	6SA7M	6/-	EBC33	8/6	HVR2A	6/6
3S4	7/6	6SJ7M	6/6	EBC41	8/6	MU14	9/-
3V4	7/6	6SN7	6/6	EBF80	10/-	P61	3/6
5U4	7/6	6V6G	6/6	ECC84	9/6	PCC84	9/6
5Y3	7/6	6X4	7/6	ECF80	9/6	PCF80	9/6
5Z4	9/6	6X5	6/6	ECH42	10/6	PCL82	11/6
6AM6	5/-	12A6	7/6	ECL80	10/6	PEN25	6/6
6BE6	7/6	12AT7	8/-	ECL82	10/6	PL82	10/6
6BH6	9/6	12AU7	8/-	EF39	5/6	PY80	7/6
6BW6	9/6	12AX7	8/-	EF41	9/6	PY81	9/6
6D6	6/-	12BA6	8/6	EF50	5/6	PY82	7/6
6FG6	7/6	12BE6	8/6	EF80	8/-	SP61	3/6
6H6GT	3/6	12K7	6/6	EF86	14/6	UBC41	9/6
6J5	5/6	12Q7	6/6	EF92	5/6	UCH42	9/6
6J6	5/6	35L6	9/6	EL32	5/-	UF41	9/6
6J7G	6/6	35Z4	7/6	EL41	9/6	UL41	9/6
6K6GT	6/6	80	9/6	EL84	8/6	UY41	8/-
6K7G	5/-	807	5/3	EZ40	7/6	U22	8/-
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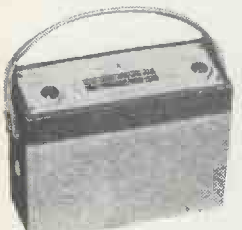


THE EASY SIX

6-Transistor Battery Portable

MAY BE BUILT FOR £9.15.0 plus 3/- p.p.

Ever Ready PPZ Battery Extra 3/3

STAR FEATURES: ★ Six 1st grade Mullard Transistors ★ Internal Ferrite Rod Aerial ★ Provision for Car Radio Aerial ★ 5in. Loudspeaker ★ Printed circuit, with component positions indicated ★ Preassembled Dial Assembly ★ 500 milliwatts Push Pull output ★ Full medium and long waveband coverage ★ Attractive two-tone Blue/Cream Vynide covered Cabinet, dimensions 8½in. x 6½in. x 3in. ★ Full point-to-point instructions supplied. ★ Weight 3lb. with battery.

Assemble it yourself and SAVE £ £ £'s

COMPACT GRAM. AMPLIFIER

2-valve printed circuit type for use on A.C. or D.C. 200/250 v. mains incorporating modern miniature valves. Output 2 watts, overall dimensions 6¼ x 2 x 3½in.

Price 59/6, plus P. & P. 2/6.

Amplifier Cabinet, £2/19/6, plus 5/- P. & P.

7 x 4in. Elliptical Speaker, £1/1/6, plus 1/6 P. & P.

Latest-type Collaro Conquest 4-spd. Changer, £7/19/6, plus 5/- P. & P.

If all the above items are purchased at the same time they can be supplied at £13/15/-, plus 10/- P. & P.

TAKE ADVANTAGE OF THESE

DRAMATIC PRICE REDUCTIONS

AVANTIC SPA11 Stereophonic Amplifier. Technical details: power output (each channel) 10 watts peak, L.S. impedance, 4, 8 and 16 ohms, 6-position input selector, bass, treble, volume on/off controls, stereo reverse switch, phase reverse switch, stereo balance control, P.U. balance control. Dimensions 14½ x 8¾ x 4in. Original price 28 Gns. P. & P. 7/6. **OUR PRICE 19 Gns.**

AVANTIC PL621 20-watt monaural Amplifier, frequency response 10 c/s-30 Kc/s. 1 dB. L.S. impedance, 4, 8 or 16 ohms. Dimensions 14in. x 8¼in. x 7¼in. Original price 29 Gns. P. & P. 7/6. **OUR PRICE 19 Gns.**

AVANTIC STEP21. Stereophonic Tape Pre-Amplifier Unit. Price £4/4/-.

SPECIAL BARGAIN OFFER

THE PERFECT STEREO SYSTEM

Two DL7/35 power amplifiers, One SP21 Stereo control unit — original cost £91 - 10 - 0 — OUR PRICE **47 gns**

Brief specifications:

DL7/35. Power output 54 watts peak; L.S. impedance 4, 8 or 16 ohms. power inputs 105-250 v. Valve line-up GZ34, 2-EL34, ECC83, EF86. Dimensions 14½ x 9 x 8¼in. Original price 30 gns.

SP21. 6 inputs for each channel, bass, treble, volume control, on/off stereo/3D/reverse stereo switch, stereo phase switch, low pass filter. Power requirements 6.3 v. at 1.3 A., A.C. 350 v. at 5 mA. D.C. Dimensions 14½ x 9 x 4in. Original price £28/10/-.

All this equipment in Brand New and in manufacturer's original sealed cartons. Full descriptive literature available.

THE Petite PORTABLE

MAY BE BUILT FOR £7.7.0 P. & P. 3/-.

Batteries extra.

H.T. 10/- (Type B126) or equivalent.

L.T. 1/6 (Type AD 35) or equivalent.

- High Q frame aerials.
- High sensitivity on both wavebands.
- Medium and long wave superhet circuit.
- Instruction book 1/6.
- Size only 8 x 8 x 4½in.
- Weight including batteries 5½lb.
- 4 valves of the economy type.

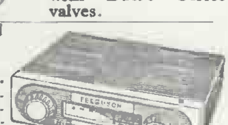
BATTERY ELIMINATOR

Housed in two containers which are to replace AD 35 and B126 Batteries.

MAY BE BUILT FOR 37/6 Plus 2/- P. & P. Only suitable for use with DK96 Series valves.

THE MODEL FMA/1 FERGUSON FM TUNER

13 gns plus 3/- P. & P.



For use with Radio Receivers or Hi-Fi equipment. Completely self-contained, self-powered and housed in a hammered metal finished steel case, 10 x 7¾ x 2½in. Frequency coverage 87.6-100 Mc/s. (continuously). Valve line-up: 2—EF80, ECF80, 2 germanium diodes and metal rectifier, for operation on A.C. mains 200/250 v. 50-60 cycles.

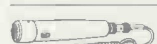
TUNERS FOR THE HOME CONSTRUCTOR BY 'JASON'

JASON JTV2. T.V. SOUND & F.M. complete with Turret Tuner and Case, less Valves, £14/19/-, plus 3/6 P. & P. Valves £1/12/-. Instruction Book available separately 3/6.

JASON FMT3. F.M. Tuner with Twin Limiters, sensitivity 5 microvolts, complete with Case and Power Supply, £9/19/- Less Valves, plus 3/6 P. & P. Valves £2/13/-. Instruction Book available separately 2/6.

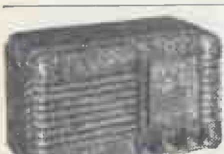
JASON MERCURY 2. Switched Tuner for F.M. and T.V Sound, less Valves and Power Supply, £10/14/-, plus 2/6 P. & P. Valves £1/4/6. Instruction Book available separately 3/6.

Power Supply Kit, suitable for above £2/14/-, plus 2/- P. & P.



THE VICEROY QUALITY CRYSTAL MICROPHONE

A good-quality crystal Microphone for the discerning enthusiast, finished in polished steel with Muting Switch and detachable lead. Price 42/-, P.P. 1/6.



WHY NOT DO IT YOURSELF!

SUPERHET may be built for £7 . 7 . 0 Plus 3/- P. & P.

T.R.F. may be built for £5 . 10 . 0 Plus 3/- P. & P.

These two receivers use the latest type circuitry and are fitted into attractive cabinets 12 x 6½ x 5½in., in either walnut or ivory Bakelite or wood 1/- extra. Individual instruction books 1/- each, post free.

THE 'CLARION'

Transistorised miniature battery-operated

TAPE RECORDER

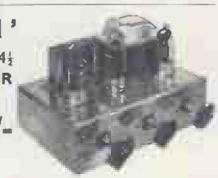
★ Completely transistorised circuit.
★ Constant governed speed of 3¾ I.P.S.
★ Recordings interchangeable with other recorders.
★ Remarkable reproduction on both speech and music.

Price complete with Microphone and tape— **25 GNS.** plus 5/- P. & P.

THE 'MID-FI'

A NEW DESIGN 4½ WATT AMPLIFIER KIT

MAY BE BUILT FOR 95/- Plus 3/- P. & P.



A new circuit for the home constructor requiring a good quality medium-powered Amplifier for reproduction of Records or F.M. Broadcasts. Technical Specifications: separate bass and treble controls. Valve line-up EF86, EL84, EZ80. Voltage adjustment for A.C. mains from 200/250 volt. 3 or 15 ohms impedance. Negative feedback. Size 7 x 5 x 2in., overall height 5in. Silver-hammered finished Chassis.

FOR THE BEGINNER

A 3-transistor, medium wave, receiver, ideally suited for the young enthusiast or the beginner. Operating on two pen torch batteries.

Simple to construct, with full instructions supplied. No headphones required.

Complete set of components, including plastic case, **27/6** plus 1/6 P. & P. Batteries extra.

THE MODEL VT41 VALVE FILAMENT TESTER

Will instantly check the filaments of all Radio and T.V. Valves, Fuses and Dial Bulbs. Will also give an accurate circuit continuity test and also has built-in 7 and 9 valve straighteners. Size 5¾ x 3¼ x 1½in. with Battery, post paid.

PRICE 30/-

CABY MODEL B20 MULTI-METER

DC/V 0-0.5 v. 0-2.5 v. (2K-ohms/V).
DC/V 10-50-250-500-1000 v. (4K-ohms/V).
AC/V 10-50-250-1000 v. (4K-ohms/V).
DC/mA 0-100 microamps (500mV).
DC/mA 0-2.5-25-250mA (250mV).
OHMS, 2K-20 meg.

COMPLETE WITH TEST LEADS—PRICE **£6/10/0** plus 2/- P. & P.

CABY MULTI-METER A-10

DC/V 10-50-250-500 1kΩ (2kΩ/V).
AC/V 10-50-250-500-1kΩ (2kΩ/V).
Ranges: DC/mA 0.5-25-250 (250mV).
OHM 0-10 kΩ-1MΩ.

Complete with test leads P. & P. 2/6. **£4/17/6**

PREMIER RADIO

309 Edgware Rd., London. W.2. Tel: PADington 6963

Visit our large and comprehensive HI-FI showrooms

PRICE including Microphone, Tape and Spare Spool **19 Gns.** Plus 15/- P. & P

First Again!!
"THE PREMIER TR/2"

Once again, Premier is first, with another magnificent offer. Introducing the "TR/2" the latest and cheapest addition to our range of popular Recorders.

Star features:

★ Latest BSR Tape Deck, with interlocking device to prevent accidental erasure.
★ Single speed 3¾in. per sec.
★ Playing time 5¾in. std. tape—1½ hours. L.P. tape—2 hrs. 8 mins.
★ Volume on/off and tone control.
★ Power output 3 watts.
★ Input sockets for Microphone, Radio/Gram.
★ Extension speaker socket.

Size: 13½ × 9½ × 6in., weight 17 lb.

TAPE DECKS

LATEST BSR MONARDECK. Single speed 3¾ i.p.s. Will take 5¾in. spools. **£8/19/6.** P. & P. 5/-.

COLLARO STUDIO TAPE TRANSCRIPTOR. 3 speeds 1⅞, 3¾, 7½ i.p.s. 3 motors. Push-button controls. Will take 7in. spools. **£12/19/6.** P. & P. 7/6.

COLLARO MK. 4 TAPE TRANSCRIPTOR. Twin track operation, 3 speeds, 3¾, 7½, 15 i.p.s. Will take 7in. spools. **£17/19/6.** P. & P. 7/6.

TAPE RECORDER AMPLIFIER specially designed to match the Collaro Studio Tape Deck. **£10/19/6.** P. & P. 4/-. Size 11½ × 5 × 3in., uses 3 valves, magic eye, contact cooled metal rectifier. Incorporates mike/gram/radio inputs, ext. l.s. jack, superimposing switch, with matching knobs.

RECORDING TAPE

By well-known manufacturers, brand new, boxed and full guaranteed.

1,800ft. on 7in. spool	32/6
1,200ft. on 5¾in. spool	22/6

P. & P. 1/- per spool.

AMERICAN C.B.S. RECORDING TAPE

Brand new, fully guaranteed and with Leader Tape:—

600ft. on 5in. Spool	17/6
1,200ft. on 5¾in. Spool	25/-
1.800ft. on 5¾in. Spool D.P.	47/-
1,200ft. on 7in. Spool	25/-
1,800ft. on 7in. Spool L.P.	35/-

Plus 1/- per Spool P. & P.

SINGLE PLAYERS

Collaro Junior 4-speed Player complete with Pick-up	£3 15 0
Garrard 4SP 4-speed Player, complete with Pick-up and automatic stop	£6 19 6
Garrard TA Mk. 2, 4-speed Player, wired for stereo, with plug-in Head	£8 10 0
Philips AG2009, 4-speed Player, with diecast turntable and Microlift, wired for stereo	£10 10 0

P. & P. 3/6 on above units.

RECORD CHANGERS

BSR UA8, 4-speed	£6 19 6
BSR UA8, 4-speed with stereo cartridge	£7 19 6
BSR UA12, 4-speed, wired for stereo and complete with Stereo cartridge	£8 19 6
Collaro Conquest, 4-speed Changer	£7 19 6
Collaro RC457, latest type 4-speed changer	£8 10 0
Garrard RC111 3-speed Changer	£7 19 6
Garrard RC120 Mk. 2, 4-speed	£8 19 6
Garrard RC121/4D, 4-speed	£9 19 6
Garrard RC121 Mk. 2, 4-speed, wired for stereo and with plug-in Head	£10 19 6

P. & P. 5/- on above units.

TRANSCRIPTION UNITS

Garrard 301	£22 7 3
Garrard 301 (Strobe turntable)	£23 18 4
Garrard 4HF (Stereo)	£19 4 8
Garrard 4HF (GC8)	£18 9 9

P. & P. 7/6 on above units.

The 'Magnaphon'

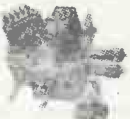
A truly top quality and versatile Tape Recorder at a price well below the original cost. Incorporating the latest Collaro 3-speed Studio Tape Deck.

★ Volume and Tone Control for recordings.
★ Volume and separate Bass and Treble Controls for replay.
★ Facilities for monitoring.
★ Output 4 watts.
★ Separate Output Sockets for Amplifier and Extension Speaker.
★ Mixing Facilities.
★ Housed in attractive red and beige two-tone Cabinet with detachable lid.
★ Fully guaranteed and supplied complete with the following accessories:—

Price £32.0.0 Plus 21/- P. & P.

Good quality Crystal Microphone with Lead and Jack Plug fitted, 5¾" Reel of Standard Tape and Spare Reel, spare Lead fitted with Jack Plug and Wander Plugs for recording from Radio.

STEREO ADAPTOR



Why not convert your Record Player or Radiogram to stereo with this easy to install Stereo Conversion Unit complete and ready to install giving an output of 3 watts.

PRICE **£2 . 19 . 6** Plus 2/- P. & P.

STEREOPHONIC PICK-UP CARTRIDGES AVAILABLE, 35/- post paid.

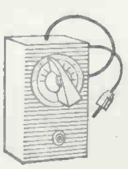
The 'Vogue'

A quality tape recorder, at a popular price including microphone, tape and spare spool.

Price 29 gns. Plus 21/- P. & P.

★ Collaro 3-speed Tape Deck.
★ Separate Input for Microphone and Gram Recording.
★ Separate Volume Controls for recording.
★ Volume On/Off and Tone Control for replay.
★ 3 watts output.
★ Housed in smart two-tone Blue/Beige Cabinet with detachable Lid.

TAPE RECORDER RADIO JACK

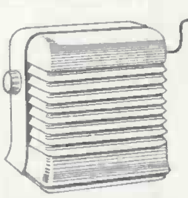


May be bu lt for 29/6 plus 1/6 p. and p. Tape Recorder Plug Extra.

Improve the quality of your recordings with the most inexpensive Radio Jack available, suitable for any type of Tape Recorder. only a short external Aerial required for full medium waveband coverage. Phono Plugs—9d., Jack Plugs—3/-.

INSTANT BULK TAPE ERASURE

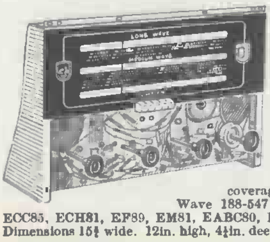
Erase complete Reels of Tape in a matter of seconds. PRICE 27/6 post paid.



THE PREMIER TRANSISTORISED BABY ALARM

79/6 Plus 3/- P. & P. Battery extra 2/9 *(Ever-Ready PP1 6 volt or equiv.)*

The answer to the modern Parents' problem for "Baby Sitting," this extremely efficient Unit is completely safe, being battery operated, its portability enables you to place the Master Unit in any part of the house. Extra Microphones may be used in different rooms without impairing the efficiency of the Unit. It is the most economical Unit of its kind and will run on one Battery for approximately two months of continuous day and night use. It is housed in an attractive bakelite Cabinet in either ivory or pastel blue. The price includes one Microphone, extra Microphones can be supplied at 12/6 and Microphone Lead at 5d. per yard.

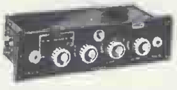


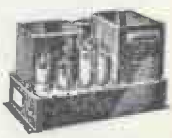
MODEL 379 AM/FM RADIOGRAM CHASSIS BY FAMOUS MANUFACTURER

PRICE £12.12.0 plus 7/6 p. & p.

Due to a fortunate bulk purchase we are able to offer these exceptionally good quality Radiogram Chassis at this ridiculously low figure. Gram./on/off. Star features of this Chassis are: piano key wavechange. Internal Ferrite Rod Aerial for AM and Magic Eye Tuning Indicator. waveband coverage: Long Wave 1098-2027 metres, Medium Wave 188-547 metres. VHF/FM 87-101 Mc/s. Valve line-up: ECC85, ECH81, EF89, EM81, EABC80, EL84, suitable for use on 200/250 v. A.C. mains. Dimensions 15¼ wide. 12in. high, 4½in. deep.

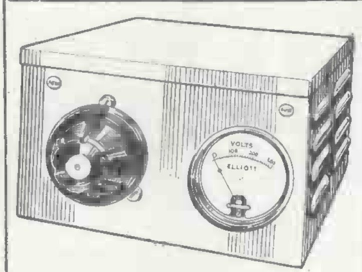
THE VERDIK QUALITY TEN AMPLIFIER AND PRE-AMPLIFIER





A truly High-Fidelity Ultralinear Amplifier with a push-pull output of 10 watts and incorporating negative feedback. Provision for Tuner, also bass and treble control and 5-position selector switch for Microphone, Radio Tape and L.P. and Standard Recordings. Finished in an attractive grey/green stove enamel.

FOR A LIMITED PERIOD ONLY **£14/19/6**
Original cost 23 gns. P. & P. 7/6.



BRAND NEW VARIABLE VOLTAGE TRANSFORMER. 230 volt A.C. input. Fitted in steel hammer finish case complete with 0–300 volt M.C. A.C. Meter, fuse and neon indicator light. Output constantly variable from 0–270 volt A.C. Type 1. 2.2 amp. Price £8/10/-, carriage 10/–. Type 2. 5 amp. Price £12, carriage 10/–.

BRAND NEW VARIABLE VOLTAGE TRANSFORMER. For 230 volt A.C. input. In cases as above with meter, fuse and indicator light. Output constantly variable from 0–230 volt A.C. Type 15. 15 amp. Price £22/10/–. Carr. 15/–.

W. W. RHEOSTAT. New. 3.5K or 5K. 25 watts. Price 7/6. P. & P. 1/6.

NEW WIRE WOUND RHEOSTAT ON CERAMIC. 58 ohm, 50 watt, complete with instrument knob. Price 8/6. P. & P. 1/6.

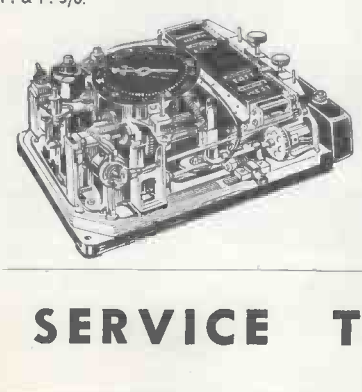
EX P.O. MAGNETIC COUNTER. 500 ohms type for 24 volt also 3 ohm type for 6 volt D.C. operation. Price 6/6 each. P. & P. 1/–.

AUTO TRANSFORMERS. Step up, step down. 110–200–220–240 v. Fully shrouded. New. 300 watt type £2/2/- each. P. & P. 2/6. 500 watt type £3/3/- each. P. & P. 3/9. 1,000 watt type £4/4/- each. P. & P. 6/6.

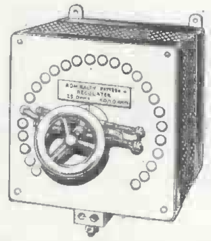
HEAVY DUTY L.T. TRANSFORMER. Very conservatively rated for continuous duty. New. In manufacturer's cases. Input 110–260 volt multi-tapped. 50 cycles, single phase. Output 28–29–30–31 volts at 21 ampere. Price £6/15/-, carriage 10/–.

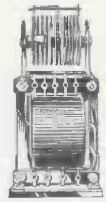
NEW GALVANOMETERS. Solid brass, 3in. dial, in polished wooden case. 70 degree scale, 35 mA either side. 100 ohm coil. Price 12/6 each. P. & P. 1/6.

EX R.A.F. AIR POSITION INDICATOR, containing 3 ball and plate infinitely variable resolving gears, miniature spur bevel and worm gear drives, also toggle, push button and rotary switches, repeater motor, 4 mechanical counters, miniature lamp holders and lamps etc. As new. Illustration below. **Price 22/6.** P. & P. 3/6.



ROTARY SWITCH REGULATOR. 25 ohms, very conservatively rated at 4 amp., will handle 8 amp. Overall size 7 x 8 x 6in. Price 15/-. P. & P. 2/6.



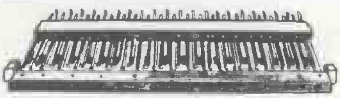


TWELVE PLATE F.W. BRIDGE CONNECTED RECTIFIER mounted on 200/250 volt A.C. input transformer. Output 36/40 volt D.C. at 1.2 amps. New, perfect. Price 16/6. P. & P. 3/6.

MINIATURE INSTRUMENT RECTIFIERS. Bridge Type 1 milliamp. Guaranteed perfect. 7/6 each.

S.T.C. RECTIFIER. 36 plates by 120 mm. Bridge connected. Maximum A.C. input 60 volt. D.C. output 15 amp. New, perfect. Price 60/-. P. & P. 3/6.

BRAND NEW FREQUENCY METERS manufactured by Nalder & Thompson Ltd. Calibrated 45 cycles to 55 cycles per second. 6in. dial. Panel mounting type. In original manufacturer's boxes. PRICE £10/15/- ea. Postage 3/6.



20-WAY STRIP containing standard Post Office telephone Jack Sockets, overall size 11 x 3½ x ½in. New. Price 15/- each. P. & P. 1/6.

10-WAY STRIP standard Post Office telephone Jack Sockets, spacing allowing Igranic Jack Plugs. New. Price 10/-. P. & P. 1/6.

19-INCH RACK MOUNTING 20-WAY P.O. JACK STRIPS with 40 terminals at rear. Price 25/-. P. & P. 3/6.

19-INCH RACK MOUNTING 20-WAY P.O. LAMP STRIPS. Price 25/-. P. & P. 2/6.

LATEST MOST MODERN TYPE OF EX W.D. MINIATURE HEADPHONES. As illustrated. Brand new, low impedance. Price: 10/6 plus P. & P. 1/6.

8-day clockwork **Time Switch.** Contacts 2½ amp., 230 volt, 24 hour phase, ½ hour divisions, allow setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 2/–.

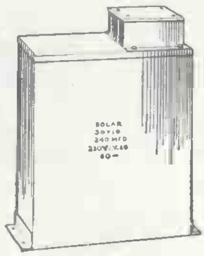
PYE LEVER OPERATING MICRO SWITCHES. Single pole change over. Brand new. 4/- each or 42/- dozen, p. paid.

TANNOY P.A. LOUDSPEAKER. For outdoor use, metal exponential horn with 20in. square flare. Overall length 30in. Speech coil 15 ohms. Guaranteed in working order and good condition. Price £7/10/-. Carriage 10/-.

PACKARD BELL BRAND NEW RELAYS. 2 pole c.o. 6 volt 80 ohms. 7/6 each. P. & P. 6d.

DIAL THERMOMETER. Made by Short & Mason. Calibrated 0–160 degrees Fahrenheit. 4½in. dial. 6in. rim for flush mounting with 6in. long rod protruding at the back. Brand new. Manufacturer's packing. Price 22/6. P. & P. 3/-.

SOLAR OIL-FILLED CONDENSER. 240 mfd. for 230 V.A.C. or 600 volt D.C. Overall size 14in. x 9in. x 5½in. plus feet. Weight 46 lb. Brand new. Guaranteed perfect. Manufacturer's packing. Price £7/10/-, carriage 10/–.



100 YARD DRUMS GLASS BRAIDED FLEX, 10/.010. New. 10/6 per coil. P. & P. 2/–

18-WAY P.V.C. COVERED 14/36 WIRE, screened overall, covered with P.V.C., all colour coded, 3/6 per yd.; £15 reel of 100 yds. Carriage paid.

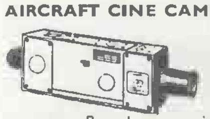
A.R.B. U.S.A. RECEIVERS. 24 volt. Covering 195–9,050 k/c. in 4 bands. As new, suitable for use on boats, etc. Price £6 including carriage.

NEW UNCHARGED UNFILLED 12 VOLT ACCUMULATOR 9 ampere in unspillable plastic cases. Comprises 6 x 2 v. separate cells connected by terminal strips. 6 x 5½ x 4½in. over terminals. Price 19/-, plus P. & P. 2/9.

245 AMP. 2 VOLT ACCUMULATOR Admiralty type in wooden casing. Size 15 x 7½ x 7½in. Weight 60lb. Unfilled, uncharged. New. Price £4. Carriage 10/–.

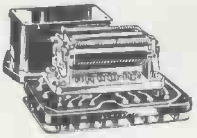
MINIATURE P.M. MOTOR. 12/24 volt, reversible. 1¾in. dia. New. Price 10/6 each. P. & P. 1/–.

AIRCRAFT CINE CAMERA G45B Mk. III. Fully modified, fitted with f/3.5 triple anastigmat lens, takes 25ft. of 16 mm. film, fitted with 24 v. motor. 16 exposures per sec. Brand new, original packing, £4/10/- each. P. & P. paid.



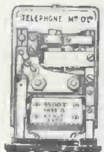
SERVICE TRADING COMPANY →

SLIDER RESISTANCES. 2 amp. 500ohms, size 14in. x 6in., plus handle 6in., 27/6. P. & P. 3/6.

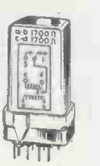


SOLENOID OPERATED MAGNETIC RELAY. Type 5CW/3945, 4 pole changeover, 10 A contacts 24 v. operation. Brand new 13/6. P. & P. 1/6.

CARPENTER'S TYPE POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/-.



HIGH SPEED RELAY. Siemens. Two bobbins 1,000 ohms each. New, 10/6 each. P. & P. 1/-.

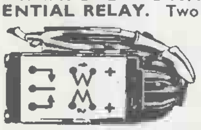


SIEMENS H.S. RELAY. Very latest type, sealed. H96E. 1,700 ohms plus 1,700 ohms, single C.O. contacts. Brand new with fixing clip. In maker's cartons. Price 16/6 each, plus 1/- P. & P.

Siemens sealed similar relay to above, but 2.2 ohms plus 2.2 ohms. Minus clips, 12/6 each. Plus 1/- P. & P.

SUPERIOR BRAND NEW RELAY. 7,000 ohms coil. Will pull in at 750 microamp. and out at 450 microamp. Change-over, platinum contacts. Vacuum sealed, will therefore not be affected by oil, moisture or water and never needs adjusting. Weight 2½ oz. Price 18/6. P. & P. 1/-.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each. Operating current minimum 140 microamp., nominal 400 microamp, maximum 8 milliamp. One pole two way, or, centre stable. Two way contact current 100 mA at 50 V A.C. or D.C. Size 1¼ x ⅝ x ½in. Price 22/6 each.



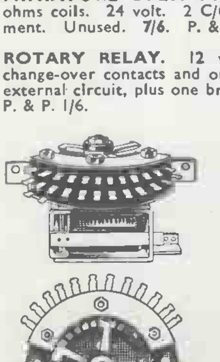
G.E.C. SEALED RELAY. Type M.1090. 180 ohms coil. 6/12 volt. 4 C/O. Brand new. 18/-. P. & P. 1/-.

G.E.C. SEALED RELAY. Type M.1092. 670 ohms coil. 12/24 volt. 4 C/O. Ex new equipment. Unused. 10/-. P. & P. 1/-.

G.P.O. 600 TYPE RELAY. 400 ohms coil. 24 volt. 2 C/O plus 2 M. New 7/6. P. & P. 1/-.

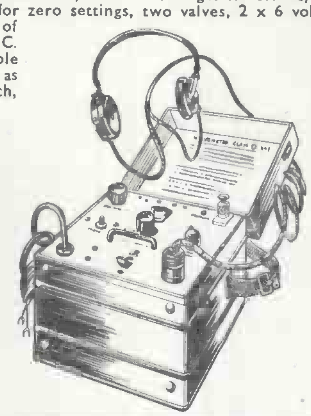
MINIATURE OPEN TYPE RELAY. 700 ohms coils. 24 volt. 2 C/O. Ex new equipment. Unused. 7/6. P. & P. 1/-.

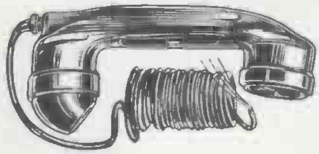
ROTARY RELAY. 12 volt. Heavy duty change-over contacts and one low current for external circuit, plus one break set. Price 7/6. P. & P. 1/6.



MINIATURE UNISELECTOR SWITCH. Two banks of ten plus home contacts one bank continuous of normal. 30 ohm coil for 24 volt operation. Brand new, manufacturer's packing. Price 22/6 each. P. & P. 2/6. As illustrated.

CLASS D WAVE METER. Latest release of these famous Hetrodyne wave meters with directly calibrated illuminated dial, most suitable for amateur transmitters, covers two ranges 1.9–8.0 Mc/s. and 4.0–8.0 Mc/s. Complete with reference crystals for zero settings, two valves, 2 x 6 volt vibrators, MAKER'S instruction book and matched set of headphones for monitoring. Designed for 6-volt D.C. operation, can easily be modified for mains and suitable transformer supplied for 7/6. In spot-on condition as tested by R.E.M.E. In transit case. **Price 5 gns. each,** plus 6/6 carriage.

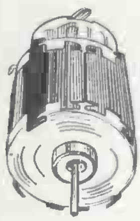




SOUND POWER TELEPHONE HANDSETS. Each couple connected by ordinary 2 core lighting flex will secure instant and reliable intercommunication. No batteries required. **Price** per set of 2 33/-, plus P.&P. 3/-.

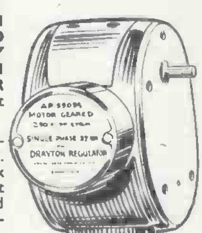
ENGINE SPEED INDICATOR. On the basis of a special ex-R.A.F. meter which we are able to supply and a few small linking parts which can be purchased anywhere, an inexpensive engine speed indicator can be made up which works on simple pulse counting principles in conjunction with the contact breaker on the distributor. Will give direct reading in R.P.M. Full conversion instructions are supplied by us. Additional standard parts required easily obtainable for about 15/-. R.A.F. meter as offered by us 16/6, plus 2/6 P. & P.

ONE ONLY, "CINTEL" DEMONSTRATION OSCILLOSCOPE. 15in. double beam. Condition as new. Guaranteed. Complete with full maker's instruction book. **Price £85.**

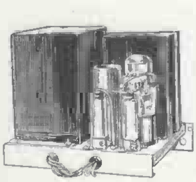


NEW IMPORTED EXTREMELY EFFICIENT MOTOR with tremendous power weight ratio. For 12 volt D.C. but very efficient on 6 volt. Three position switch. Weight 2.1 oz., size 1⅜in. x 1¼in. dia. Speed 7,000 r.p.m. Self lubricating. 15/-, plus 1/- P. & P.

PRECISION MADE GEARED MOTOR BY DRAYTON REGULATOR CO., for 230 volt 50 cycles A.C.



TYPE R.Q.R., reversible. 37 r.p.m. overall size 5in. x 4in. x 5¼in. Weight 4½ lb. Ex brand new equipment. Unused. Price £3/17/6. P. & P. 3/-.



MAINS POWER SUPPLY UNITS Potted and sealed transformer and choke by famous maker. Mounted on metal chassis 6½ x 7½in., complete with 5Z4 rectifier valve and full smoothing.

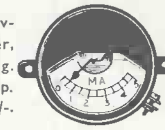
Input tapped 220–230–240 volts.
Output: 300 V. D.C. at 100 mA.
6.3 V. A.C. at 4.5 amp.
6.3 V. A.C. at 2 amp.
Rectifier supply 5 V. A.C. at 3 amp. Very conservatively rated. Price 47/6 plus P. & P. 6/6.

METERS GUARANTEED PERFECT

Charging Types	
2½ amp. D.C. M.I. 2in. fl. rnd.	7/6
5 amp. D.C. M.I. 2½in. fl. rnd.	11/6
7½ amp. D.C. M.I. 3½in. proj. rnd.	12/6
9 amp. D.C. Hot Wire W.R. 2½in. fl. rnd.	6/6
15 amp. D.C. M.C. 2in. rnd.	10/6
30 amp. D.C. M.C. 2in. fl. sq.	12/6
100 amp. A.C. M.I. 4½in. fl. rnd.	32/6
Voltmeters	
12 v. D.C. M.C. 2½in. proj. rnd.	8/6
20 v. D.C. M.C. 2in. fl. sq.	10/6
25 v. D.C. M.C. 2in. fl. rnd.	7/6
30 v. M.I. 3in. proj. rnd.	10/6
40 v. M.C. 2in. fl. sq.	10/6
300 v. A.C. M.C. 2½in. fl. rnd.	27/6
300 v. A.C. M.I., 2½in. fl. rnd.	22/-
400 v. A.C. M.I. 4½in. rnd.	35/-
90–180 v. A.C. M.I. 4½in. fl. iron	25/-
Milliammeters	
1 mA. M.C. 2½in. fl. rnd.	25/-
200 mA. M.C. 2½in. fl. rnd.	12/6
500 mA. M.C. 2½in. fl. rnd.	12/6
Microamp	
50 microamp., scaled 0–100, M.C. 2½in. fl. rnd.	42/6
50 microA. 2½in. square, side fitting scales	35/-
500 microamp., M.C. 2in. rnd. F.L. scaled 15/600 volt. NEW	16/6

Postage on all meters 1/- each.

Miniature latest type moving coil 0–5 milliamp meter, 1½in. diameter, flush fitting, complete with fixing clip. Price 17/6. P. & P. 1/-.



CRYSTAL CALIBRATOR No. 10. A crystal controlled 4-valve high-grade instrument in the same category as the famous B.C. 221. Directly calibrated, does not require cross reference or charts — functions as follows:— (1) A crystal controlled oscillator which provides fixed frequency signals of 500 KC and all harmonics of 500 KC to beyond 10 Meg. and up to 30 Meg.

(2) A variable oscillator from 250 KC to 500 KC, this enables all intermediate frequencies between 250 Kc/s. and 30 Meg. to be produced and modulated.

Supplied complete with 3 spare valves, all leads and maker's instruction book in carrying haversack. The complete outfit is brand new—repeat NEW. Price £4/19/6. Carr. 3/-.

Postages and carriage shown above are inland only. For overseas please ask for quotation.

SERVICE TRADING Co.

PERSONAL CALLERS ONLY: **9 Little Newport Street, London, W.C.2** *TEL: GER 0576*
ALL MAIL ORDERS. ALSO CALLERS AT:
47-49 High Street, Kingston-on-Thames
Telephone: KINgston 4585

R.S.C. HI-FI TAPE RECORDER KIT

Build a high quality recorder in the £70 class for only

$25\frac{1}{2}$ GNS. Carr. 17/6.

Can be assembled in $\frac{1}{2}$ hour.

OR DEPOSIT £5/7/6 and 12 monthly payments of 42/-. Cash price if settled in 3 months.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR THE LINEAR LT45X HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7×4in. LOUDSPEAKER, Reel of Best Quality TAPE, Spare Tape Spool, a Portable Cabinet, size approx. 16 × 13 × 9in., finished in durable and attractive duo-tone Policrome, and connection diagram for wiring amplifier to transcriptor.

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 EFFECTIVE AUTOMATIC ERASURE.

Full descriptive leaflet supplied on receipt of S.A.E.

HI-FI 10 WATT AMPLIFIERS

BRAND NEW CARTONED MANUFACTURERS DISCONTINUED MODEL. **£6.19.9** Carr. 7/6.

A REMARKABLE OPPORTUNITY

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 loudpseaker. Guaranteed, tested and in perfect working order. Please state speaker matching required when ordering.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode F/changer is used. Pentode I.F. and double Diode 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 500 mV. input depending on Ae location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is £4/15/-. Point-to-Point wiring diagrams and instructions 2/6.

CONSTRUCTIONAL ENVELOPES
Repanco 3 Dee Transistor Radio 1/3. Repanco Mini 3 Pocket Portable Transistor Radio 1/6. Repanco Mini 7 Transistor Pocket Portable (total building cost 9 gns) 1/6. R.S.C. All 12-watt High Fidelity amplifier 1/9. R.S.C. STEREO/TEN High Quality Stereo Amplifier 1/9.

RE-ENTRANT LOUDSPEAKERS

For factory or outdoor use.

Tannoy 7.5 ohms 8 watts 25/9.

Parmeko horn type, highly efficient. Handles up to 10 watts. 15 ohm 200 ohm and 600 ohm matching 59/6. R.C.A. 20 watt rating, 3 ohm, 15 ohm.. 200 ohm. and 600 ohm matching 6 gns.

ACOS HI-FI CRYSTAL 'MIKES'

Mic 30 hand or Desk type **27/9** (Listed 45/-)

39-1 Stick type **39/6** (Listed 5 Gns.)

Limited number.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator, Size $5\frac{1}{4} \times 4\frac{1}{4} \times 2$in. approx. Completely replaces batteries supply 1.4 v. and 90 v. where A.C. mains 200-250 v 50 c/s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 46/9.

Type BM2. Size $8 \times 5\frac{1}{2} \times 2\frac{1}{2}$in. 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 H.T. 2 v. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v accumulator

Complete kit with diagrams and instructions. 49/9 or ready for use 59/6.

TAPE RECORDERS AT WHOLESALE PRICES. Leading makes. 26 gn. model 18 gns. 29 gn. model 20 gns. 40 gn model 27 gns. 42 gn. model 29 gns. 63 gn. model 45 gns. 64 gn. model 44 gns. All brand new with manufacturer's guarantee. Make and model No. on request. No H.P.

VALVES! Full range at really competitive prices.

THE SKY FOUR T.R.F. RECEIVER

A design of a 3 valve 200-250 v. A.C. mains L. and M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, SP61, 6F6 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 cabinet. Available in brown or cream bakelite or veneered walnut.

EXTENSION SPEAKERS. Handsome walnut veneered cabinets. All standard 2-3 ohms. $6\frac{1}{2}$in. 29/9; 8in. 35/9.

R.S.C. A12 STEREO AMPLIFIER KIT

4 GNS.

A complete kit of parts to construct a good quality 3 + 3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. Carr. and packing 7/6. Suitable for use with all stereo pick-up heads at present available. Ganged volume and tone controls. Preset balance control. Outputs for matched 2 3 ohm speakers. For 200-250 v. A.C. mains. Astonishing value.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER KIT

Valves EZ81, ECC83, ECC83, EL84, EL84. Separate Bass and treble controls, giving "cut" and "boost." Sensitivity 50 mV. 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch, ganged volume, ganged treble, ganged bass, and balance. Outputs for 3 ohm speakers. Point-to-Point wiring diagrams and instructions. Carr. 7/9. **8 Gns.**
Illustration full constructional details and priced parts list 1/9.

SELENIUM RECTIFIERS

We can quote special prices for quantities of 12 to 10,000 of most types Special types made to order.

L.T. Types	
2/6 v. $\frac{1}{2}$ a. h.w.	1/9
6/12 v. 1 a. h.w.	2/9
Following F.W. (Bridge)	
6/12 v. 1 a.	3/11
6/12 v. 2 a.	6/11
6/12 v. 3 a.	9/9
6/12 v. 4 a.	12/3
6/12 v. 5 a.	14/6
6/12 v. 6 a.	15/6
6/12 v. 10 a.	25/9
6/12 v. 15 a.	35/9

H.T. Types H.W.	
120 v. 40 mA.	3/9
250 v. 50 mA.	3/11
250 v. 60 mA.	4/11
250 v. 80 mA.	6/11
250 v. 250 mA.	12/9
Contact Cooled	
250 v. 80 mA.	6/11
250 v. 75 mA.	10/11
F.W. (Bridge)	

JUNCTION TRANSISTORS. R.F. Type 11/6. Audio type, 5/9. Power type Goltop V15/10P 2 watts, 17/9. OC71 10/-. OC72 16/9. XB102 10/-. XB104 10/-. XA101, XC101, OC44 17/6. XA102, XA103, XA104 12/9 and many other types.

RECORDING HEADS. Baird Record Playback and Erase (housed in one container) 9/6 pair.

Battery Chargers and Kits for 200-230-250 v. 50 c/s. A/C. Mains

SPECIAL OFFER. of R.C.A. replacement styli for Collaro Studio "O" and "P" Ronette and other pick-up heads. Sapphire type standard of L.P. 3/11 each. Diamond type normally 83/5. Only 29/11.

HEAVY DUTY CHARGER KIT

6/12 v. variable charge rate up to 6 amps. Consisting of Mains Trans., F.W. (Bridge) Selenium Rectifier, 0-7 amp. meter, multi-position switch with knob, fuses, fuse-holders, panels, plugs, and circuit. Only 59/6. Post 4/6.

ASSEMBLED CHARGERS

6 v. 1 a.	19/9
6 v. 2 a.	29/9
6/12 v 1 a.	29/9
6/12 v. 2 a.	38/9

Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. & Pkg. 3/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.

0-9-15 v. $1\frac{1}{4}$ a.	12/9
0-9-15 v. $2\frac{1}{2}$ a.	15/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, fuse-holders, grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp.	24/9
As above, with ammeter...	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. (inclusive of ammeter)	42/9
6 v. or 12 v. 4 amps. with variable charge rate selector and ammeter	59/9

CHARGER AMMETERS

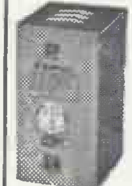
0-1.5 amp., 0-3 amp., 0-4 amp., 0-7 amp., 0-25 amp., 0-60 amp. 8/9

ASSEMBLED CHARGER

6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only Carr. 3/9. **49/9**

As above, but for 3 amp. charging. Only 59/6. Carr. 3/9

ASSEMBLED 6 v. or 12 v. 4 amps.



Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads. **69/9** Carr. 5/-. Or Deposit 13/3 and 5 monthly payments of 13/3.

As above, but for 6 amp. charging 4 GNS. Carr. 5/-. Or Deposit 16/- and 5 monthly payments of 16/-. The 6 amp. model only is slightly store soiled and is being offered at well below usual price.

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 2/3 ohm speaker. Three miniature Mullard valves. Size only $6 \times 5 \times 5\frac{1}{2}$in. 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.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts, 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. £4/10/9. Please state whether 3 ohm or 15 ohm required.

D.C. SUPPLY KITS. Suitable for electric trains. Cousist of mains trans. 200-250 v. 50 c.p.s.; 12 v. 1 amp. selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction switch, variable speed regulator. partially drilled steel case and circuit. Very limited number, 33/9.

REPANCO TWINETTE TRANSISTOR PORTABLE RADIO DESIGN. Constructional Envelope and parts list 1/3. Built-in Ferrite Aerial, 7in. × 4in. speaker, Long and Medium waves. Size approx. 7×4×3in. Total cost of all parts 5 gns.

LINEAR TAPE PRE-AMPLIFIER Type TP/1. Switched negative feedback equalisation. Positions for Record $1\frac{7}{8}$in., $3\frac{3}{4}$in., $7\frac{1}{2}$in. and Playback. EM84. Recording level indicator. Designed primarily as the link between Collaro Tape Transcriptor and high fidelity amplifier but suitable almost any Tape Deck. **9 Gns.**

POWER PACK KITS. Only 18/11. 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.

P.M. SPEAKERS. 2-3 ohms $2\frac{1}{2}$in. Perdio 21/9. 5in. Goodmans 17/9. 7 × 4in. R.A. Elliptical 19/9. $6\frac{1}{2}$in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 25/9. 8 × 6in. Elac. with high flux magnet 25/9. 10in. R.A. 28/9. 10 × 6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. R.A. 3 or 15 ohms. 10 watts, 12,000 lines, 59/6.

TWEETERS. 4in. Plessey, 3 ohms, 18/9. R.A. 15 ohms 25/9.

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC38, 807 807, GZ34. 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 OR 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 associated 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. 20 mA. and 6.3 v. 1.5 A. FOR A RADIO FEEDER UNIT. Price in kit form with easy-to-follow wiring diagrams.

ONLY **11 Gns.** Carr. 10/-. Or Factory built with 12 months' guarantee £13/19/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 31/9 and 9 monthly payments of 31/9.

Cover as illustrated 18/9 extra. Type 807 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 ± 3 D.B. 30-20,000 c/s. Tone Controls ± 12 D.B. at 50 c/cs. ± 12 D.B. to − 6 D.B. at 12,000 c/cs., hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12 × 9 × 9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Outputs 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.

FULL RANGE OF LINEAR HIGH FIDELITY AMPLIFIERS ALWAYS IN STOCK.

GL3A MINIATURE 3 WATT GRAM AMPLIFIER

For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11¾ × 2¾ × 2½in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 59/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts 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. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is 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 alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/- 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

WE CAN QUOTE FOR SPECIAL OR STANDARD TYPES IN ANY QUANTITY. OUR FACTORY HAS SUPPLIED LEADING EQUIPMENT MANUFACTURERS AND GOVT. DEPTS. FOR 15 YEARS.

MAINS TRANSFORMERS. Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING.

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a 2½-3-3ins.	17/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/11
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9
450-0-450 v. 250 m.A., 6.3 v. 5 a., 5 v., 3 a.	59/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	16/11
250-0-250 v. 100 mA., 6.3 v. 3.5 a.	19/9
250-0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a.	21/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a	29/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 5 v. 3 a.	47/9

ELIMINATOR TRANSFORMERS.

120 v. 40 mA., 5-0-5 v. 1 a.	14/9
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS

6.3 v. 1.5 a.	5/9	12 v. 1 a.	7/9
6.3 v. 2 a.	7/6	6.3 v. 3 a.	8/11
0-4-6.3 v. 2 a.	7/9	6.3 v. 6 a.	17/9
		12 v. 3 a. or 24 v. 1.5 a.	17/9

AUTO (Step Up/Step Down) TRANSFORMERS

50-80 watts 110-120 v./230-250 v.	11/9
150 watts 110-120 v./200-230-250 v.	27/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	3/9
Small Pentode 5,000 Ω to 3 Ω	3/9
Standard Pentode 5,000 Ω to 3 Ω	5/9
Standard Pentode 8,000 Ω to 3 Ω	5/9
Push-pull 8 watts 6V6 to 3 ohms	8/9
Push-pull 8 watts EL84s to 15 ohms	8/9
Push-pull 10-12 watts 6V6 to 3 Ω or 15 Ω	16/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω	17/9
Push-pull EL84 to 3 or 15 ohms 10-12 watts	17/9
Push-pull Ultra Linear for Mullard 510	27/9
Push-Pull 15-18 watts, sectionally wound, 6L6, KT66, etc., for 3 or 15 ohms	23/9
Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15 Ω Fully shrouded	47/9

MICROPHONE TRANSFORMERS

120:1 High quality, clamped	6/9
120:1 High quality Mu metal screened	8/9

SMOOTHING CHOKES

250 mA., 5 H., 100 Ω	11/9	80 mA., 10 H., 350 Ω	5/6
150 mA., 7-10 H., 250 Ω	11/9	60 mA., 10 H., 400 Ω	4/11
100 mA., 10 H., 200 Ω	8/9	1 amp. 0.5 Ω L.T. type	6/6

PARMEKO MAINS TRANSFORMERS. Fully shrouded.

500-0-500 v. 120 mA., 6 3 v. 4 a., 5 v. 3a.	31/9

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES

Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10 High sensitivity. Includes 5 valves: ECC83, ECC83, EL84, EL84, 5Y3. 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 ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 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 plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx.: 12-9-7in. For A.C. mains 200-250 v. 60 c/cs. Output for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 45/- extra). ONLY **8 Gns.** Carr. 10/-

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/3 and 9 monthly payments of 24/3. Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets. Speakers, Microphones, etc., with cash and credit terms.

R.S.C. PORTABLE GUITAR AMPLIFIERS

JUNIOR 5 WATT. High Quality Output. Separate Bass and Treble "cut" and "boost" controls Sensitivity 15 mv. High Flux 8in. l/speaker. Input sockets for Radio/Tape or Gram Pick-up and Mike /Instrument Pick-up. Handsome strongly made cabinet (size approx. 14 × 14 × 7in.). Finished in attractive and durable Policrome and fitted carrying handle.

£8/19/6 Carr. 7/6. Or Deposit £1 and nine monthly payments £1.

Send S.A.E. for leaflet.

SENIOR 10 WATTS. High-Fidelity Push-Pull output. Separate Bass and Treble "cut" and "boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two Loudspeakers are incorporated a 12in. P.M. for Bass notes, and 1 7 × 4in. elliptical for Treble. Cabinet is well made and finished as Junior model. Size approx. 18 × 18 × 8in. 15 Gns. Plus 10/- carr H.P. TERMS. DEPOSIT 34/9 and 9 monthly payments 34/9. Both models for 200-250 v. A.C. mains.

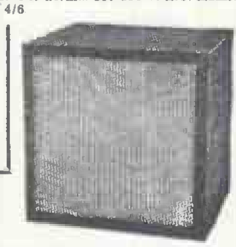
COLLARO CONTINENTAL 4 SPEED DE LUXE MIXER AUTO-CHANGERS with TX88 Transcription Cartridge for standard and L.P. records. For normal 200-250 v. A.C. mains. Few only at unrepeatable price of £10/19/6. Carr. 4/6

COLLARO CONQUEST 4-SPEED AUTO-CHANGERS. With studio pick-up with turnover head. Latest model for 200-250 v. A.C. mains. £6/19/6 Carr. 4/6.

B.S.R. MONARCH AUTO-CHANGERS. Type UA8. 4 speed T/O Pick-up with sapphire stylus £6/19/6. Carr. 4/6.

Any of the above supplied with T/O stereo/monaural head for £1 extra.

COLLARO JUNIOR. 4-speed Single Players with Hi-Fi T/O crystal pick-up head, £3/19/6.



LOUDSPEAKER IN POLISHED WALNUT FINISHED CABINET. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4/19/6. Carr. 5/-. TERMS: DEPOSIT 11/- and 9 monthly payments of 11/-.

12in. 20 WATT 15,000 line l/speakers 15 ohms in Cabinet finished as above. Size 18 × 18 × 8in. £7/19/6 or Deposit 17/9 and 9 monthly payments of 17/9.

ACOS HGP59 Hi-Fi Crystal Cartridges. (Turnover type with sapphire stylus). Standard replacement for Garrard and Collaro. Only 19/9. B.S.R. Ful-Fi 19/9. Garrard GC2 19/9. Acos Stereo/monaural 49/9.

ACOS HIGH FIDELITY PICKUPS. GP54 with HGP59/52 Cartridge. Turnover sapphire styli, cream finish. Limited number at approx. half price. Only 35/9.

R.C.A. TRANSCRIPTION PICK-UPS. Variable Reluctance type for standard and L.P. Records. Normal price approx £14. Limited number brand new perfect at £3/19/6.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms), consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only £5/19/6. Or Deposit 13/9 and 9 monthly payments of 13/9

R.S.C. (LEEDS) LTD. MANCHESTER, LEEDS & BRADFORD

Open to callers at the following branches:—

5-7 County (Mecca) Arcade, Leeds, 1.
54-56 Morley Street (above Alhambra), Bradford.
8-10 Brown Street (Market St.), Manchester, 2.

TERMS: C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra on all orders under £2, 2/9 extra under £5 unless carriage stated. Trade supplied. Post orders to: Mail Order Dept.
29-31 Moorfield Road, Leeds, 12.

REPLACEMENT, REBUILT T.V. TUBES 12 months guarantee

Carr. & Ins. 15/6.

21in. tube £8/10/-. 17in. tube £7/10/-. £2 allowed on old tube. 12, 14, 15in., tubes £5/10/-. £1 allowed on old tube. Terms available over 10 weeks.

NEW YEAR BARGAIN SALE!

PLESSEY T.V. CHASSIS FOR SPARES 9'6

56 resistances. 54 condensers. 13 valve holders. 4 transformers, Chokes 250 ma. Metal rectifiers 300 volts @ 250 ma. Fuse panel. Focus magnets. Plugs. Sockets. Carr. 7/6.

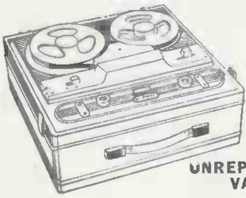
17" T.V.'s $17\frac{1}{2}$ gns.

Modern CHASSIS, modified

Complete 17in. TUBE. VALVES — SPEAKER — KNOBS. Tuned ITV/BBC. Ready to use, fully guaranteed, TUBE 12 months, CHASSIS and VALVES 3 months. Cabinet to fit £1/11/6 if ordered with set. Salvage. Set—tube—cabinet despatched separately. Carr. & Ins. on set £1/5/-; on Cabinet 8/6.

Fully Assembled Sets delivered 75 miles London

FAMOUS TAPE RECORDER



LISTED ~~29~~ gns. NOW 18 gns. UNREPEATABLE VALUE

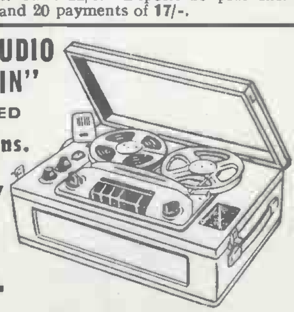
Famous manufacturer. Huge purchase allows us to offer at this amazing price. Beautifully styled, rexine covered cabinets. Colours: Red, Grey, Black. Storage space for 4 tapes, mike and lead. Incorporating the latest B.S.R. Deck. LOOK AT THESE EXPENSIVE FEATURES. Controls: Record/Playback switch and rewind with interlocking device to prevent accidental erasure. Tone and volume controls. Superimpose and electronic eye. Small overall size $14\frac{1}{2} \times 14\frac{1}{2} \times 7\frac{1}{2}$in. Lightweight, only 21lb. $5\frac{3}{4}$in. standard tape. Terms: Carr. & Ins. 12/6. Microphone 27/6 extra. Tapes 19/9.

DELUXE TAPE RECORDER

LISTED ~~31~~ gns. our price 22 gns.

Beautifully styled rexine covered cabinet in Red/Beige with carrying handle. Size: $14\frac{1}{2} \times 13 \times 9\frac{1}{2}$in. Storage comp. in lid for tapes and mike. Speed $3\frac{3}{4}$in. per second. Compact set using latest 5 valve amplifier with 4-stage amplification and separate valve for Bias osc. 2 controls. Contains 7 × 4in. elliptical speaker and incorporating B.S.R. Tape deck. $5\frac{3}{4}$in. standard tape. 3 months' guarantee. Ins. & Carr. 12/6. Deposit £8 plus Ins. Carr. and 20 payments of 17/-.

"STUDIO TWIN"



LISTED ~~40~~ gns. NOW 29 gns.

Quality Tape Recorder at this amazing reduced price. 7in. 1,200ft. Standard reels. Latest Studio 3-speed Deck, $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ I.P.S. Includes Twin Tracks, Reverse counter, Pause control and magic eye recording indicator. Volume and tone control, superimpose switch. 3 watts output. Attractive design cabinet in beige. Size 19in. × 13in. × 8in. Ins. & Carr. 12/6.

EXTRAS: Microphone 27/6. Tape 25/-.

RECORD PLAYER CABINET R.P.9 19/6

Exceptional offer. A lightweight portable player Cabinet in two-tone Rust and Cream. Famous manufacturer. Size $14\frac{1}{2} \times 11\frac{1}{2} \times$ 6in. Complete with moulded deck board of attractive design. Takes B.S.R. TU9 single player; 2 control Amplifier; 5in. round Speaker. Post, Packing & Ins., 4/6.

B.S.R. TAPE "MONARDECK" £9.9.6

Single speed. $3\frac{3}{4}$in. per sec. Uses $5\frac{3}{4}$in. spools. Complete with Record-Playback and erase heads. Simple control for R/P.B. and fast rewind with safety switch for record. Size: $13 \times 8\frac{3}{4} \times 2\frac{1}{2}$in. Colours: two-tone grey. P. & P. 4/6. Deposit 60/- plus P. & P. and 20 weeks at 8/-.

TAPE RECORDER AMPLIFIER £7.19.6

Compact, well designed 5 valve amplifier. Output 3.5 watts. Valve line up—ECC83, double triode first audio amplifiers, ECL82 triode pentode further audio amplifier and output valve, 6BW6 bias and erase oscillator, EM84 record level indicator. EZ80 H.T. rectifier. Input for mike, radio and gram. Controls: record playback volume and on/off playback tone. Dia. $8\frac{1}{2} \times 3 \times 4\frac{3}{4}$in. ins. and carr. 4/6. Terms.

EXTRAS: Knobs 2/6 per set. Beautiful Perspex dial plate, Complete with sockets for mike, radio and superimposed switch 3/6.

NEW LOOK AMPLIFIER 59/6

Ideal stereo attachment. Brown/Ivory cabinet, carrying handle. Contains high flux 8in. speaker. A.C. mains. 3 valves—10F3, 10P14, U404. Max. output 5 watts. $14 \times 11 \times 6\frac{1}{2}$in. Completely converted. Ideal stereo, Mike, Guitar, Records. 2 units give world of amusement and special stereo effects. 12 months' guarantee. P. & P. 5/6. Deposit 30/- plus P. & P., 10 weeks at 8/-.

AMPLIFIERS. All portable 12 months' guarantee

MK. D5. 39/6

Simple circuit employing ECL80 triode pentode output valve giving 3 watts output. A.C. only. Mains isolated. Single control for volume and on/off switch with knob. P. & P. 3/6.

MK. D2A. 79/6

Latest design incorporating negative feedback, giving 4 watts undistorted output. Valves: ECL82, triode pentode and contact cooled metal rectifier. Tone and volume control panel on flying leads with compact amplifier chassis suitable to mount under modern autochangers to give easy mounting in small cabinet. A.C. only. Mains isolated. Output for 2-3 ohms.

MK. D3A. 89/6

As above de luxe model, with separate tone controls for treble and bass.

PORTABLE AMPLIFIER (Salvage) 69/7

3 valves. 5 watts output. Size 7 × 5 × 4in. An ideal amplifier for stereo record players, Tape Recorders, Microphone, Baby Alarm, etc. Volume and tone controls. 200-250 v. A.C./D.C. P. & P. 4/6.

RECORD PLAYER CABINET R.P.2 FOR ONLY 59'6

Made by famous manufacturer. In polka dot cloth with clipped lid and carrying handle. Size: $16 \times 14\frac{1}{2} \times 8\frac{3}{4}$in. deep. Carr. & Ins. 4/6. Will take B.S.R. Monarch Autochanger, £6/19/6; 7in. × 4in. Elliptical Speaker 15/9; Our Mk. D2A Portable Amplifier 79/6.

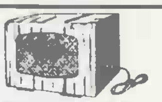
BARGAIN SPEAKER 5/9
8in. P.M. Repaired cone defect not affecting reproduction quality.

8in. P.M. SPEAKER 6/9
As above but with output transformer.

8in. P.M. SPEAKER 9/9
Perfect quality. Fitted output transformer.

ELLIPTICAL SPEAKERS 15/9
8 × 3in. and 7 × 4in. Brand new. Also 9 × 4in. at 19/9. P. & P. on each 2/9.

EXTENSION SPEAKERS 19'9

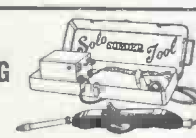


8in. P.M. Speakers fitted into polished cabinets. Standard matching to any receiver. (Complete.) Switch and flex included. P. & P. 3/9.

TELEPHONE SETS 7'9

X.W.D. Wireless remote control unit. E.M.K.II (ZA11954). Including morse tapper, switched, jack plugs, etc. Less phone. Ins. and carr. 3/6.

SOLO SOLDERING TOOL ONLY 12'6



110 v., 6 v. or 12 v. (special adaptor for 200/250 v., 10/- extra). Automatic solder feed including 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post 3/6.

DELUXE TAPE RECORDER CABINET

Beautifully made Tape Recording Cabinet. ONLY 29'9 Size: $13 \times 10\frac{1}{2} \times$ 7in. Covered in two-tone coloured rexine cloth. Stylish design. Carrying handle with detachable lid. Easily adapted to Record Player Cabinet. Exceptional value at this very low price. P. & P. 4/6.

DUKE & CO. (LONDON) LTD.

621/3 Romford Road, Manor Park, E.12. ILF 6001/3

Send for a FREE CATALOGUE

STERN'S MULLARD DESIGNS

COMPLETE KIT OF PARTS

Designed by MULLARD—presented by STERNS strictly to specification

MULLARD "5-10" MAIN AMPLIFIER

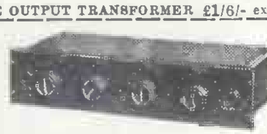
For use with the MULLARD 2-stage pre-amplifier with which an undistorted power output of up to 10 watts is obtained. We supply SPECIFIED COMPONENTS AND NEW MULLARD VALVES including PARMEKO MAINS TRANSFORMER and choice of the latest Ultra-linear PARMEKO or the PARTRIDGE Output Transformer.

Price: COMPLETE KIT (Parmeko O/put Trans.)........ **£10.0.0**

Alternatively we supply ASSEMBLED AND TESTED.... **£11.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

MULLARD'S 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

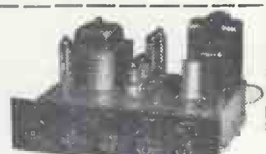


Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER but also perfectly suitable for other makes. Supplied strictly to MULLARD SPECIFICATION and incorporating:

- Equalisation for the latest R.I.A.A. characteristics.
- 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.

Price: COMPLETE KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

COMPLETE MULLARD 5-10 AMPLIFIER



The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Specified components and new MULLARD VALVES are supplied including PARMEKO MAINS TRANSFORMERS and choice of the latest PARMEKO or PARTRIDGE ULTRA Linear Output Transformers.

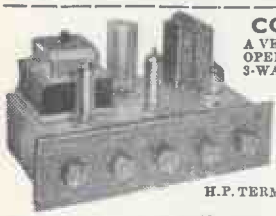
Price: COMPLETE KIT. Parmeko Transformer...... **£11.10.0**

Alternatively we supply ASSEMBLED AND TESTED. **£13.10.0**

Hire Purchase (Assembled Amp. only). Deposit £2/14/-, 12 months at 19/10.

ABOVE incorporating PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

COMPLETE MULLARD 3-3



A VERY HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-VALVE 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.

Price for COMPLETE KIT OF PARTS **£7.10.0**
(Plus 6/6 carriage and insurance).

Alternatively supplied ASSEMBLED AND FULLY TESTED (Plus 6/6 carriage and insurance).... **£8.19.6**

H.P. TERMS: Deposit £2 and 8 monthly payments of £1.

Our kit is complete to the MULLARD specification including supply of specified components, valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

STEREO "3-3" MAIN AMPLIFIER

Comprises two MULLARD 3-3 Main Amplifiers on one chassis. Operates with MULLARD STEREO PRE-AMPLIFIER. Output power 6 watts. Inputs for Crystal Pick-up and Radio Tunrer.

KIT OF PARTS.......... **£10.0.0** or ASSEMBLED........ **£11.15.0**

Mk. II "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard Amplifiers.

FOR THE CONSTRUCTOR.... **£10.10.0** or ASSEMBLED.... **£14.5.0**

SPECIAL CASH ONLY OFFER !!

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY **£8.7.6** (plus 7/6 carr. and ins.). The Amplifier consists of a 2-stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey Colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-stage (plus Rectifier) AMPLIFIER £4 2 6
(b) The PORTABLE CARRYING CASE £3 17 6
(c) 6½in. P.M. SPEAKER.... 18 9

(Carriage and Insurance 4/- extra)

"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY GOODMANS—WHARFEDALE—W.B.
ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

THE "ADD-A-DECK" incorporating the NEW B.S.R.

"MONARDECK" & MATCHED PRE-AMPLIFIER
Thus providing full tape Recording facilities.

Carriage and Insurance 10/-.
Deposit £3/12/-
12 mths. £1/6/2 **£17.17.0**

Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER or Small Amplifier which first-class results are obtained. It consists of a Twin Track Tape Deck, incorporating matched Pre-amplifier, and operates at 3¾in./sec. speed. Supplied fully tested and only requires connections to the mains supply and the Pick-up Sockets, for which purposes "floating" leads are incorporated.

H.P. TERMS ARE AVAILABLE ON ALL EQUIPMENT OVER £9. FULLY DESCRIPTIVE LEAFLETS ARE AVAILABLE FOR ALL EQUIPMENT, BUT PLEASE SEND S.A.E.

PRICE REDUCTIONS

(a) The COMPLETE KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-Stage Pre-Amplifier Control Unit............ **£15.15.0**

(b) The "5-10" and the 2-Stage Pre-Amplifier both Assembled and Tested.............. **£18.18.0**
H.P. TERMS: Deposit £3/16/- and 12 months of £1/7/8.

(c) The COMPLETE KIT OF PARTS to build the Dual Channel "3-3" Amplifier and the Dual Channel Pre-Amplifier Control Unit...... **£21.10.0**

(d) The Dual Channel "3-3" Amplifier and the Dual Channel Pre-Amplifier Control Unit both Assembled and Tested..................... **£25.0.0**
H.P. TERMS: Deposit £5 and 12 months of £1/16/8.

(e) The COMPLETE KIT OF PARTS to build one "5-10" Main Amplifier (Parmeko Transformer) and the Dual Channel Pre-Amplifier Control Unit **£21.10.0**

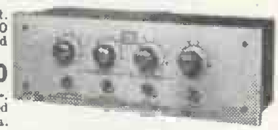
(f) One "5-10" Amplifier (Parmeko Transformer) and the Dual Channel Pre-Amplifier both Assembled and Tested............... **£25.0.0**
H.P. TERMS: Deposit £5 and 12 months of £1/16/8.

(g) COMPLETE KIT OF PARTS to build Two "5-10" Main Amplifiers (incorporating Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit........... **£31.0.0**

(h) Two "5-10" Amplifiers (Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit both Asesmbled and Tested **£36.0.0**
H.P. TERMS: Deposit £7/4/- and 12 months of £2/12/-.
Carriage and insurance 7/6 extra.

Prices quoted are subject to £1/6/- extra for Partridge Trans.

MULLARD FOUR CHANNEL MIXING UNIT



Self powered with Cathode follower output. Incorporates Two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICKUPS and a Fourth for Radio or Tape.

KIT OF PARTS **£8.8.0** ASSEMBLED AND TESTED **£10.0.0**

Terms: Deposit £2 and 12 months at 15/-. Model I.L. one microphone input matched for moving coil or ribbon mike £1/17/- extra.

COMPLETE STEREO AMPLIFIER

Meets the many requests for a low priced but good quality Stereophonic Amplifier. Output power is 4 watts. Inputs for Crystal Pick-ups and Radio Tuner.

KIT OF PARTS.............. **£8.10.0** or ASSEMBLED...... **£10.10.0**

STEREO DUAL CHANNEL PRE-AMPLIFIER

This model incorporates two 2-valve Pre-Amplifiers (described above) combined into a Single Unit enabling it to be used for both STEREOPHONIC and MONAURAL operation. It is designed primarily to operate with our range of MULLARD MAIN AMPLIFIERS but will also operate equally well with any make of Amplifiers requiring an input of 250 m/v.

Price: COMPLETE KIT OF PARTS **£12.10.0** Alternatively ASSEMBLED and TESTED **£15.0.0**

H.P. Terms on assembled unit: £3 Deposit and 12 months of £1/2/-.

!! RECORD PLAYERS !!

The LATEST MODELS are in Stock. Many at REDUCED PRICES!!!

Send S.A.E. for ILLUSTRATED LEAFLET

B.S.R. MONARCH UA8 4-spd. Mixer Autochanger with Crystal Pick-up **£6.19.6**
The COLLARO "CONQUEST" 4-spd. Autochanger, Studio "O" Pick up **£7.10.0**
The NEW COLLARO Model RP594, 4 speed Single Record Player, Studio Cartridge **£9.18.9**
The COLLARO 4-speed Single Record Player, incorporating the Studio "O" Pick-up **£6. 9.6**
THE NEW B.S.R. Model UA12 is in stock. A 4-"SPEED" MIXER AUTOCHANGER **£8. 7.6**
UA12 is also available incorporating the B.S.R. STEREO Pick-up, plays L.P. and 78 records. **£10.10.0**
GARRARD RC210 4-speed Autochanger fitted with latest Crystal Pick-up **£10.10.0**
The latest GARRARD TRANSCRIPTION MOTOR "301".... **£22.7.3**
The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A.12 Pick-up arm and G.C.S.Crystal Cartridge **£18.7.6**
GARRARD Model TA/Mk. II Single Record Player fitted with high output Crystal Pick-up, detachable head.......................... **£8.10.0**

HIRE PURCHASE TERMS available on all units £8/19/6 and over
Carriage and insurance on each above 5/- extra.

!! HOME CONSTRUCTORS !!

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS

Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" speakers give really first-class reproduction and are well recommended. Models are also available to accommodate high-quality Amplifiers, Pre-amplifier, Tuning Units, Record Players, etc. All models are very easily assembled, in fact only a screwdriver is required.
Fully illustrated leaflets are available, including complete specifications of the various STENTORIAN LOUDSPEAKERS. Please enclose S.A.E.

STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

Each Model incorporates the highly successful HF/TR3 Amplifier (described opposite), thus ensuring truly "Hi-Fi" record and playback facilities.

All prices quoted provide for the COMPLETE RECORDER including CRYSTAL MICROPHONE and 1-200ft. Spool of Tape.

There are no "better value for money" Tape Recorders on the market—if you can't call and hear them send S.A.E. for fully descriptive leaflets.

Stern's "fidelity" TAPE RECORDERS

BEFORE YOU BUY—YOU SHOULD HEAR THESE RECORDERS—THEY ARE COMPARABLE TO THE MUCH HIGHER PRICED MODELS

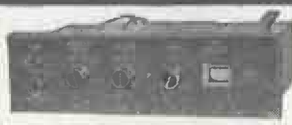
MODEL CR3/S. Incorporates the new Collaro "STUDIO" TWIN TRACK 3-speed Deck **£39.10.0**
H.P. Terms: Deposit £7/18/- and 12 months of £2/17/11.

MODEL CR3/T. Incorporates the very popular 3-speed COLLARO Mk. IV "TRANSCRIPTOR" Deck, which has both upper and lower tape tracks **£47.10.0**
H.P. Terms: Deposit £9/10/- and 12 months of £3/9/8.

MODEL TR3/Mk. VI. Incorporates the New TRUVOX Mk. VI TWIN TRACK 2-speed Tape Deck **£49.10.0**
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7.

TAPE AMPLIFIERS and PREAMPLIFIERS presented from MULLARD DESIGNS

MULLARD TYPE "C" TAPE-PREAMPLIFIER ERASE UNIT



The "Hi-Fi" link to add full tape recording facilities to High Fidelity home installations. Incorporates FERROXCUBE POT CORE PUSH-PULL OSCILLATOR and 3-speed treble equalisation by FERROXCUBE POT CORE INDUCTOR. FOR WEARITE—COLLARO—TRUVOX—BRENELL or MOTEK TAPE DECKS. Includes separate Power Supply Unit.

KIT OF PARTS.......... **£14.0.0** or ASSEMBLED........ **£17.0.0**
H.P. £3/8/- Deposit and 12 months at £1/4/11.
(Excluding Power Unit £11/15/- and £14/10/- respectively.)

MODEL HF/TR3 TAPE AMPLIFIER

(Mullard Type "A" design)
A very high quality Amplifier incorporating 3-speed treble equalisation, using the latest FERROXCUBE POT CORE INDUCTOR. FOR COLLARO-TRUVOX-BRENELL WEARITE or MOTEK Tape Decks, has GILSEN Output Transformer. Includes separate Power Supply Unit.

KIT OF PARTS........ **£12.15.0** or ASSEMBLED.......... **£16.10.0**
H.P. £3/6/- Deposit and 12 months at £1/4/2

FOR THE HOME CONSTRUCTOR SPECIAL "COMBINED ORDER" PRICES

(a) The COLLARO "STUDIO" TAPE DECK and our Mullard Type "C" PRE-AMPLIFIER and Power Unit assembled and tested **£29.10.0**
H.P. Terms: Deposit £5/18/- and 12 months at £2/3/3.

(b) As above but Type "C" PRE-AMPLIFIER supplied as complete Kit of Parts.......... **£26.10.0**

(c) The COLLARO Mk. IV TAPE DECK and the MULLARD Type "C" PRE-AMPLIFIER and Power Unit assembled and tested.......... **£35.0.0**
H.P. Deposit £7 and 12 months £2/11/4.

(d) As above but the Type "C" supplied as complete Kit of Parts **£32.0.0**

(e) The TRUVOX Mk. VI TAPE DECK and the assembled Type "C" PRE-AMPLIFIER and Power Unit...... **£40.0.0**
H.P. Deposit £8 and 12 months £2/18/8.

(f) As above but the Type "C" supplied as complete Kit of Parts **£36.10.0**

(g) The BRENELL Mk. V Deck and the assembled Type "C" PRE-AMPLIFIER and Power Unit.......... **£46.0.0**
H.P. Deposit £9/4/- and 12 months at £3/7/6.

(h) As above, but the Type "C" supplied as complete Kit of Parts.......... **£43.0.0**

(i) The WEARITE 4A DECK with Type "C" assembled and tested **£56.0.0**
H.P. Deposit £11/4/- and 12 monthly £4/2/1.

(Carriage and Insurance on above quotes 10/- extra.)

EACH OF ABOVE CAN BE SUPPLIED IN PORTABLE CASE FOR £5/10/- extra, THUS FORMING A COMPLETE PORTABLE PRE-AMPLIFIER SEND FOR DETAILS.

(a) COMPLETE KIT to build the HF/TR3 Amplifier, together with the COLLARO "STUDIO" DECK **£25.10.0**

(b) As above but HF/TR3 ASSEMBLED and TESTED **£29.0.0**
H.P. TERMS: Deposit £5/16/-, 12 months of £2/2/6.

(c) COMPLETE KIT to build the HF/TR3 together with the Mk. IV COLLARO "TRANSCRIPTOR" DECK **£30.15.0**
(£1 extra if we are required to wire up Deck switches.)

(d) As above but HF/TR3 ASSEMBLED... **£34.10.0**
H.P. Terms: Deposit £7, 12 months at £2/10/5.
(£1 extra if we are to wire up Deck Switch Banks.)

(e) COMPLETE KIT to build the HF/TR3 together with the NEW TRUVOX Mk. VI TAPE DECK......... **£36.0.0**

(f) As above but HF/TR3 ASSEMBLED and TESTED... **£39.10.0**
H.P. Terms: Deposit £7/18/-, 12 months of £2/17/11.

(g) COMPLETE KIT to build the HF/TR3 AMPLIFIER with the BRENELL Mk. V TAPE DECK.......... **£41.10.0**

(h) As above but HF/TR3 ASSEMBLED and TESTED... **£45.0.0**
H.P. Terms: Deposit £9, 12 months of £3/6/-.

(i) THE ASSEMBLED and TESTED HF/TR3 AMPLIFIER with the WEARITE MODEL 4A DECK, incorporates Wearite Head Lift Transformer, etc.......... **£55.0.0**
H.P. TERMS: Deposit £11, 12 months of £4/0/8.

(Carriage and insurance on each above is 10/- extra.)

Attractive PORTABLE CASE is available to accommodate the TRUVOX or COLLARO TAPE DECKS and we offer it together with ROLA/CELESTION 10 x 6in. LOUDSPEAKER—ACOS CRYSTAL MICROPHONE—and 1,200ft. SPOOL E.M.I. TAPE—ALL FOR............ **£9.10.0**
(Carriage and Insurance 5/- extra.)

OUTSTANDING PRICE REDUCTIONS FOR NEW TAPE EQUIPMENT

WALTERS "Model 404" PORTABLE TAPE RECORDER

A 1960 Model designed to sell for 42 gns.

WE OFFER IT ENTIRELY COMPLETE, including Crystal-Microphone, Tape and Radio/Gram Recording Leads and Plugs. **20 GNS.**

DEPOSIT £4/5/-, 12 months £1/10/10. Carriage and insurance 10/-.

EACH ARE BRAND NEW AND CARRY WALTER INSTRUMENT CO'S FULL GUARANTEE.

Twin Track Two Speed Recorder operating at $3\frac{3}{4}$ and $7\frac{1}{2}$ in./sec. speeds, plays up to size 7in. tape spools and INCORPORATING ... REVOLUTION COUNTER-PAUSE CONTROL—RECORD SAFETY BUTTON (prevents accidental erasure)—MAGIC EYE INDICATOR—EXT. LOUDSPEAKER OUTPUT—TONE CONTROL. Also operates as independent amplifier for direct reproduction from Gram or Radio Tuner.

TRUVOX AT REDUCED PRICES . . .

WE ARE ABLE TO OFFER . . .

- The highly successful TRUVOX Mk. IV Tape Deck, for............ **£16.10.0**
  H.P. Deposit £3/6/-. 12 months £1/4/3.
- And the associate TRUVOX Type "K" Tape Amplifier, for......... **£15.0.0**
  H.P. Deposit £3/2/-. 12 months £1/2/9.

Alternatively

- A COMBINE ORDER FOR BOTH TAPE DECK and AMPLIFIER for **£30.0.0**
  H.P. Deposit £6. 12 months £2/4/-.
- MATCHING ROLA/CELESTION 10 x 6in. LOUDSPEAKER...... **£1.10.0**

This represents a **TREMENDOUS BARGAIN . . .** the retail price of the Mk. IV Deck is £27/6/- and the Type "K" Amplifier is £19/19/-.

EACH ARE BRAND NEW and CARRY MESSRS. TRUVOX'S FULL GUARANTEE.

STERN RADIO LTD. DEPT. W 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

FULLY DESCRIPTIVE LEAFLETS ON ALL OF ABOVE ARE AVAILABLE—BUT PLEASE ENCLOSE S.A.E.

HARVERSON SURPLUS CO. LTD.

83 HIGH STREET, MERTON, S.W.19. CHERRYWOOD 3985/6/7

Special Offer

Mullard OC. 76 —10/6. Matched Pair—£1.0.0 Don't miss this —P. & P. 6d.

MINIATURE AMPLIFIER

Miniature amplifier, size 3¾ x 2½ x 4½ins. Ideal for record player, etc. Controls, volume/on-off, bass and treble. Supplied ready built, less valves (UY85, UF89, UL84), and mains transformer, at the give away price of **14/-** P. & P. 2/6.

HARVERSON SUPERHET 4 KIT

A medium and long wave superhet, incorporating two I.F. stages, modern B9 valves (UCH81, UBF89, UCL83, U785), built-in ferrite rod aerial. All you need supplied from theoretical wiring diagram to last nut and bolt (main components ready mounted), including an attractive contemporary styled cream plastic cabinet with gold trimmings. Size 11¼ x 4½ x 6¼in.

PRICE **£6.12.6** Post 3/6.

12 Wire wound Colvern Pots—all different values. 10/6. P. & P. 9d.

THE FAMOUS E.M.I. ANGEL TRANSCRIPTION P.U. (Model 17A)

A Pick-up for the connoisseur originally priced at £17.10.0. The last remaining few offered at **£4.10.0** Plus P. & P. 5/-.

500-500 Twin gang condensers with geared slow motion drive. 3/6 each. 36/- per doz. P. & P. 6d.

A few only—Transistor record player cases in light grey cloth—complete with motor board. Size—12" x 8" x 6"—18/6 each. P. & P. 1/9.

EXTENSION SPEAKER

An attractive cabinet 8 x 6 x 2in. fitted with 3 ohm 5in. speaker complete with lead, a few only.

19/6 P. & P. 2/6.

This Month's Bargain

Complete and ready for your cabinet, 4 valve superhet chassis, complete with valves, ferrite aerial, dial and knobs. Valve line-up—UCH81; UBF89; UCL83; UY85. L and M wave. Price £4/19/6. P. & P. 3/6.

MIDGET GRAM AMPLIFIER READY-BUILT with Speaker

A 2½ watt gram amplifier fitted with bass, treble, and vol./on-off controls. Supplied complete with 6 x 4in. 3Ω speaker, valves (UY85, UF89, UL84), knobs, etc., all mounted on an attractive baffle board, size 10½ x 7½ins.

OUR PRICE ONLY **49/-** P. & P. 3/-.

TRANSISTOR BARGAINS

ALL MULLARD FIRST GRADE

OC71	8/–
OC72	12/–
OC72 Matched Pair	25/–
OC45 Green Spot	15/–
OC45 Blue Spot	15/–
OC44	15/6
SB305 Semi Conductor	10/6
QA41 Diode	3/6

Postage on all the above 6d.

MONAURAL AMPLIFIER

This amplifier made by a leading manufacturer. Mullard valves—ECC83, EL84 x EL84, EZ80. Bass, Treble and Volume on remote panel. Elegant Knobs. OUR PRICE one month only £4.16.6 plus P. & P. 3/6.

SPEAKER FRET

Super quality heavily woven fret. 54 inches wide. Usual price 50/- per yard. P. & P. 1/-. OUR PRICE, **19/-** per yard

RECORD CHANGERS

GARRARD	RC 98 Mk. 4H. 4-speed autochange	£16.10.0
	RC 120/D Mk. 2 „ „	£9. 0. 0
	RC 120 Mk. 4D „ „	£9. 0. 0
	RC 120 Mk. 4H „ „	£9. 0. 0
	RC 121 Mk. 1 „ „	£11.0. 6
	RC 121 Mk. 4H „ „	£11.0. 6
	RC 121/40 Mk. 2 „ „	£11.0. 6
COLLARO	RC 54 4-speed autochanger ...	£6.19. 6
	RC 594 „ „ ...	£7.19. 6
	Conquest „ „ ...	£6.12. 6
	Challenger „ „ ...	£7.19. 6
B.S.R.	Monarch UA8 4-speed autochange	£6.19. 6
	TU4-speed single player less pick-up	£2.10. 0

Carriage and ins. on each of above 5/- extra.

NOTE: Any of the above with Stereo Cartridge and Fittings, 16/- extra.

RECTIFIERS FOR BATTERY CHARGERS

12 v. 1 amp.	4/3	12 v. 4 amp.	12/6
12 v. 2 amp.	7/–	12 v. 5 amp.	14/6
12 v. 3 amp.	10/–	P. & P. 6d.	

PICK-UP CARTRIDGE BARGAINS

STUDIO P	17/6
ACOS HIGH G	17/6
E.V. POWER POINT	12/6
RONETTE	18/6
G.C.Z.	16/6

P. & P. 1/-.

MIDGET I.F. TRANS & COILS

A pair of midget 465 kc/s. I.F. transformers, plus LW and MW coils. OUR PRICE 10/- per set. P. & P. 1/9.

CYLDON 12 CHANNEL TURRET TUNERS

New purchase offered at still lower price. I.F. 33-38 Mc/s. Complete with PCC84 and PCF80 valves and 8 sets of Coils for 5 Band I channels and 8, 9, 10 Band III. New and unused. Value over £7 OUR PRICE, Post paid. **32/6**

TAPE DECKS

B.S.R. MONODECK, 3¾in. per sec. simple control, 5¾in. spools. £7.10.0 plus 5/6 carriage and Insurance (Tapes extra)

TRUVOX MK. III DECK. push button controls, 3 shaded pole A.C. motors, up to 7 inch reels.................................. £10.6.6 plus 6/- carriage and insurance.

COSSOR C.R.T. SNIP

108K 10-inch. New and boxed, 15/-, plus 6/- P. & P. 75K 10-inch. New and boxed. 15/-, plus 6/- P. & P.

ION TRAP MAGNETS

To suit the above, 2/9 each. P. & P. 3d.

CONDENSER / RESISTOR PARCEL

50 mixed P.F. Condensers and 50 mixed Resistors. An assortment of useful valves. All popular sizes—all new—a must for the serviceman and constructor. ONLY 10/-. P. & P. 1/-.

YOU ARE INVITED!

Spend a day browsing around our premises at
83 HIGH ST., MERTON, S.W.19
(one minute South Wimbledon Tube)

We have a wealth of components, valves, chassis, tape decks autochangers, amplifiers, F.M. tuners, record players, tape recorders, cabinets, and a whole host of other things we just don't have the space to describe. Please come and look for yourself. We will be pleased to see you, and there's no obligation to buy.

STEREO AMPLIFIER

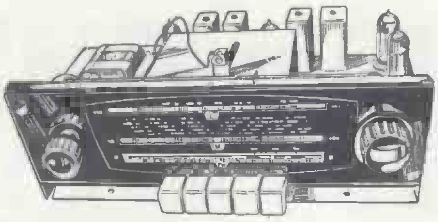
Complete with 2 Loudspeakers

A compact amplifier combining latest features with good reproduction, and ample volume. Complete with valves (ECL82, ECL82, EZ80), panel, knobs, etc. and 2 matched 3Ω loudspeakers, Few only—Order Now. Plus 4/6 P. & P. **£5.10.0**

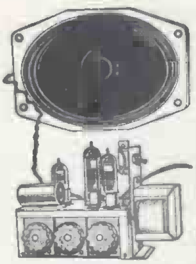
GUARANTEED VALVES ★ NEW and BOXED ★ PROMPT DISPATCH ★ POST 6d. per Valve extra ★

ATP4	3/3	EB34	1/9	ECL82	9/9	EY51	9/3	KTZ41	3/8	PY80	7/-	U50	7/6	UL41	9/6	1C5GT	11/9	3S4	7/-	6AQ5	7/-	6D6	4/6	6K7M	6/3
AZ1	9/3	EB41	8/-	EF41	9/3	EY86	9/3	N37	18/6	PY81	8/-	U76	7/6	UL44	25/-	1D5	11/9	3V4	8/-	6AT6	8/-	6CH6	9/9	6K8G	7/-
AZ31	11/2	EBC33	6/3	EF42	10/3	EZ40	7/-	N78	18/6	PY82	6/6	U801	28/-	UL46	25/-	1D6	11/9	5R4GY	9/-	6AU6	9/9	6F6G	7/-	6K6GT	6/6
B36	14/-	EBC41	8/9	EF50	3/9	EZ80	6/6	N339	28/-	PY83	8/-	UABC80	9/6	UL84	8/6	1H5GT	10/-	5U4G	6/3	6B8G	3/9	6F6M	7/-	6K7GT	5/6
CBL31	22/9	EBF80	9/-	EF80	7/-	EZ81	6/6	QZ4	5/-	PZ30	18/6	UAF42	8/9	UU6	18/6	1L4	6/-	5V4	10/9	6BA6	7/-	6F1	13/-	6K8GT	9/9
CCH35	22/9	EBF89	9/-	EF85	7/-	EZ90	7/-	P61	3/3	PEN45DD		UBC41	8/6	UU8	25/-	1LD5	3/-	5Y3G	7/6	6BE6	7/6	6F13	13/-	6K25	18/6
CL4	11/9	ECC81	7/6	EF86	11/6	GZ32	11/-	PCC84	8/6		25/-	UBF80	8/9	UYIN	11/9	1N5	9/9	5Y3GT	7/6	6BG6G	22/-	6F15	13/-	6L1	14/6
CL33	18/-	ECC82	7/-	EF89	8/-	KT32	9/3	PCF80	9/-	SP41	3/9	UCC84	10/-	UY21	11/9	1R5	7/-	5Z4G	8/6	6BH6	8/6	6F17	11/9	6L6G	7/6
CY31	15/9	ECC83	8/6	EF91	5/6	KT33C	8/-	PCF82	11/9	SP61	2/9	UCC85	10/6	UY41	7/-	1S4	9/9	5Z4M	9/6	6BJ6	8/6	6F33	16/6	6L6M	9/-
DAF96	8/3	ECC84	9/3	EL38	24/6	KT36	28/-	PCL82	11/6	SP4/5	9/9	UCF80	15/6	UY85	6/6	1S5	6/-	6A7	10/6	6BR7	11/9	6H6	2/3	6L7G	7/-
DF96	8/6	ECC85	9/-	EL41	9/6	KT55	10/3	PCL83	13/6	SP4/7	9/9	UCH42	9/9	VP41	8/-	1T4	5/6	6A8G	8/6	6BW6	8/6	6H6GT	2/3	6L18	10/3
DH63	11/6	ECF80	11/3	EL42	9/6	KT61	9/6	PL38	16/6	T41	22/-	UCH81	9/9	VP133	14/-	2X2	4/-	6AC7	6/-	6BW7	8/-	6J5GT	4/6	6L19	14/-
DK96	8/6	ECF82	12/3	EL81	15/6	KT63	7/-	PL36	14/6	U22	7/6	UCL82	15/6	X22	16/9	3A4	6/6	6AG5	5/3	6C4	3/9	6J5M	6/-	6N7GT	7/-
DL96	8/6	ECH21	22/-	EL84	8/6	KT66	16/-	PL81	11/9	U25	13/-	UCL83	11/6	1A3	3/-	3A8GT	5/6	6AK5	6/-	6C5GT	6/-	6J6	5/6	6P28	25/-
EA50	1/3	ECH42	9/-	EM84	8/9	KT88	21/-	PL82	8/-	U26	11/9	UF41	8/6	1A5GT	5/6	3D6	4/6	6AL5	6/-	6C6	4/6	6J7G	6/-	6Q7G	7/-
EABC80	8/6	ECH81	8/6	EM80	9/3	KTW61	6/-	PL83	11/-	U37	25/-	UF85	8/6	1A7GT	11/9	3Q4	7/6	6AM5	11/9	6C31	7/-	6J7M	8/6	6Q7GT	9/-
EA?12	9/6	ECL80	9/3	[illegible]	9/6	KTW88	7/-	PX25	11/9	U45	14/-	UF89	8/6	IC2	11/-	3Q5GT	9/-	6AM6	4/6	6CD6G	28/-	6K7G	3/9	6SA7GT	7/6

BRAND NEW AM/FM (V.H.F.) CHASSIS AT £13.6.8. (P. & P. 10/-)



Tapped input 220-225 v. and 226-250 v. A.C. ONLY.
Chassis size 15 × 6¾ × 5¼in. high. New manufacture. Dial 14½ × 4in. in gold and black.
Pick-up Extension speaker, Ae., E., and Dipole sockets. Five " piano " push buttons - OFF. L.W., M.W., F.M. and Gram. Aligned and tested.
With all valves & O.P. Transformer, Tone-control fitted.
Covers 1,000-1,900 M., 200-500 M.; 88-99 Mc/s.
Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker and Cabinet to fit chassis, 47/6.
10 × 6in. ELLIPTICAL SPEAKER, 20/- to purchasers of this chassis.
TERMS:—(Chassis £5/7/6 down inc. carr.—and 6 Monthly Payments of 30/-. or with Cabinet and Speaker £5/10/- down and 7 monthly Payments of 32/-.
Some tarnished but fully working unused chassis at £10 (10/- carr.).

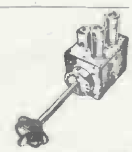


3-VALVE AMPLIFIER (INCL. RECT.)

Capable of giving 4 watts. Mains and output transformer. Valves ECC83, EL84, EZ80 3 Controls, volume, bass and treble. On/Off switch. Fully guaranteed. Chassis size 6½ × 3 × 2½in.; with 7 × 4in. elliptical speaker or 6½in. round (Goodmans); state which.
ONLY 67/-. (3/- P. & P.).

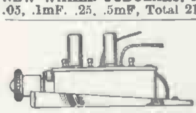
STUPENDOUS OFFER! 13-CHANNEL TUNER

I.F. 34-38 Mc/s. complete with valves PCF80 and PCC84. Removed from chassis but in working order.
15/- (2/6 P. & P.) Knobs 2/6 extra. Some tuners less valves 7/6.



50 SILVERED MICA AND CERAMIC CONDENSERS, 10/-. 50 RESISTORS 5/-.
ALL NEW

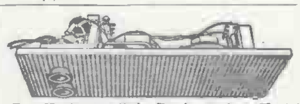
NEW WAXED TUBULARS. 350 v. or above, 3 of each. .001, .002, .005, .01, .02, .05, .1mF. .25, .5mF, Total 21 for 4/6, (post 9d.) Not more than 3 of one type.



NEW ITA AND BBC TUNER

By well-known manufacturer for superhet TVs with 35-38 Mc/s. I.F. For all areas; covers all 13 channels. Switch gives BBC and two ITA selections. Suits G.E.C. sets BT45-43, 4544 5146, 5147, 5543, 5642 and 6641 without alteration. Easily adapted as aerial convertor, and instructions can be provided free.
Has ITA and BBC co-axial sockets and separate gain controls.
WITH VALVES PCF80 and PCC84, 22/6 (P. & P. 3/-).
Some without valves at only 12/6 (P. & P. 3/-).

GRAMOPHONE AMPLIFIER

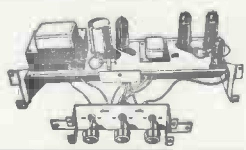


with 5in. SPEAKER. On Fabric-covered Baffle 12½ × 5in. Mains and Output Transformers. EZ40 and EL41 Valves. Tone and Volume Controls. On/Off switch. Plenty of Volume. Fully Guaranteed. Two Knobs supplied. Ready to play. Useful for Stereo. ONLY 57/-, post 3/-. ALTERNATIVE SIZE 12½" x 6".

PUSH-PULL AMPLIFIER £4/15/-.

3/- P. & P.

Brand new 200-240 A.C. mains. Bass, treble and vol. controls flying panel. With valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 × 3½ × 3½in. With o.p. trans. for 2-3 ohm speaker.



A Quality Tape Recorder. Valves EZ80, ECC83, ECL82, DM70 Record Level Indicator, Acos Crystal Mike. 850ft. Emitape. Extra spool. 3¾in./sec. B.S.R. Monardeck (1) Vol. (2) On/Off Tone. (3) Ext. L.S. (4) Monitor. (5) Radio Input. (6) Mike input. Fast forward and reverse controls. Cabinet size 14 x 11½ x 7in. Today's Best Value at £18 (10/- P. & P.). Low Interest Terms: £4 down and 5 monthly payments of £3. Write for descriptive leaflet. Terms include carr.

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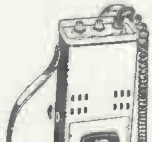

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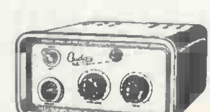

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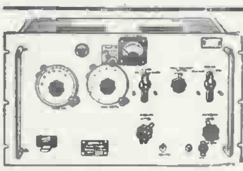

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Frequency Range 95-150 mc/s. (2 to 3 meters)

Gives reception of Police, Aircraft and Amateur transmissions.
Valve line up: 1st and 2nd R.F. Amp. VR.136 (EF.54), 1st Local Oscillator; VR.65 (SP.61), 2 Oscillator Multipliers; VR.136 (EF.54); 3 I.F. Amp.; VR.53 (EF.39); A.G.C. 6Q7; Output 6J5; Muting VR.92 (EA.50); Noise Limiter VR.92 (EA.50); B.F.O. 6J7; Mixer VR.136 (EF.54); Det Mod. 6Q7. Slow motion tuning, normally crystal controlled, or tunable over 95–150 Mc/s. Power supply required: 240–250 volts at 80 mA., 6.3 volts at 4 amps. Size 19in. x 10in. x 10in. Standard Rack Mounting.

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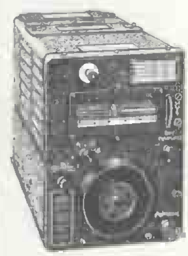

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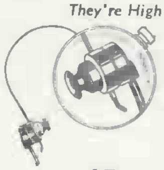
AMERICAN LIGHTWEIGHT HEAD SET

They're High and Low Impedance!



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ONLY **15/-**
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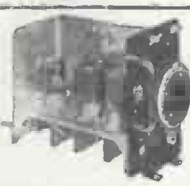

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R.F.24. 20-30 Mc/s. Switched tuning......... 22/6
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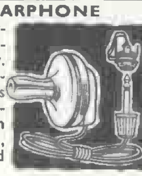
A really sensitive dynamic earphone of exceptionally fine quality. Provides clear reproduction of music as well as speech. Fully Guaranteed and complete with ear insert, 3 feet cord, sub-miniature plug and socket.



Model CR.5 Crystal Earpiece, high imp., 12/6. Post 1/-.
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SPECIFICATION:
Range: 540 kc/s to 32 Mc/s in 6 bands.
Power Supply: 110/260 v. A.C.
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Sensitivity: From 15 to 2.5 µv per 500 mW.
Image Ratio: From 1,000,000 at 60 kc/s to 200 at 28 Mc/s.
Circuit: Two R.F. stages (6SG7); Oscillator (6J5); Frequency Changer (6SA7); Three I.F. stages (6SJ7); A.V.C./Detector (6H6); Noise Limiter (6H6); Audio Amplifier (6SJ7); Power Output (6K6); B.F.O. (6J5); Voltage Regulator (VR-150); Rectifier (5Y3); I.F. —455 kc/s.
Size: 19¼ x 11 x 19½in.

PRICE FULLY GUARANTEED ONLY
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Model AR-88 L.F. 73–550 kc/s and 1.48–30.5 Mc/s. **ONLY £37/10/-.** Carriage 50/-.

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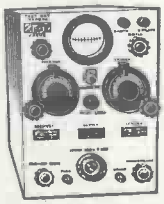

This basic scope represents one of the finest buys we have ever made. Contains Brilliance, Focus, Gain and 2-speed time base controls. Separate X plate terminals. Signal generator modulated at 2 freqs. over 150–255 Mc/s. Complete with 12 valves, VCR 139A tube, internal A.C. power pack and complete circuit and technical details.

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VARIABLE TRANSFORMERS

● Input Voltage 230 v. continuously variable output from 0–260 v. ● GOOD REGULATION. Output voltage is substantially independent of load. ● SMOOTH CONTROL. Can be set closely to any output voltage within its range. ● HIGH EFFICIENCY. Very low losses under all load conditions. ● LONG LIFE. The same as that of any standard fixed-ratio power transformer when operated at rated loads. ● SMALL SIZE. Smaller than any other type of control of equal power rating. ● LINEAR OUTPUT VOLTAGE. Continuously adjustable from zero to 30% above line voltage by a 320-degree rotation of the knob. The dial is calibrated to read directly in output voltage at rated line voltage. ● DIRECT-READING DIALS. All models are supplied with reversible direct-reading dials. Large white figures, easy to read at a distance. ● MODERATE TEMPERATURE RISE. Less than 50 degrees C. for continuous use. ● ADVANCED MECHANICAL DESIGN. Rugged construction—no delicate parts—protected with a strong, iron cover.
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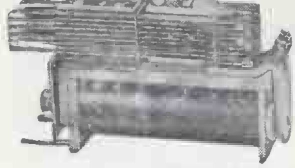

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100Ω+100Ω	H85N	**15/-**	670Ω	4 C.O.	M1092	**21/6**
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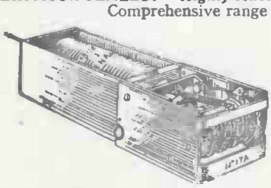
Comprehensive range available from stock.



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Counting to 9999.

2-6 v. D.C., **15/-** each, post 1/6, 75-230 v. D.C., **15/-** each, post 1/6. HIGH SPEED TYPE No. 100c., **35/-**, post 1/6.

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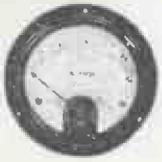
METERS GUARANTEED

F.S.D.	Size	Type	Price
100 Microamp	3½in.	MC/FR	**80/-**
50 Microamp	2½in.	MC/FR	**70/-**
250 Microamp	2½in.	MC/PR	**40/-**
500 Microamp	2½in.	MC/FR	**37/6**
1 Milliamp	2½in.	MC/FR	**35/-**
2 Milliamp	2½in.	MC/FR	**25/-**
30 Milliamp	2½in.	MC/FR	**15/-**
100 Milliamp	2½in.	MC/FR	**15/-**
200 Milliamp	2½in.	MC/FR	**15/-**
1 Ampere	2½in.	MC/FR	**35/-**
3 Ampere	2½in.	MC/FR	**35/-**
5 Ampere	2½in.	MC/FR	**35/-**
10 Ampere	2½in.	MC/FR	**35/-**
20 Volts	2½in.	MC/FR	**35/-**
30 Volts	2½in.	MC/FR	**35/-**
40 Volts	2½in.	MC/FR	**35/-**
500 Microamp	2in.	MC/FR	**25/-**
1 Milliamp	2in.	MC/FR	**27/6**
5 Milliamp	2in.	MC/FR	**27/6**
10 Milliamp	2in.	MC/FR	**27/6**
20 Volts	2in.	MC/FR	**27/6**
30 Volts	2in.	MC/FR	**27/6**
40 Volts	2in.	MC/FR	**27/6**
15 Amps	2in.	MC/FR	**12/6**
3 Amps	2in.	MC/FS	**27/6**
5 Amps	2in.	MC/FS	**27/6**
30-0-30 Amps	2in.	MC/FR	**15/6**
50-0-50 Amps	2in.	MC/FS	**12/6**
500 Milliamps A.C.	3½in.	MI/FR	**30/-**
25 Amps D.C.	2½in.	MI/FR	**7/6**
50 Amps A.C.	4in.	MI/F or PR	**65/-**
300 Volts A.C.	2½in.	MI/FR	**25/-**



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Complete list of meters available including the new Taylor pocket-size Multimeter Model 127A. 20,000 ohms per volt. 20 megohms, 20 ranges, A.C. and D.C. **£10**, post 2/6.

FREQUENCY METERS. 45-55 cycles per second 230 volts, 6in. dia., Flush Round. Brand new in maker's box, **£10/10/-**, post 3/6.
METER RECTIFIERS 250μA 1 M.A., 5 M.A., F.W. bridge, **8/6**, post 6d.
CROSS POINTER METERS. 2 separate 100 microamp movements, **22/6.**
MICROAMMETER. 250 F.S.D. 3½in. F.R. Sangamo Mod. S37. Scaled for valve voltmeter. Circuit available free, **55/-**, post 1/6.
UNI-PIVOT GALVANOMETER, by Cambridge Instruments, 50-0-50 microamps, dia. 4in. Knife pointer, mirror scale. Complete with leather carrying case. Ideal for laboratory use, **£10**, carriage 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 3/6.
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RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base, 4ft. 10in. in stock.

Your Own Telephone 75/-

TELEPHONE SET TYPE "A." Ringing and Speaking both ways on a four-core cable. Carries the voice loudly and clearly over any distance. Two handsets are supplied as illustrated and the set is complete with Pushes, Buzzers, Battery, Plugs and Sockets. We can supply 4-core PVC cable at **10d.** per yard or 2-core at **3d.** per yard extra. Price **75/-** set, post 3/6.
TELEPHONE SET "TELE-F." This is the best known portable telephone ever made, it has a built-in generator for ringing the other instrument and requires only twin wire between the sets. The set of two instruments and batteries in carrying case, **£7/10/-**, post 7/6. Twin flat P.V.C. wire **3d.** yard.
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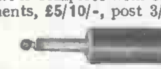
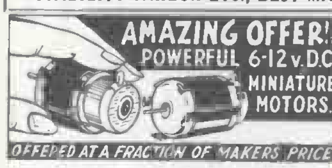
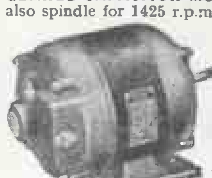


SOCKETS. One hole fixing for above, **3/6**, post 6d.

RESISTORS EX STOCK, IN QUANTITY WIRE WOUND, HIGH STABILITY CARBON ETC., BEST MAKES AT LOWEST PRICES.



MINIATURE PRECISION MOTOR, 12 v. D.C. Size 1⅝ × 1¼in. diam. Latest development. Extremely powerful with low consumption. Weighs as little as two ounces and totally enclosed in polythene protective case. Three position switch; forward, reverse and stop. 7,000 r.p.m., self lubricating and long life sintered bronze bearing; **15/6**, post 9d. Ask for free length of polythene flexible drive.
ROTARY CONVERTERS. Input 12 D.C. Output 230 A.C. 50 cy. 135 watts. In fitted case with variable resistance, 0/300 voltmeter. The ideal job for T.V. and tape recorders where A.C. mains at not available. **£10**, carr. 15/-. Special connectors, one fitted with 6ft. heavy duty flex and clips for D.C. side, **10/-** set, post 1/-. **ROTARY CONVERTER,** input 12 v. or 24 v. D.C., output 230 v. A.C., 135 watts, **£8/10/-**, carriage 7/6.
ROTARY CONVERTER. Input 24 v. D.C. Output 220 v. A.C. 250 watts. Pedestal type with D.P. Ironclad switch. **BRAND NEW, £17/10/-.** Cge. 15/-.
BATTERIES. Portable Lead Acid type, 6 volts 125 ampere hours. In metal case 16in. × 8in. × 11in. (Two will make an ideal power supply for our 12 volt Rotary Converters.) Uncharged **£6/10/-** each, carriage 15/-. 24 volts 85 amperes, **£14** each, carriage 15/-.
15 AMP. BATTERY CHARGER (Westinghouse Type B.C.3) will charge three lead acid cells at 15 amps. Input 200/250 volts, 50 cycles A.C. Charging current is regulated by four-position switch and variable resistance for fine control. Fitted with 0/20 ammeter, rotary on/off switch and rewirable fuses. This first-class instrument at the bargain price of **£15**, carriage 15/-.
GEARED CAPACITOR MOTORS. 220-240 v. 50 cy., 30 watts, 300 r.p.m. also spindle for 1425 r.p.m. A powerful and useful motor, **75/-**, post 3/6.



¼ H.P. CAPACITOR MOTORS

230/240 volts, 50 cycles, 1420 r.p.m. ⅝in. shaft, resilient mounting. Or with ½in. shaft on Standard foot mounting. Either type, **£5/10/-**, carriage 10/-.

SWITCHES ONE-HOLE FIXING

Single pole changeover, 3 amp. 250 volts, **1/6** each, **12/-** doz., **£37/10/-** per 1,000. Double pole on/off, 3 amps. 250 volts, with indicator plate, **3/-** each. Double pole on/off, 10 amps. 250 volts, Painton with chrome pear dolly, **5/-** each. Single pole on/off, rotary-type by Lucas, suitable for car dashboard, with chrome front, **5/6** each. Postage on all switches 9d.
SLYDLOK FUSES. 15 amp. with rewireable cartridge fuse. Latest type G15 M.M. Complete with studs, nuts and washers, **3/6** each, post 6d.
AUTO CABLE waterproof. Single. 14/36. **20/-** per 100 yds., post 1/6.

ELAC LOUDSPEAKERS P.M.

5in. Round, 3 ohms, 12/6, post 1/6.

NIFE BATTERIES, Nickel Cadmium, alkaline filled. 2.4 volt 10 ampere hours, **20/-** each, post 3/6.
PUMP Electrically Driven by a 24 v. D.C. motor. Works efficiently on 12 v. Totally enclosed, self lubricating driven through 4 to 1 reduction gearbox delivering 60 g.p.h./30lb./sq. in. Inlet and outlet unions ¼ BSP **37/6**, post 2/6.
OSCILLOSCOPE No. 11 with high-class amplifier, 230 v., **£12/10/-**, cge. 15/-

L. WILKINSON (CROYDON) LTD.
19 LANSDOWNE RD. CROYDON SURREY
Phone: CRO 0839 Grams: WILCO CROYDON

S.T.C. SELENIUM METAL RECTIFIERS. F/B, FOR BATTERY CHARGERS, ETC.

6 or 12 v. 1 amp. 5/-;	24 v. 1 amp. 10/-;
12 v. 2 amp. 7/6;	24 v. 2 amp. 15/-;
12 v. 2½ amp. 12/6;	24 v. 3 amp. 25/-;
12 v. 4 amp. 15/-;	24 v. 4 amp. 30/-;
12 v. 6 amp. 20/-;	24 v. 6 amp. 32/6;
12 v. 10 amp. 35/-;	24 v. 10 amp. 70/-;

NEW AND UNUSED ACCUMULATORS

12 v. 25 A.H. (as illus.) 45/-. Carr. 7/6. (Ideal for use with our Amplifier in centre column).

2 v. 100 A.H. 75 actual (ex-Govt.) with carrying handle. Size 6½ x 6½ x 3½in., 15/- each. Carr. 3/6.

2 v. 16 A.H., as above. 7½ x 4 x 2in., 5/- each. P. & P. 2/-. 6 for 24/-. P. & P. 10/-.

2 v. 14 A.H., as above (less handle). 7 x 2½ x 2½in., 5/- each. P. & P. 2/-.

TRANSFORMERS

POTTED C CORE

Pri.: 230 v. 50 c/s. Sec.: 450-0-450 v. 220 mA. 5 v. 3 amps., 6.3 v. 5 amps., 6.3 v. 3 amps. £2/10/-.
Pri.: 230 v. 50 c/s. E.S. Sec.: 500-0-500 v. 500 mA. 6.3 v., 500 mA. 6.3 v. 5 amps., 5 v. 6 amps. £3/10/-.
Pri.: 230 v. 50 c/s. Sec.: 6.8 v. 5 amps., 6.3 v. 1 amp., 6.3 v. 3 amps., 6.3 v. 1.5 amps., 6.3. v. 2 amps., 6.3 v. 3 amps., 6.3 v. 4 amps. £1/12/6. Carr. 5/- each item.

MAINS ISOLATING TRANSFORMER (Gresham). Pri. 230/250 v. Secs. 240-0-240 v. 1.5 amps., 5 v. 12.5 amps. Potted. Size 7in. x 7¼in. x 10½in. Weight 50 lb. Ideal for obtaining TWO ISOLATED 240 v. lines at 360 watts each. Perfect condition. 80/-. Carr. 10/-.

L.T. TRANSFORMERS for Battery Chargers etc. All Pri.: 200/250 v. Tapped 50 cycles. Type 048B. Sec. 24, 30, 36 v. 6 amps. 4 x 4 x 4in. £2/9/6. Type 066A. Sec. 18, 24, 30, 36 v. 8 amps. 4 x 4 x 5in. £3/19/6. Type 053A. Sec. 12, 24, 30 v. 10 amps. 4 x 5 x 5in. £4/4/-. Carr. 3/6 each item.

AUTO TRANSFORMERS. 0-110, 205, 225, 245 v. Fully shrouded. Terminal block connectors.
Type 063A. 500 w., 4 x 5 x 5in. £3/7/6. Carr. 3/6.
Type 064A. 750 w. 4 x 6 x 5in. £3/17/6. Carr. 3/6.
Type 065A. 1000 w. 4 x 7 x 5in. £4/17/6. Carr. 5/-.

3 kV/A. AUTO TRANSFORMER. 250/110 v. 50 cycles (fully tapped primary and secondary). Capable of 25% over actual rating. Brand new and unused, £12/10/-. Carr. 20/-. Also **6 kV/A.** as above. £18. Carr. 20/-.

20 kV/A. AUTO-TRANSFORMER. 230/115 v. 50-60 cycles, by Jefferies Transformer Co., U.S.A. Perfect condition, £20. Carr. 20/-.

CONSTANT VOLTAGE TRANSFORMER 190-260 v. primary, sec. 115 v. at 1½ kV/A. (listed at 2 kV/A). Brand new and unused. £25 or £45 per pair. Carr. 10/- each.

E.H.T. TRANSFORMER. 8,000-0-8,000 at 400 mA. Primary 230 v. 50 cycles. Oil filled. New and in original crates. £25. Carr. 10/-.

E.H.T. TRANSFORMER. 1,800-0-1,800 at 1 kV/A. 230 v 50 cycles primary. Fully tropicalised. New and boxed. £6/10/-. Carr. 10/-.

E.H.T. TRANSFORMER. 1,100-0-1,100 at 250 mA. plus 4 v. L.T. Pri. 200/250 v. at 50 cycles. £5. Carr. 10/-.

HEAVY DUTY REGULATING RESISTOR. 0.25 ohm. 200 amps. Wheel control. £4/15/-. Carr. 10/-.

CONDENSER, oil filled. 240 mfd. 230 v. A.C. or 600 v. D.C. Made in U.S.A. Size 21in. x 5¼in. x 9in. Brand new in original cases. £7/10/-. Carr. 5/-.

ROTARY CONVERTER. 24 v. D.C. input. 230 v. A.C. output at 250 watts. Complete with starting switch. New and unused. £15. Carr. 7/6.

ROTARY CONVERTER. 24 v. D.C. to 230 v. A.C. 50 cycles, 150 watts. Brand new and unused. £8/10/-. Carr. 7/6. Ditto, 100 watts £6/9/6. Carr. 7/6.

ROTARY CONVERTER. Ex-Govt. 12 v. D.C. input, 230 v. A.C. output 50 cycles at 135 watts. Complete in carrying case with lid. Voltage control, sliding resistance, mains switch and 0-300 v. A.C. flush meter. In good condition. £10. Carr. 10/-.

Motor only, without case, etc. Brand new and unused. £8/10/-. Carr. 5/-.

GEE BROS. (RADIO) LTD.

15 LITTLE NEWPORT STREET, LONDON, W.C.2. *GER. 6794/1453*

ADJOINING LEICESTER SQ. TUBE STATION—Open 9-6 Weekdays. 9-1 Sat.

BAKERS 'SELHURST' SPEAKERS

ALL BRAND NEW

SPECIAL NEW ARRIVAL!
" 15in. VISCOUNT AUDITORIUM "
15 ohms at 400 c.p.s., 35 watts. Flux density 18,000.
OUR PRICE £15.

"12in. P.M.," 15 ohms, 15 watts, 30-14,000 c.p.s. Our price £4/10/-.
" AUDITORIUM " 12in., 15 ohms, 12 watts. 35-16,000 c.p.s. Flux density 14,500. OUR PRICE £7/10/-.
" SUPER HI-FI 25 " 12in., 15 ohms, 25 watts 25-20,000 c.p.s. Flux density 17,600. OUR PRICE £9/9/-.
Full descriptive specification is available.

12 VOLT D.C. AMPLIFIER (Parmeko, Ardente). As new, 15 watt output with 2-EL35's in push-pull. Mike and gram. inputs, tapped output transformer, £9/19/6. Carr. 10/6. (Suitable microphone for above 30/- extra.)

EXPONENTIAL HORNS by famous manufacturer of P.A. systems, **15 watt,** 25 in. long, 20in. square flare 15 ohms speech coil. (Tannoy) Good condition, £7/10/-. Carr. 10/-.

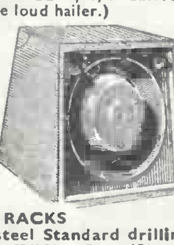
NEW P.M. HEAVY DUTY SPEAKERS Complete with O.P. trans., in all steel blue-grey double grilled cabinet. 6in. 30/-. 8in. 32/6. Carr. 3/6 each.

10in. SPEAKER in wooden cabinet, size approx 14 x 16 x 8in. with padded interior and volume control, 50/-. Carr. 3/6.

RE-ENTRANT LOUD HAILERS (Ex-Govt.) Heavy duty 20 watts all-metal 15 ohms. Diameter 15in., length 15in. (approx.) good cond. £6/10/- Carr. 10/-. Ditto. Brand new, £8. Carr. 10/-.

HEAVY DUTY ALL STEEL TRIPOD STANDS (as illus. Sept. issue). Adjustable every 6in. to approx. 9ft. 6in. when fully extended. (Folds up to only 4ft. 6in. for storage.) Suitable for outdoor speakers, public address systems, flood-lighting, etc. OUR PRICE £3/10/-. Carr. 5/-. (Ideal stand for the above loud hailer.)

TRUVOX/TANNOY LOUD-HAILERS
With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case. Brand new 25/-. Carr. 4/6.



G.P.O. RACKS
19in. Heavy duty all steel Standard drilling.
5ft. 6in. angle uprights. £3/10/-. Carr. 15/-.
6ft. channel uprights. £5. Carr. 15/-.
7ft. channel uprights. £6. Carr. 15/-.

QUALITY TEST EQUIPMENT

WAVEMETER CLASS D. Freq. band 1,900 Kc/s. to 8,000 Kc/s. (158-37.5 metres) in two ranges, 1,900 Kc/s-4,000 Kc/s also 4,000 Kc/s-8,000 Kc/s. Supply 6 v. D.C. Input. Complete with twin crystal, spare vibrator, headphones, original instruction manual and transit case. Condition as new. £5/5/-.

EVERSHED AND VIGNOLES MEGGER CIRCUIT TESTER (low reading ohm meter). 2 ranges 0-3, 0-30 ohms. The perfect meter for continuity and polarity testing, complete with test leads and ready to use. Brand new. Only £4/17/6. P. & P. 3/-.

BRIDGE MEGGERS. Evershed and Vignoles. Series 2 in perfect condition. 250 v. £22. Carr. paid. Leather case available at 20/- extra.

MARCONI SIGNAL GENERATOR. TYPE TF517-F/1. Covering 10-18 Mc/s. 33-58 Mc/s. 150-300 Mc/s. In very good condition. Complete with full technical data and instructions. Unrepeatable at only £12/10/-. Carr. 20/-.

BRAND NEW CRYSTAL CALIBRATOR No. 10. (Battery powered 1.4 v. valves.) Complete with full working instructions, circuit diagram, carrying haversack, connecting lead and spare valves. Frequency range: 1.5 to 10 Mc/s. (nominal) but can actually be used up to 30 Mc/s. Weight 5lb. Size 7 x 7½ x 4in. As fully described in "Practical Wireless," Dec. issue, pages 691-693. ONLY £4/19/6. P. & P. 2/6.

MULLARD BRIDGE. Type GM. 4140/1. Mains operated from 100-250 v. A.C. Will test resistances from 0.1 ohm to 10 megohms and condensers from 10pf. to 10mfd. Good condition and complete with instruction booklet. £6/19/6. P. & P. 2/6.

TAYLOR VALVE TESTER Model 47A. Input 200-250 v. A.C. Will test all types of English and American valves with filaments from 1.1 v. to 117 v. Perfect condition. Complete with full instruction manual, £12/10/-. Carr. paid. Also MODEL 45A available at £10/10/-.

10-LINE TELEPHONE SWITCH-BOARDS. For the complete control of 10 extensions (Tele. "F" etc.). Complete with jacks, leads and operator's hand set. Good condition. £9/19/6. Carr. 10/6.

TELEPHONE SETS (TELE "F")
Housed in Bakelite cases, complete with built-in ringing generators and batteries. Ideal between two or more positions up to practically any distance. Tested before despatched. ONLY 70/-. P. & P. 3/6. 2 sent for £6/10/-. Carr. paid.

R.C.A. AR88-D RECEIVER

Mint condition. Freq. coverage 540 Kc/s.-32 Mc/s. £50. Carr. 20/-. Also L.F's available. Freq. coverage 75-550 Kc/s., 1.5-30 Mc/s. £45. Carr. 20/-.

A.C.-D.C. RECTIFIER POWER SUPPLY UNITS

110/230 v. A.C. 50 cycles input, 100/110 v. D.C. output max. 2½ amp. Brand new and unused. £4/10/-. Carr. 7/6.
230 v. A.C. 50 cycles input, 200/220 v. D.C. output at 3/4 amps. approx. Good condition. £10. Carr. 10/-.
200/250 v. pri., 110 v. sec. at 4 amps. max. Brand new and unused. £8/10/-. Carr. 10/-.
Type 67. 200/230 v. A.C. 50 cycles input, 240-0-240 v. D.C output at 1½ amps. (Valve rectification.) With overload controls. Brand new in maker's original crates. £10. Carr. 10/-.

AIRBORNE TRANSMITTER RECEIVER TYPE 1986. A mobile 10-channel crystal controlled V.H.F. Tx/Rx. covering 124.5/156 Mc/s. I.F. band width 23 kc/s. Complete (less external attachments) in metal case, with all valves and 24 v. rotary power unit. Used but in first-class condition. ONLY £8/10/-. Carr. paid. Also, complete with control box and all necessary connecting leads, £12, carr. paid.

COLLARO "STUDIO" TAPE TRANSCRIPTORS. Brand new in original cartons 3 speeds. 1⅞, 3¾, 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spool instructions and fixings. A.C. 200/250 v. operation. **SPECIAL PRICE £12/10/-** only.

RECORDING TAPES. Super quality P.V.C. 1,800ft. L.P. 7in. spools, 30/-; 1,200ft. Std. 7in. 19/-; Empty 7in. spools 3/9 each.
Send S.A.E. for current Tape Bargain List.

DOUBLE BEAM 'SCOPE'

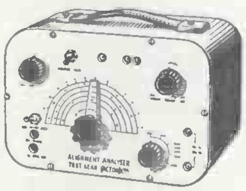
For D.C. & A.C. APPLICATIONS

Engineered to precision standards, this high-grade instrument is made available at the lowest possible price, incorporating the essential features usually associated with luxury instruments. This "SCOPE" will appeal particularly to Service Engineers and Amateurs. A high gain, extremely stable differential Y-Amplifier (30 mV/C.M.). Provides ample sensitivity with A.C. or D.C. inputs. Especially suitable for measurement of transistor operating conditions where maintenance of D.C. levels is of paramount importance. Push-Pull X amplifier; Flyback suppression; Internal Time base Scan Waveform available for external use; pulse/output available for checking T.V. Line O/P Transformers, etc.; Provision for external X 1/P and CRT. Brightness Modulation. A.C. mains 200/250 v £19/19/- plus P. & P. 7/6 or 50/- deposit, plus P. & P. 7/6 and 12 monthly payments of 33/4.

FULL 12 MONTHS' GUARANTEE INCLUDING VALVES AND TUBE

ALIGNMENT ANALYSER TYPE MC12

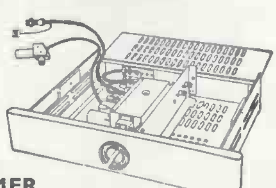
A.C. MAINS, 200/250 volts. Provides:—"WOBBULATOR" (SWEPT FREQUENCY) OPERATION, for FM/TV alignment linear frequency sweep up to 12 Mc/s. From 400 Kc/s—80 Mc/s. CAPACITANCE MEASUREMENT. Two ranges provided 0-60 pf. and 0-120 pf. SPECIAL FACILITY enables true resonant frequency of any tuned circuit I.F. transformer, etc., to be rapidly determined. Cash price £6/19/6 and 5/- P. & P. H.P. terms 25/- deposit and 5/- P. & P. and 6 monthly payments of 21/6.



CHANNEL TUNER

Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with P.C.C. 84 and P.C.F. 80 valves (in series) I.F. 16-19 or 33-38. Also can be modified as an aerial converter (instructions supplied).
Complete with knobs.

32/6 Plus 3/6 P. & P.



HEATER TRANSFORMER

To suit the above. 200-250 v. 6/- Plus 1/6 P. & P.

B.S.R. MONARCH UA8 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: $12\frac{1}{4}$in. x $10\frac{1}{2}$in. Space required above baseboard $4\frac{5}{8}$in., below baseboard $2\frac{1}{2}$in. Fitted with Ful-Fiturnover crystal head. £6/19/6. Plus 5/- P. & P.

STEREO HEAD £7/19/6 Plus 5/- P. & P.

LINE E.H.T. TRANSFORMER

With built-in line and width control. 14 KV. Scan coil, 90° 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 4/- P. & P.

As above, but for 625 lines **£2.10** Plus 4/- P. & P.

FOCUS MAGNET suitable for the above (state tube), 10/-. 2/6 P. & P.

MAINS TRANSFORMERS

All with tapped primaries 200-250 volts.

0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps., 10/6, 280-0-280, 80 ma., 6.3 v., 2 amp., 6.3 v., 1 amp., 10/6. 350-0-350, 70 ma., 6.3 v. 1 amp., 6.3 v. 2 amp., 10/6. 250-0-250. 70 ma., 6.3 v., 2 amp., 10/6. Postage and packing on the above 3/-.

SURFACE BARRIER TRANSISTORS

type SB 305, 15 Mc/s. **7/6** each.

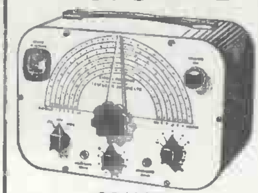
100% AUDIO TRANSISTORS

5/- each.

BATTERY RECORD PLAYER AND AMPLIFIER

Incorporating 45 r.p.m. "Starr" motor, "Acos" crystal pick-up, 3 transistor push-pull amplifier complete with transistors. Output 500 milliwatts, 49/6 plus 3/6 P. & P.

SIGNAL GENERATOR

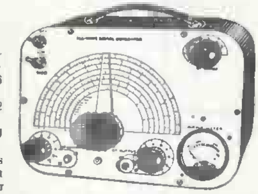


£6/19/6

Covering 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. x $6\frac{3}{4}$in. x $5\frac{1}{4}$in. grey hammer finish. Incorporating three minature 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%.
Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

SIGNAL GENERATOR

Coverage 120 Kc/s.—230 Kc/s., 300 Kc/s.—900 Kc/s., 900 Kc/s.—2.75 Mc/s., 2.75 Mc/s.—8.5 Mc/s., 8 Mc/s.—28 Mc/s., 16 Mc/s.—56 Mc/s., 24 Mc/s.. 84 Mc/s. Metal case 10in. x $6\frac{1}{2}$in. x $4\frac{1}{2}$in. Size of scale $6\frac{1}{2}$in. x $3\frac{1}{2}$in 2 valves and rectifier A.C. mains 230-250 v Internal modulation of 400 c.p.s. to a depth of 30 per cent. modulated or unmodulated R.F. Output continuously variable, 100 millivolts C.W. and mod. switch variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%. **£4/19/6**

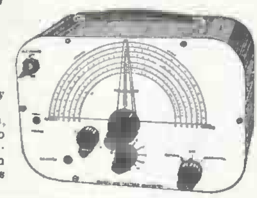


Or 25/- deposit and 4 monthly payments 21/6. P. & P. 5/- extra.

SIGNAL & PATTERN GENERATOR

£6/19/6 P. & P 5/-.

Or 25/- deposit. P. & P. 5/- and 6 monthly payments of 21/6.
Coverage 7/6 Mc/s.-210 Mc/s. in five bands, all on fundamentals slow motion tuning audio output. 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy ±1% A.C. mains 200-250 v.



CYLDON TURRET TELETUNER

I F 34/38 Mcs. Brand new complete with biscuit for channels 2, 4, 8 & 9.

less valves **10/-** plus 2/6 P. & P.
(Valves required P.C.C., 84 & P.C.F. 80.)
Pair of knobs to suit above, 3/6.

3-TRANSISTOR POCKET RADIO

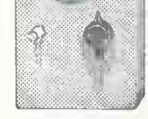
INCORPORATING MINIATURE SPEAKER Plus GERMANIUM DIODE and PRINTED CIRCUIT

Size $3\frac{1}{4}$ x 4 x $\frac{7}{8}$in.

Incorporating Ferrite Rod Aerial. Two Surface Barrier Transistors and one Audio. Tunable over medium and long waves.

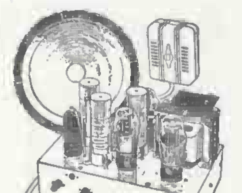
To build yourself **39'6** Plus 1/6 P. & P.

ALL PARTS SOLD SEPARATELY.
Circuit diagram 1/6, free with kit.



All transistors guaranteed 100%

8 WATT PUSH-PULL AMPLIFIER



COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER

A.C. mains 200/250 v. Size $10\frac{1}{2}$in. x $6\frac{1}{4}$in. x $2\frac{1}{2}$in. Incorporating 6 valves. H.F. pen. 2 triodes, 2 output pens., and rectifier. For use with all makes and types of pick-up and mike. Negative feed-back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 Kc/s. ±2 db.; 4 db. down to 20 Kc/s. Output 8 watts at 5% total distortion. Noise level 40 db down. all hum. Output transformer tapped for 3 and 15 ohm speech coils. For use with Std. or L.P. records, mucsial instruments such as Guitars. etc.

£4.19.6 Plus P. & P 7/6.

Or £1 deposit, plus P. & P. 7/6 and 4 monthly payments of 23/-.

PORTABLE AMPLIFIER

On printed circuit or A.C. Mains 200/250 v Size 4in x 3in. with tone and volume control Valves: ECL82 and EZ80, 39/6. P & P. 2/6

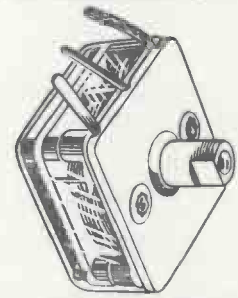
RADIO AND T.V. COMPONENTS (ACTON) LTD.
23A, ACTON HIGH STREET, LONDON, W.3
GOODS NOT DESPATCHED OUTSIDE U.K. ALL ENQUIRIES S.A.E. TERMS OF BUSINESS C.W.O.

MICRO-MINIATURISATION

FOR BUILDING THE SMALLEST TRANSISTOR SUPERHET EVER

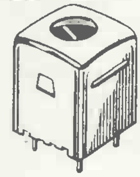
With these components you can build an unbelievably small six transistor superhet capable of receiving anything from 50 to 100 programmes under favourable conditions. Transistor arrangement—Convertor, 2 I.F., Diode, Audio Driver and two in P.P. to give up to 300 mW. Aerial coil and Ferrite Rod Aerial available very shortly.

- *FULL CIRCUIT DIAGRAMS AND CONSTRUCTIONAL DETAILS FREE*
- *ILLUSTRATIONS SHOW ACTUAL SIZE OF COMPONENTS*
- *TRADE ENQUIRIES INVITED*



2 GANGED TUNING CONDENSER

With built-in trimmers. Enclosed in polystyrene casing. Size 1in. sq. x $\frac{7}{16}$in. dp. **17/6**

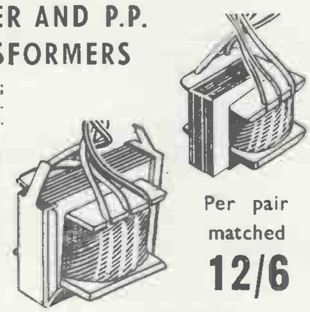


I.F. TRANSFORMERS AND OSCILLATOR COIL

Set of 3 I.F.s and coil. Can size $\frac{1}{2}$in. high x $\frac{3}{8}$in. sq. Individually checked before leaving factory. Very high Q, better than 125. Complete set...... **21/-**

MATCHED DRIVER AND P.P. OUTPUT TRANSFORMERS

Driver—size $\frac{7}{16}$ x $\frac{7}{16}$ x $\frac{3}{8}$in.; Output—size $\frac{11}{16}$ x $\frac{9}{16}$ x $\frac{5}{8}$in. 300in. mW. Coloured leads.



Per pair matched **12/6**

HIGH GAUSS MINIATURE LOUDSPEAKER

$1\frac{3}{4}$in. diam. x $\frac{3}{4}$in. deep M.C. speaker. 9,500 Gauss ensures remarkably good quality. **25/-**

FROM STOCKISTS EVERYWHERE!

Details on application to:

TSL TECHNICAL SUPPLIERS LTD. HUDSON HOUSE, 63 Goldhawk Rd., London, W12
Telephone: SHEpherds Bush 2581 and 4794

UNIVERSAL ELECTRONICS

22-27, LISLE STREET, LEICESTER SQUARE LONDON, W.C.2. Tel: GERrard 8410 & 4447

Shop Hours: 9.30 a.m. to 6.0 p.m. OPEN ALL DAY SATURDAY *Thursday 9.30 a.m. to 1.0 p.m.*

LABORATORY RECONDITIONING & RECALIBRATION SERVICE

RCA, AR88D and LF Receivers, and all HF, VHF and UHF types

Completely reconditioned to original specification and supplied with complete Test Report and Guarantee for 12 months.

TEST EQUIPMENT

- Audio Signal Generators.
- Radio Frequency Generators.
- Wavemeters. Frequency meters.
- Voltmeters, ampmeters and multi-range instruments.
- Valve voltmeters, Micro-wave equipment.

AIRCRAFT INDUSTRY please note:

A laboratory test certificate can be issued in accordance with the current requirements of the Air Registration Board.

ESTIMATES GIVEN ON REQUEST

BARGAIN OFFERS *for the Constructor!*

TAPE RECORDER

Manufacturers' brand new current production offer. Latest 5-valve circuit based on Mullard's famous design. Magic eye level indicator. Volume and tone controls. T.C.C. printed circuit already wired. Only power pack and controls to assemble and wire. Valves EF86, ECC83 EL84, EM84 & EZ80. A sensitive quality recorder at Special Unit Prices.

Wired printed circuit, power pack components, controls and knobs, etc. P. & P. 2/6	£5 15 0
Set of 5 valves, as above. P. & P. 1/-	£2 5 0
B.S.R. Monardeck Tape Unit. P. & P. 4/6	£8 19 6
Bargain reduction for complete kit Carr. 5/-	£16 10 0
Attractive two-tone Cabinet and 9in. x 5in. speaker to house above at special discount price. P. & P. 4/6	£3 5 0
Illustrated Handbook with full details. Post free	2 6
Collaro Studio Tape Deck can be supplied with modified circuit as alternative for approx. (extra)	£5 10 0

RECORD PLAYER BARGAINS Latest 4-speed models

NEW RELEASE by E.M.I.—4 speed Single Player Unit fitted with latest stereo and monaural xtal cartridge and dual sapphire styli. Auto stop and start. A fidelity unit and bargain buy at only £6/19/6, carr. & ins. 3/6

SINGLE PLAYERS. B.S.R. (TU9) 90/-; COLLARO JUNIOR studio P.U. £4/10/-. AUTOCHANGERS. B.S.R. (UA8), £6/19/6; UA8 STEREO £7/19 6. B.S.R. (UA14) latest model. £7/19/6. COLLARO CONQUEST. £7.19/6. COLLARO CONTINENTAL £8 19 6.

BARGAINS GARRARD PLAYER UNITS

SINGLE PLAYERS
Model 4SP £6/17/6. Carr. 3/6.
Model TA Mk. 2, £7/19/6. Carr. 3/6.
Model 4HF, £18. Carr. 3/6.
AUTOCHANGERS. Model RC 210. With plug-in GC8 Head. 10 gns. Carr. 4/6.
Transcription Auto Changer Model "A" just realeased £18/19 6. Carr. 5/-.

NEW BOXED VALVES ALL GUARANTEED

1T4	6/-	EABC80	8/6	EZ81	7/6
1R5, 1S5	7/6	ECC84	9/6	MU14	9/-
3S4, 3V4	7/6	ECF80	9/6	PCC84	9/6
5Z4	9/-	ECL82	10/6	PCF80	9/6
6K7	5/-	ECL80	10/6	PCL83	12/6
6K8	7/6	EF80	8/-	PL81	12/6
6Q7	7/6	EF86	12/6	PL82	9/6
6V6	6/6	EF91	5/-	PL83	10/6
DAF96	9/-	EL41	9/6	PY80	7/6
DF96	9/-	EL84	8/6	PY81	9/6
DK96	9/-	EY51	9/6	PY82	7/6
DL96	9/-	EY86	10/-	U25	12/6

SPECIAL PRICE PER SET
1R5, 1T4 1S5 or 3S4 or 3V4. 25/-
DK96 DF96, DAF96, DL96, 35/-
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5, 32/6.

AUTO CHANGER RECORD PLAYER KIT

A.C. Supply 200v.-250v. Attractive 2-tone cabinet—famous B.S.R. Monarch 4-speed, full mixer, 10-record gram unit. Full-fi xtal pick-up with dual styli for Std. L.P. recordings. 2-valve amplifier with quality neg. feedback circuit, volume and tone controls. Fully isolated from mains by double-wound transformer, NOT the line chassis type as often offered in cheap commercial models.

A recommended buy while stocks last!

Ready wired 2-valve Amplifier, complete with 6in. high flux speaker. £3/19/6, P. & P. 2/6

Two-tone Cabinet 18in. × 13in. × 9in. £3/3/-, P. & P. 3/6

B.S.R. Monarch U.A.8 (160 v. model). £5/19/6, P. & P. 4/6

Complete 3 unit kit at special Autumn Bargain price. £12/12/6, Carr. 7/6

Simple assembly, a screwdriver only required.

TRANSISTORS BVA—1st Grade
New Reduced Prices

MAZDA		MULLARD		G.E.C.	
XA101	14/6	OC70	9/6	GET114	9/6
XA102	16/6	OC71	12/6	GET15	12/6
XA103	15/-	OCT72	15/-	Newmarket	
XA104	18/-	OC44	23/6	"Goldtop"	
XB102	10/-	OC45	21/-	V15/10P	
XC101	10/6				15/-

Germanium Diodes OA70 2/9; OA81 3/6; GEX34 4/-.

JASON FM TUNER UNITS (87-105 Mcs)

Designer-approved kits of parts for these quality and highly popular tuners available as follows:—

STANDARD MODEL (FMT)—as previously extensively advertised. COMPLETE KIT. 5 gns., p. & p. 2/6. Set of 4 spec. valves. 20/-.

LATEST MODEL (FMT2)—attractively presented shelf mounting unit in enclosed Metal Cabinet with Built-in Power Supply. COMPLETE KIT. £7, p. & p. 3/6. Set of 5 spec. valves. 37/6.

MODEL JTV2. Self-powered Switch Tuned B1-B2-B3 AM/FM Unit. 5 preset stations. AFC and AGC circuits. Complete Kit incl. ready-built and valved Turret Tuner, £13/19/6. p. & p 3/6. 4 spec. valves. 32/6 extra.

MERCURY 2 similar to JTV2 less power pack. Complete Kit inc. ready-built turret unit 10 gns. p. & p. 2/6. 4 spec. valves 25/-.

NEW JASON COMPREHENSIVE F.M. HANDBOOK, 2/6 post free. 48hr. Alignment Service, 7/6, p. & p. 3/6.

MAINS TRANS. AND QUALITY OUTPUT TRANS. Mfd. in our own workshops to top grade spec. Fully interleaved and impregnated. Enquiries welcomed for small production runs prototypes or individual jobs.

TRANSISTOR PORTABLE

Famous manufacturer's 6 × 1 design based on Mullard and G.E.C. developments. Printed circuit. 6BVA 1st grade transistors, XA102, XA101 (2), OA70, XB103, XC101 (2) or equivalents. Quality components only supplied to ensure best results at attractive price.

Set of 6 BVA Transistors and Diode. P. & P. 6d.	70/-
Printed Circuit, I.F.'s (3). Osc. coil. Driver Trans. and Ferrite rod aerial. P. & P. 1/6	51/6
Resistors, Condensers Twin Gang and Volume control. P. & P. 1/6	37/6
7in. × 4in. Quality 35 ohm matching Speaker. P. & P. 1/6	25/-
Or	
Complete Kit at special offer ONLY (post free)	£8/19/6.
Handbook and Circuit details, post free	2/-

KNOBS. Modern Continental types, walnut and ivory. 1⅛in. dia. with GOLD RING 1/- ea. 1in. with GOLD CENTRE 1 3 ea. 1in. dia. with GOLD ..1 .. 9d. ea. 1in. with GOLD CENTRE 10d. ea. LARGE STOCKS—SEND YOUR ENQUIRIES.

CRT HTR ISOLATION TRANSFORMERS
New improved types, low capacity, small size and tag terminated A.C. 200/250 v. Secondaries Nil +25% +50% BOOST for 2 v., 4 v., 6.3 v., 10.5 v., 12 v. or 13 v. tubes. 12/6 each. P. & P. 1/6.

COAX 80 ohm CABLE
Now only d. a yard.

High grade low loss Cellular Air Spaced Polythene—¼in diam.—Famous mfr.

BARGAIN PRICES—SPECIAL LENGTHS.

20 yds.	9/-	P. & P. 1/6
40 yds.	17/6	P. & P. 2/-
60 yds.	25/-	P. & P. 3/-

Coax Plugs, 1/-; Coax Sockets, 1/-; Couplers, 1/3; Cable End Sockets, 1/6 Outlet Boxes, 4/6.

RE GUNNED TV TUBES
NEW REDUCED PRICE

. . . and now 12 months' guarantee!

All tubes rebuilt with new heater, cathode and gun assembly — reconditioned virtually as new.

12in. £5, 14in. £5/10/-, 17in. £6, etc.

10/- part exchange allowance on old tube

Carr and ins. 10/-. Comprehensive stocks—quick delivery.

CONDENSERS—Silver Mica. All pref. values, . pf. to 1,000 pf., 6d. each. Ditto ceramics 9d. each. Tubulars 450 v. T.C.C. etc., .001 mfd.-01 and .1/350v., 9d. each. .02-.1 500v., 1 - each. Ex Ernts 1/6. .5 T.C.C. 1/9. .001 6kv 5/6. .001 20 kv. 9/6.

RESISTORS—FULL RANGE 10 ohms—10 megohms 20% ¼ w and ½ w. 3d., 1 w. 5d. (Midget type modern rating) 1 w. 6d., 2 w. 9d., 10% Hi-Stab. ½ w. 5d., 1 w. 7d., 5% ½ w. 9d., 1% HI-STAB. ½ w. 1/6 (10-100 ohms 2/-).

PRE-SET W/W POTS. T/V type. 25 ohms—50 K ohms 3/-. 50K—2 Meg. (Carbon 3/-).

SPEAKER FRET—Expanded Bronze anodised metal 8 × 8in.. 2/3: 12 × 8in. 3/-: 12 × 12in. 4/6: 12 × 16in. 6/-: 24 × 12in. 9/-: 36 × 12in. 12/6, etc. etc.

TYGAN FRET (Contemporary pat.). 12 × 12in. 2/-. 12 × 18in. 3/-: 12 × 24in. 4/-: etc.

LOUDSPEAKERS—P.M. 3 ohms, 2½in. Elac. 17/6: 3½in Goodmans 18/6: 5in. Rola. 17/6: 6in. Elac. 13/6: 7 × 4in. Goodmans Elliptical 18/6: 9in. Rola 20/-: 10in. R. and A. 25/-. 10in W.B.-HF1012. 55/-: 12in. Plessey 15 ohms with 6-4in. Tweeter and Cross Over Filter. 57/6.

Electrolytics All Types New Stock
TUBULAR CAN TYPES

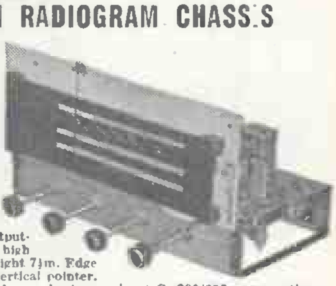
25/25 v. 50/12 v	1/9	8 + 8/450 v.	4/-
50/50 v. 100/25v.	2/-	8 + 32/... v.	4/6
8/450 v. 4/350 v.	2/3	5 + 50/... v.	6/-
16 + 16/450 v.	5/6	50 + 25 + 25 v.	12/-
32 + 32 450 v.	6/6	100 + 200/275 v.	12/6

Comprehensive range in stock.

VOLUME CONTROLS—5K—2 Megohms ALL LONG SPINDLES MIDGET TYPE 1½in diam Guar 1 yr LOG or LIN. Ratios less Sw. 3/-. D.P. Sw. 4/6. Twin gang stereo controls less Sw.. 6/6. D.P. Sw. 9/-.

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve Line-up: ECC85, ECH81, EF89, EABC80, EL84, EM81 EZ80.



Three Waveband and Switched Gram positions. Med. 200-500 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 coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ × 6½in. Height 7½in. Edge illuminated glass dial 11½ × 3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250 v. operation. Magic-eye tuning.

***Aligned and tested ready for use.* £13 . 10 . 0** *Carr. & Ins. 5/-.*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra. Three ohm P.M. speaker only required. Recommended quality speakers.

10in. Rola (Heavy Duty)	30/-
8in. Goodmans special cone	21/6

Post & Pkg. 1/6.

As previously announced fresh supplies are now being received, but we regret some slight delay may be experienced in fulfilling orders for this popular item.

RECORDING TAPE BARGAINS

EMI 1st grade. Brand new sealed boxes

Standard		Long Play	
3in., 175ft.	7/-	250ft.	9/-
5in., 600ft.	19/-	850ft.	25/-
5¾in., 850ft.	25/-	1,200ft.	31/6
7in., 1,200ft.	31/5	1,800ft.	45/-

SPARE REELS: Emitape, new, boxed: 3in. 3/-, 5in. 3/8, 5¾in. 4/-, 7in. 4/6.

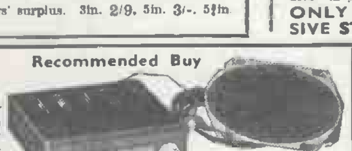
SPECIAL PURCHASE. Famous manufacturers, 1st grade tape, in sealed white boxes.

Standard		Long Play	
5in., 600ft.	15/-	850ft.	19/6
5¾in. 850ft.	16/6	1,200ft.	22/6
7in. 1,200ft.	21/-	1,800ft.	32/6

Plastic Tape Reels, special offer. Manufacturers' surplus. 3in. 2/9, 5in. 3/-, 5¾in 3/3, 7in. 3/6.

2 WAVEBAND CAR RADIO KIT
Recommended Buy

12v. operation Med. & Long Waves



Modern development of the famous Brimar Hybrid vibratorless car radio circuit. Five latest type Brimar low voltage valves and power transistor. R.F. stage and permeability pre-aligned Cyldon Tuner Unit provide extremely good sensitivity and signal noise ratio. Printed circuit for easy construction and 7 × 4in. elliptical speaker for fidelity output. Self-contained in neat metal cabinet 8 × 7 × 2¾in. with attractive calibrated dial. Speaker and power transistor stage mounted separately approx. 8 × 5 × 3in.

Complete Kit Bargain Price **£12.19.6** P&P 3/6.

Instruction booklet and parts list available. 3/6 post free.

ONLY A FEW ITEMS ARE LISTED FROM OUR COMPREHENSIVE STOCK. WRITE NOW FOR FULL BARGAIN LISTS, 3d

Terms: C.W.O. or C.O.D., post and packing up to ½lb. 7d.; 1lb. 1/1; 3lb. 1/6; 5lb. 2/-; 10lb. 2/9.

RADIO COMPONENT SPECIALISTS

70 BRIGSTOCK RD., THORNTON HEATH, SURREY

Established 1946

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STOCKISTS FOR THE FOLLOWING

AMPLIFIERS, STEREO AND MONAURAL, BY:
VERDIK, QUAD, ARMSTRONG, LEAK, ROGERS, W.B., DULCI, etc.

V.H.F. TUNERS BY:
ARMSTRONG, T.S.L., LEAK, DULCI, QUAD, ROGERS, etc.

HI-FI SPEAKERS BY:
GOODMAN, W.B., PLESSEY, T.S.L., WHARFEDALE, G.E.C., LORENZ, etc.

THE NEW JASON range for CONSTRUCTORS

JTV2 Tuner completely assembled ready for use £25/7/-.

FMTI FM Tuner. In kit form for cabinet mounting. One of the most popular tuners. Up to 60 miles normal range. Including valves £6/15/-. Power pack kit £2/14/9.

FMT2. In kit form with free standing case with power pack. Including valves £8/19/6.

FMT3. Variable tuner 88-108 mc/s. Variable AFC control dual limiters, approx. 80 mile range, including valves £10/19/6.

JTV2 Tuner self powered switched tuner for FM and TV sound. Both BBC and ITA as required, including valves £13/19/6.

MERCURY II switched FM/TV sound tuner in kit form for building into cabinet, including valves, £10/10/-. Power pack kit, £2/14/9.

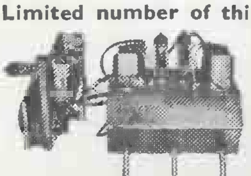
EVEREST 6 s/het transistor portable, p/pull output, high quality speaker, matched transistors, neatly designed case, aerial input for use in car, complete kit £13/19/9.

EVEREST 7 transistor s/het portable, p/pull output, high quality speaker extra RF stage, neatly designed cabinet, aerial input for use in car all components complete £15/18/9. 2/6 post and pkg. on all the above, S.A.E. for details.

DECCA PORTABLE AMPLIFIER. As supplied in famous DECCAMATIC III. Complete with small cream knobs. Full range tone and volume controls. Employs ECL82 valve, Metal Rectifier. Size 3 x 3½ x 8¾in. Only 59/6 plus 2/6 P. & P.

SPECIAL CELESTION 8 x 6in. elliptical high flux loudspeaker to fit. 30/- plus 1/- P. & P.

Limited number of this stereo offer



Compact stereo amplifier, 3 watts each channel, using 2-ECL82, 1-EZ80, separate balance and tone controls, volume and on/off switch, channel reverse switch, designed for crystal p/up, separate power pack, including 2-6½ P.M. speakers in cabinets, finished imitation Rexine. Complete and ready for use, £8/19/6. P. & P. 10/-.

BRAND NEW AND GUARANTEED

7in. reels of 1,200ft. P.V.C. base tape, 21/-, plus 1/6 post and pkg.
5in. reels of 600ft. P.V.C. base tape, 14/6, plus 1/6 post and pkg.
4in. reels of 300ft. P.V.C. base tape, 9/6, plus 1/- post and pkg.
7in. reels of 1,800ft. L.P. P.V.C. base tape, 32/6, plus 1/6 post and pkg.
5¾in. reels of 1,200ft. P.V.C. base tape, 25/-, plus 1/6 post and pkg.
Brand new E.M.I. 7in. take-up spools in polythene bag, 3/9 each post free, 6 for 20/-.

EMISCOPE 3/18 TV TUBES. 12in. round, 8v. heaters, 3 A. current. Final anode 55, deflection angle 50°. Aluminized at the ridiculous price of 35/-, plus crating and carriage 12/6.

BUY NOW!!!

Definitely the last of the remaining stocks of the

AVANTIC BEAM-ECHO HI-FI EQUIPMENT

SP21 STEREO PRE-AMP CONTROL UNIT

A twin channel pre-amp control unit, has 6 inputs for each channel **INPUT SENSITIVITY** for 250 M/V or 1.5V output **TUNER** 100 and 250 M/V **Tape** 100 M/V flats 250 M/V. **PICK-UP** 5 and 50 M/V Frequency response: 40 c/s. to 15 Kc/s. **TAPE OUTPUT** 50 M/V., continuously variable bass and treble controls, loudness control and stereo balance control. Power required 6.3 V. at 1.3 amp. A.C. 350 v at 5 M/A D.C. Will match any hi-fi amplifier. Manufacturer's price £28/10/-. **OUR PRICE** now £16/19/6. Carr and packing 7/6.

AVANTIC PL6-21

High quality monaural power amplifier and pre-amp compactly housed and suitable for shelf mounting or cabinet. Two EL84, three EF86, one ECC83, one EZ81. 30 watts peak; speaker impedance, 4, 8 or 16 ohms. Sensitivity: 4M/V on pickup 3M/V on tape, 100M/V on tuner Intermod. distortion 1% at 10W equivalent Sinewave output. Maker's price £28/10/-. **OUR PRICE 19 gns.** Post and packing 7/6.

AVANTIC SPA11 Stereo Amplifier

A twin channel amplifier and pre-amp., push-pull output, 10W peak each channel, rumble filter speaker impedance 4, 8 and 16 ohms Tape output: 100M/V Continuously variable treble and bass, stereo balance control. Input sensitivity: for 7W. 100M/V radio; 100M/V tape; 650M/V pickup. Manufacturer's price 28 gns. **OUR PRICE 19 gns.** Post and packing 7/6.

STEP 11 stereo pick up pre-amp. unit £4/14/6. P. & P. 2/6.

STEP 21 stereo tape pre-amp., £4/14/6. P. & P. 2/6.

ANOTHER BARGAIN
The Famous VERDIKSI Tape Recorder as supplied under Famous Name at 50 gns.
A high quality recorder using 7in. spools operating at 3¾ and 7½ i.p.s., twin track, record level indicator, fastwind and rewind, tone control, mic., radio and gram. input sockets, ext. speaker, rev. counter, beautifully designed, dimensions 15½ x 14½ x 5½ in two-tone grey finish, complete with external mic., 1-7in. reel of tape and empty spool. A.C. 200/250 volts. **Our Price 29 gns.** Carriage and crating 25/-.

THE VERDIK "QUALITY TEN"

10 watt push-pull ultra linear hi-fi amplifier with pre-amp. Mic., radio, gram and tape inputs, bass and treble controls. Beautifully finished. Control panel in gold lettering on grey green, Fully guaranteed. Original price 23 gns. **Our price £14/19/6.** P. & P. 7/6.

HI-FIDELITY TAPE HEADS

Made by famous manufacturer. Brand new. Upper or lower track. record/play-back, high impedance giving up to 12,000 c.p.s. at 7½ I.P.S. output 5 m/volts at 1 KC at 7½ I.P.S. Erase heads low impedance.
Only 39/6 per pair. Post 1/-. *State upper or lower track.*

TAPE DECK OFFERS

B.S.R. **MONARDECK**, uses 5¾ tape spools, twin track. Single speed, 3¾ I.P.S. at £8/19/6. Post & Pkg. 5/-.

Suitable tape amplifier for B.S.R. deck. Completely assembled, 3 watt o/put, valve line up ECC83, ECL82 EL84, metal rectifier, magic eye level indicator, frequency response 60 c/s—5000 c/s, inputs for radio gram, mic., superimpose, ideal for monitoring impedance, tone control, volume control Dimensions 11½in. x 4in. deep x 6½in. high. **OUR PRICE** £9/15/0. P. & P. 3/6.

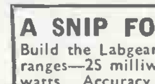
FOR TAPE RECORDER CONSTRUCTORS

The new Collaro studio tape deck, using 3 motors, 3 speeds at 1⅞, 3¾ and 7½ I.P.S., will take 7in. spools, push button controls, £12/19/6, 5/- post and pkg. Well designed tape recorder amplifier (not a kit) for the studio deck, incorporating Mic/Gram/Radio inputs, ext. loudspeaker, superimposing switch, with matching knobs, separately mounted mains transformer Frequency response 60-10K/c 3DB at 7.5 I.P.S., magic eye level indicator Using ECC83, ECL82 and EM85 and metal rectifier. Assembly instructions. The 2 units, £25/10/- complete. Crating and insurance, 17/6. Suitable Acos mic. 40 for above, 25/-.

A repeat of our previous popular offer. The Collaro Mk. IV tape transcriptor tape deck, £17/10/-, Crating and carr. 11/6.

The new **ARMSTRONG TAPE PRE-AMPLIFIER PABO-3,** high quality unit, can be used with any Hi-Fi equipment, will operate most tape decks, equalisation for tape speeds 3¾, 7½, 15 I.P.S., can play prerecorded tapes. Valve line up, EF86, ECC82, EM81 and OA81 diode, freq. response, 30-17000 C.P.S., at 15 I.P.S. 40-13000 C.P.S. at 7½ I.P.S. Mic/radio/gram inputs. 20 watts maximum power required, attractive control panel. **Complete 16 gns.** 3/6 post & pkg. Power pack £2/19/6 extra.

BRAND NEW TV TUBES CHEAPER THAN REBUILDS



All brand new in famous maker's cartons. (1) 17in. rectangular aluminized 6.3 HRTS. .3 A. current; max. anode voltage 16 kV. Usual price £17/5/-. **OUR PRICE** £7/19/6. Crating and carr. 15/-.
(2) 14in. rectangular Tube, 6.3 heaters; .3 amp. current; max. anode 14 kV; ion trap; external conducting coating; B12A base. £7/9/6. Crating and carriage 12/6.
(3) Ferranti 9in. Tube, round white fluorescence, 4 v. heater, max. anode voltage 7 kV. **OUR PRICE** 25/-. Crating and carr. 11/6.

A SNIP FOR CONSTRUCTORS

Build the Labgear Audio Output meter. Two ranges—25 milliwatts to 1 watt, 1 watt to 100 watts. Accuracy 5W. Input impedance 3, 15 and 600 ohms. Printed circuit. All components including 0-1MA moving coil meter and silver hammertone enamel case. Kit complete with instructions 59/6, post and pkg. 1/6.

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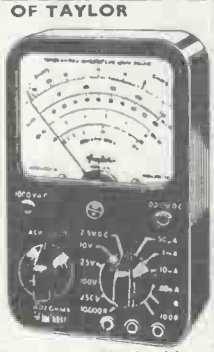

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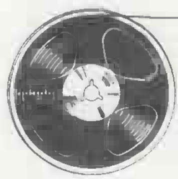

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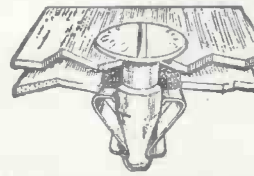

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MARCONI TF-195L BEAT FREQUENCY OSCILLATORS. Frequency Range 0-40,000 c/s. Output 2 watts into 600 and 2500Ω. Calibration Accuracy ±2% ±2 c/s. Mains operation. P.P. 20/-. £65 0 0

MARCONI TF-885A VIDEO OSCILLATOR Frequency 25 c/s. to 5 Mc/s. sinewave and 50 c/s. to 150 kc/s. squarewave output. Max. output 1W/1,000Ω sinewave, and 32V peak/1,000Ω squarewave. 11-step attenuator calibrated in Volts and dB. 100/125 and 200/25 v. A.C. Mains operation. P.P. 25/-. £150

GENERAL RADIO TYPE 700A WIDE RANGE BEAT FREQUENCY OSCILLATOR. Range 50 c/s. to 5 mc/s. in two ranges; Incremental frequency control. Output Impedance 3,500Ω. P.P. 20/-. £70 0 0

DAWE INSTRUMENTS TYPE 400C WIDE RANGE RESISTANCE TUNED OSCILLATOR. Frequency Range .1 to 1000 c/s. in two ranges. Accuracy ± 3% from 1 to 1000 c/s and ± 10% from .1 to 1 c/s. Output 100mW. into 10,000 balanced. Total Harmonic Distortion 3%. Monitoring 1in. Cathode Ray Tube. P.P. 15/-. £70

MARCONI TF-142E DISTORTION FACTOR METERS. Fundamental Frequency Range 100-8,000 c/s.; Distortion Factor Range 5% and 50%. First reading at .05%. Impedance 600Ω. Power Supplies 200-250V. Mains. operation. P.P. 20/-. £65 0 0

DAWE INSTRUMENT TYPE 700A DISTORTION FACTOR METER. Frequency range 100 to 8,000 c/s. on fundamentals; Distortion range .1 to 50% with an accuracy of 10%. Input impedance 600Ω. Sensitivity 1 milliwatt. Mains operation. P.P. 20/-. £60 0 0

R.C.A. TYPE 69C NOISE AND DISTORTION METER. Direct measurements of Noise level from 0 to −75 dB. and measurements of Distortion from 0.3 to 100% when used with a low distortion Oscillator Frequency Range from 0 to 40,000 c/s. P. & P. 20/-. £55 0 0

WAYNE KERR TYPE A201 WAVEFORM ANALYZER. Frequency range 20 c/s to 20 kc/s in two bands. Input voltage 80 mV to 25 V approx. Input attenuator. Harmonic measurements range from −65 to +1 db. Mains operation. P.P. 15/-. £110 0 0

CT49 ABSORPTION AUDIO FRQUENCEY METERS. Variable Capacitor tuned L-C Resonant Circuit. Detector and Valve Voltmeter Stage. Microammeter resonance indicator. Range 450 c/s. to 22.0 kc/s. in four directly calibrated bands. Power required: dry batteries 1.5 V. and 22.5 V. P.P. 15/-. £22 0 0

OSCILLOSCOPES

COSSOR DOUBLE BEAM Type 339 £30 0 0

DUMONT SINGLE BEAM Type 168, 5in. Tube. Time Base up to 30 kc/s., 115 V. operation £25 0 0

DUMONT SINGLE BEAM Type 241, as above £25 0 0

DUMONT SINGLE BEAM Type 208, 5in. tube, Time Base up to 50 kc/s. £30 0 0

AIRMEC Type 830 SINGLE BEAM. Time Base range .05 sec. to 1.5μsec. triggered or free-running. Frequency response 30 c/s. to 20 mc/s. on low gain and up to 1 mc/s. on high gain. Adjustable E.H.T. Voltage. Mains operation £110 0 0

AIRMEC TYPE 723 SINGLE BEAM. Time Base 1μsec. to .5 millisec sweep, triggered or free-running. Amplifier Frequency Response D.C. to 5 mc/s. for sensitivity of 200 mV/cm. and 30 c/s. to 30 kc/s. for sensitivity of 20 mV/cm. Automatic brilliance control. Adjustable EHT Voltage. Mains operation £75 0 0

COSSOR TYPE 1035 DOUBLE BEAM. Time Base 15μsec. to 150 millisec. triggered or free running. Y1 Amplifier gain 3 to 3,000, with frequency response up to 7.0 mc/s. for low gain and up to 60 kc/s. for high gain. Y2 Amplifier directly calibrated in Volts. £100 0 0

EMI TYPE 3794TA HIGH SPEED WAVEFORM VIEWING OSCILLOSCOPE. Time Base 1.5μsec to 50 m/sec. triggered or free running. "Y" amplifier provides sensitivity of 2 to 120 mm/V. Time rise .07μsec. Frequency response D.C. to 5 mc/s for 2.5 db down. Time measurements range .1μsec. with an accuracy of ±2%. Voltage measurements range 0-300 V. D.C. or R.M.S. in six ranges, with accuracy of ±3% F.S.D. Mounted on a trolley, with mains power supply unit. P.P. 50/-. £90 0 0

TS-239/UP HIGH SPEED OSCILLOSCOPE. Single Beam. Sinewave observable 10 c/s. to 5 mc/s. Minimum rise time .08μsec. Sweep time .5μsec. to 50,000 μsec. triggered or free-running. Calibrating Voltage .1 to 1V peak. Brightness modulated timing marks of .2-1-10-100-500μsec. Sensitivity .1 to 100 V. for an image size of .6in. Illuminated graticule with adjustable brightness. 115 V. operation. Complete with accessory cables and probe £183 0 0

R.C.A. TYPE 327A SINGLE BEAM 6in. OSCILLOSCOPE. Time Base Range 1 c/s. to 50 kc/s. Sensitivity .1 to 100 V. per 6in. deflection. Identical "X" and "Y" Amplifiers. Push-button "X" and "Y" Attenuators. DC Voltmeter for Voltage measurements. This oscilloscope is especially suitable for demonstration purposes £65 0 0

TS-34/AP PORTABLE OSCILLOSCOPE. 2in. Cathode Ray Tube magnified to 3in. Field. Time Base 10 to 50,000 c/s. free running and 5, 50 and 250μsec. single stroke sweep. 1μsec. internal calibrating pulse. Input .1 to 1 V. for 1in. deflection max. 115 V. A.C. operation. Complete with cables and probe £50 0 0
Packing and carriage £1 per instrument.

"MEASUREMENTS CORPORATION" TYPE 84 "STANDARD" SIGNAL GENERATOR

Range: 300-1,000 Mc/s. Direct Calibration.
Accuracy: 0.5%.
Output Level: 0.1μV-100 mV. continuously variable.
Internal Modulation:—
Sinewave—30% Max. at 400, 1,000 and 2,500 c/s.
Pulse—1 to 50μsec., width delay variable from 0 to 50μsec., p.r.r. 60 to 100,000 c/s.
Output Impedance—50 ohms.
Percentage Modulation Meter.
PRICE, in as new condition, tested before despatch and fully guaranteed £220 0 0
Packing and carriage £2 0 0

HETERODYNE WAVEMETERS

TS-173 Heterodyne Crystal Controlled Frequency Meters, range 90 to 450 Mc/s. Individual Calibration Books with numerous crystal check points. Accuracy .005% nominal and .01% interpolation. Power required: dry batteries 6 V. and 135 V. PRICE £120 0 0

MARCONI TYPE TF-783 PRECISION HETERODYNE WAVEMETER. Range 3 to 15 Mc/s. on fundamentals, extendible to at least 30 Mc/s. by using harmonics. Accuracy better than .005%. Crystal Reference Oscillator giving check points every 20 and 200 kc/s. Direct calibration with linear interpolation. Power supplies 230 V. mains. PRICE £75 0 0

ALSO BC-221 and LM-14 FREQUENCY METERS. Prices and details on application.

"HIVOLT" TYPE 105PHB HIGH FREQUENCY HIGH VOLTAGE POWER SUPPLY UNIT. This unit will provide H.F. voltage continuously variable from 0 to 30kV. Mains operation. P.P. 25/-. £65 0 0

PEN RECORDERS

EVERSHED PORTABLE RECORDING VOLTMETERS.

150V D.C. 3in. chart, clockwork chart drive, two speed, ½in. and 6in. per minute £30 0 0

50mV. D.C., ditto £30 0 0

150mV. D.C., ditto £30 0 0

EVERSHED SWITCHBOARD PATTERN RECORDING MILLIAMMETERS

Single Pen 2.5-0-2.5mA. D.C. Centre zero, electric chart drive, 230 V. A.C. at 3in. per minute. 6in. chart. £45 0 0

Single Pen 5mA D.C. Electric chart drive 230V. A.C., 12in. per minute, 6in. chart width; fully rebuilt and guaranteed £50 0 0

Single Pen 1 mA. D.C., otherwise as above £53 10 0

Single Pen 1mA or 5mA Range, fitted with "operation" pen to mark the beginning and end of an event, the magnitude of which is recorded by other pen. Operation pen is energised from an Internal transformer by shorting the external leads. Fully rebuilt and guaranteed.

ImA. Range £58 10 0

5mA. Range £55 0 0

Twin Pen 5mA. D.C. Electric chart drive 230V. A.C. Chart speed ½in. per minute, 6in. chart width, fully overhauled and guaranteed £65 0 0

Ditto 1mA. D.C. £72 0 0

ELLIOTT SINGLE PEN SWITCHBOARD PATTERN RECORDING MILLIAMMETERS

Single Pen 5mA D.C. Electric chart drive 230V. A.C., 6in. chart width. speed 3in. per minute £45 0 0

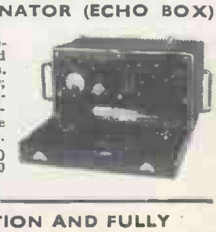
Ditto 1mA. D.C. £48 10 0

CAMBRIDGE 4-decade WHEATSTONE BRIDGES. 10-10-100-1000Ω decades; Ratio Arms 1-10-100-1000Ω. Built-in suspension Galvanometer and Battery and Galvanometer Keys. PP. 15/-. £50 0 0

MARCONI TYPE TF-366A CIRCUIT MAGNIFICATION METER. Frequency Range 15 to 170 mc/s. in four ranges ±2%. Magnification Range 60 to 1,200 in three ranges. Tuning Capacitor 12 to 85μμF with Vernier Tuning Dial. P.P. 20/-. £130 0 0

B.T.H. "X" BAND PERFORMANCE TESTING RESONATOR (ECHO BOX)

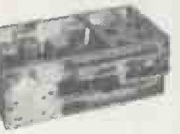
Directly calibrated frequency dia., graduated from 9,170 to 9,470 Mc/s. Graduated Attenuator; Microammeter Resonance Indicator; complete with R.F. Cable and Waveguide Adaptor.
PRICE .. £32 0 0
P. and carr. 15 0



ALL THE ABOVE EQUIPMENT IS FULLY OVERHAULED TO MANUFACTURERS SPECIFICATION AND FULLY GUARANTEED FOR SIX MONTHS FROM THE DATE OF PURCHASE.

V.H.F. RECEIVER UNITS BC-624

(part of SCR-522 Transmitter-Receiver)



4 Crystal controlled channel. 100-156 Mc/s. (3.0-1.93 metres). Valves 9003 R.F. stage; 9003 Mixer; Three I.F. stages 12SG7; Det/AVC/Audio 12C8; Second Audio 12J5GT; Oscillator 2AH7GT, Harmonic Generator 9002; Harmonic Amplifier 9003; Audio Squelch—other section of 12AH-7GT. High and Low Impedance output. PRICE complete with valves, with description and circuit diagram, but without squelch relay 25/-, p.p. 5/-. PRICE, chassis only, less valves 7/6, p.p. 3/6.

ALSO LIMITED QUANTITY ONLY:

TRANSMITTER UNITS BC-625

(part of SCR-522 Radio Set)

Valves: Speech Amplifier 6SS7; Push-Pull Modulator (two 12A6); Oscillator 6G6G; 1st Harmonic Ampl. 12A6; 2nd Harmonic Ampl. 832; Power Ampl. 832. Output 8 watts.

PRICE, complete with valves, description and circuit diagram .... p.p. 5/-. 22/6

Price, chassis only, less valves ...... p.p. 3/6 7/6
Descriptions and circuits available at 8d. each.

RATCHET MOTORS, 12 v

1 Amp. (Impulse Motors) 5.75 ohms .... 3/6 each

Packing and postage 1/6

D.C. SOLENOIDS

Type 700-28 Push-Pull Type, 24-28V, 1 Amp. holding force 12 lbs.; stroke 5/16in. Flange Mounting; Dimensions: 2¼in. high × 2in. × 2in....... 6/6, p.p. 2/-.

Type 137 Push-Pull Type; 26V. 12 Amps; Holding Force approx. 40 lbs.; Stroke ½in.; Dimensions 3½in. high × 2¼in. × 2¼in. .... 8/6, p.p. 2/-.

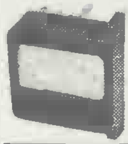
Type 768-2, Pull Type, 28V. 17.5 Amps; Holding Force approx. 50lbs.; Stroke ⅝in. Dimensions 3in. high × 2¼in. × 2¼in. Flange Mounted .... 8/6, p.p. 2/-.

VENNER 8-day clockwork time switches. 24-hour dial with one make and one break. 1 amp. 230V. contacts. Second-hand, good condition, complete with winding key. .... p.p. 2/-. 27/6

P.O. BUZZERS

Post Office Buzzers model T Mk. I. Minimum operating voltage 3 volts. PRICE (p.p. 1/6). 4/6

3-RANGE MICRO-MILLIAMMETER



Basic movements 50μA D.C. M.C. Ranges of 50μA, 250μA and 1mA switched by a trigger switch in the back, geared with sliding scale having separate graduations for each range. Instrument is fitted with leads for soldering to test prods or crocodile clips (not supplied) 50/-

WESTINGHOUSE SELENIUM RECTIFIER POWER UNITS

Input 115/230V., fully smoothed and fused. Output adjustable from 80 to 140V. D.C. by means of fine and coarse tap switches in the secondary winding. Maximum current 400mA. continuous. Dimensions: 17½in. × 10½in. deep × 3½in. high .... p.p. 7/6 40/-

AVO CR BRIDGES

Portable Mains Operated Serviceman's Component Bridge. Ranges of measurements; Capacity from 5mmF. to 50 mF.; Resistance from 5 ohms to 50 megohms. Valve Voltmeter from 0 to 15 V. RMS: Neon Leakage Indicator. Power Factor measurements in %.

PRICE .... p.p. 10/- £9

NEW FOREIGN MADE POCKET MULTIMETERS

Basic Movement 300μA. Sensitivity 1,000Ω/V. A.C. and D.C. Ranges: 10-50-250-500-1,000V. D.C. and A.C. 1-100-500mA. D.C., 2K/200K ohms. Accuracy: 3% FSD and D.C., 5% FSD on A.C. 10% on. Resistance scale. Dimensions: 5¼in. × 3½in. × 2¼in. Complete with test leads with prods and 1.5V cell, fully guaranteed 80/-.

REVERSIBLE 12 V. D.C. MINIATURE MOTORS

Power approx. 5 watts at 7,000 R.P.M. Dimensions 1⅝in. long × 1½in. dia. Shaft .077in. dia. × 4in. long. Centre of reversing switch integral with the motor. Self-lubricating sintered bronze bearings. PRICE, brand new, 15/6 post free.

PORTABLE METERS

EX-A.M., 150 Volts D.C. M.C., in bakelite cases, with side terminals. Dimensions: 6¼in. × 6¼in. × 3½in. deep. PRICE ....35/-. p.p. 3/9.

200μA D.C., M.C.: 2½in. Rd. Fl. Meter mounted in a waterproof die-cast case fitted with rubber feet and carrying handle. Phone jack connection. Dimensions 6in. wide × 6in. high × 3½in. deep. Unused. P.P. 2/6. £2

160V AC/DC M.I. MIRROR SCALE, dimensions 9in. × 9in. × 3½in. Unused .... p.p. 5/-. £5.

TURNER MODEL 32 6in. RD.FL. METERS, mirror-scale, mounted in wooden boxes with leads; dimensions 8½in. × 9in. × 4½in.:

1 mA. D.C.	£8 0 0
10 mA. A.C. Rectifier	£8 0 0
100 mA. D.C.	£6 0 0
250 mA. A.C. Rectifier	£8 0 0
10A and D.C.	£6 0 0
1V. D.C.	£8 0 0
50 V. A.C. Thermocouple	£10 10 0
100 V. A.C. Thermocouple	£10 10 0
200 V. A.C. Thermocuple	£10 10 0
500 V. A.C. Thermocouple	£10 10 0

Packing and Postage 7/6.

WESTON MODEL 155 M.I. MIRROR SCALE, dimensions 7½in. × 8½in. × 3½in. Range 150 Amps. p.p. 5/- £5

AIRMEC TYPE 698B STABILIZED POWER SUPPLY UNIT. This power unit will provide all the necessary voltage for a klystron. Cathode-Volts 1.0 to 2.4 kV.; Grid-to-Cathode: 0 to 220 V.; Reflector-to-Cathode 0 to 550 V.; Cathode current 18 mA. max.; Heater supplies 4 V. at 1.5 A. max.; Internal modulation: square-wave at 2 to 4 kc/s., 70 V. peak-to-peak, sawtooth 160 to 600 c/s., 0 to 30 V. peak. Ripple 20 mV. H.Y. and 150 mV. L.T. Mains operation 210-250 V. A.C. p.p. 20/-. £50 0 0

TESTED AND GUARANTEED VALVES

OA2 ..	6/-	5T4 ..	9/-	6L5G	6/-
OC3/VR105	5/6	5U4G	5/-	6L6 ..	9/-
OD3/VR150	5/6	5V4G	9/-	6L6G	7/-
1A3 ..	3/-	5Y3GT	6/-	6L7 ..	5/-
1AH4	5/-	5Z3 ..	7/-	6L7G	4/6
1L4 ..	3/6	5Z4M	9/-	6N7 ..	6/-
1Q22	100/-	6A6 ..	5/-	6N7G	5/-
1R4 ..	7/-	6AB4	5/-	6Q7G	6/-
1R5 ..	6/-	6AB7	4/-	6R7 ..	6/-
1S5	6/-	6AC7	3/-	6SA7	6/-
1T4 ..	5/-	6AG5	3/6	6SA7Y	7/-
1U5 ..	6/-	6AG7	6/-	6SC7	7/-
1V2 ..	4/-	6AK5	5/-	6SG7	6/-
2C26	2/-	6AL5	4/-	6SH7	4/-
2C26A	5/-	6AM5	5/-	6SJ7	5/-
2C34	4/6	6AM6	4/6	6SK7	5/6
2C39A	100/-	6AQ5	7/-	6SN7GT	4/-
2C40	40/-	6AQ6	7/-	6SQ7	6/-
2D21	6/-	6AR5	4/-	6SS7	3/6
2X2	4/-	6AT6	5/-	6X4 ..	5/-
3A4 ..	5/-	6AU6	7/-	6X5GT/G	5/-
3A5 ..	5/-	6AV6	6/-	6V6GT	5/6
3B22	20/-	6B4G	4/-	6Z4 ..	6/-
3B24	3/6	6B7 ..	6/-	7A4 ..	4/-
3B26	20/-	6B8 ..	6/-	7AG7	5/-
3B29	30/-	6B8G	3/6	7C7 ..	5/-
3C45	30/-	6BF6	5/-	7E5 ..	5/-
3D6 ..	4/-	6BN6	7/-	7F7 ..	5/6
3D21	20/-	6C4 ..	2/-	7W7 ..	6/-
3E29	60/-	6CB6	4/-	11E2	20/-
3Q4 ..	7/-	6C5G	7/-	11E3	20/-
3S4 ..	5/-	6C8G	7/-	12A6	3/-
3TP7	7/6	6D4	10/-	12AH7GT	4/6
4B28	15/-	6F6 ..	5/-	12AT7	6/-
4C35	60/-	6F8G	6/6	12AU7	6/-
4E27	60/-	6G6G	2/6	12AX7	7/-
5B21	20/-	6H6	1/6	12C8	3/-
5B/502A	80/-	6J5	4/6	12H6	2/-
5R4GY	9/-	6J5G	3/-	12J5GT	1/6
		6J6	3/6	12SH7	3/-
		6K7 ..	5/-	14A7	6/-
		6K7G	4/-		
		6K8 ..	9/-		

24G	30/-	801A/801	10/-	832 ..	15/-	1625	6/-	5517	6/-	5725	7/-
25Z6GT	6/-	807(UK)	5/6	832A	35/-	1616 ..	7/-	5651	8/-	5783WB	25/-
28D7	7/-	808 ..	12/6	927 ..	15/-	2050	7/6	5654	10/-	5786	200/-
39/44	3/-	811A	30/-	931A	60/-	4033A	15/-	5678	7/-	5787	10/6
41 ..	7/-	813 ..	70/-	955 ..	4/-	4033L	30/-	5687	10/-	5814	9/-
53A ..	3/-	815 ..	40/-	956 ..	2/-	4043	15/-	5693	20/-	5829	5/-
54G(HK)	25/-			957 ..	5/-	4061A	12/6	5702	15/-	5839	25/-
				1005	35/-	4242A	35/-	5718	6/-		

76 ..	5/-	5852	10/-
83 ..	10/-	5899A	10/-
83V ..	9/-	5963	7/-
249B	25/-	6064	10/-
267A	15/-	6065	10/-
284B,D	20/-	6213	15/-
313C	30/-	7193	2/-
323B	40/-	8016	5/-
350A	15/-	9001	4/-
357A	80/-	9002	5/6
559	3/-	9003	6/-
703A	30/-	9004	4/-
705A	15/-	9006	2/6
717A	4/-	AC/HL	5/-

AC/SP3	4/6	EL38	15/-	UL84	8/-
ACT-19	80/-	EL84	7/-	VGT128	10/-
ARDD5	1/6	EZ80	6/-	VR21	2/6
ARP34	4/-	EY51	9/-	VR35	5/-
ARTH2	7/-	EY86	10/-	VR53	4/-
ATP4	5/-	FW4/800	8/6	VR54	1/6
AW3	4/6	KT33C	6/-	VR55	8/-
ATR387	70/-	KT63	6/-	VR56	4/6
C3R14	10/-	KT66	12/6	VR65	4/-
CK522AX	10/-	KT81	17/6	VR92	1/-
DAF96	7/6	KTZ63	9/-	VR-100	7/-
DF96	7/6	L63 ..	6/-	VR135	2/6
DH63	6/-	MH4	6/-	VR136	4/-
DK96	8/-	MHL4	3/6	VR137	4/-
DL94	6/6	ML6 ..	6/-	V868	4/6
DL95	7/-	NGT1	3/6	VT31	50/-
DL96	7/6	PEN44	20/-	VT52	4/6
DSL10	4/-	PCC84	9/-	VT61	7/-
EABC80	8/-	PCF80	9/6	VT501	3/-
EAC91	4/-	PL36	13/-	VU39	7/-
EC91	5/-	PL81	10/-	VU111	4/-
ECC81	6/-	PL82	8/6	VU-120	4/6
ECC82	6/-	PL83	11/-	VX3208	5/6
ECC83	7/-	PT15	15/-	VX8190	5/6
ECC84	8/-	PY81	8/6	VX8142	5/6
ECC85	8/-	PY82	7/-	Z21	10/-
ECC91	3/6	QQV06-40	40/-	X66	10/-
ECF80	10/6	QV04-7	15/-	CV25	15/-
ECF82	10/6	RK60	9/-	CV53	80/-
ECL80	10/-	RZ1-150	15/-	CV-92	40/-
EF40	6/-	8130P	5/-	CV117	30/-
EF50	1/6	8340	100/-	CV-303	10/-
EF55	5/-	TT11	3/-	CV233	3/-
EF80	7/-	TT-15	40/-	CV1029	30/-
EF91	4/6	TTR31	60/-	CV2208	5/-
EF92	3/6	TZ40	40/-	CV4014	10/-
		U19	17/6	CV4025	10/-
		UF80	7/6		

CATHODE RAY TUBES

Type	dia.	V_h	V_{a1}	V_{a2}	V_g	Screen	Defl.	Focus	Price
3ACP2	3in.	6.3	545V	2,000V	60V	Gr.	ES	ES	20/-
3BP1	3in.	6.0	575V	2,000	60	Gr	ES	ES	17/6
5FP7	5in.	6.3	250V	7,000V	45	Gr/Y	EM	EM	12/6
5SP7*	5in.	6.3	430V	1,500V	30	Gr/Y	ES	ES	140/-
7BP7	7in.	6.3	330	7,700V	45	Gr/Y	ES	EM	45/-
7BP7A	7in.	6.3	770	8,800V	70	Gr/Y	EM	EM	60/-
10UP21	10in.	6.3	770	13,000V	70	Y/R	EM	EM	70/-
12SP7	12in.	6.3		9,000V	250	G/Y	EM	EM	40/-
CV961	7in.	4.0	450	500	70	Gr.	ES	ES	25/-
CV956**	12in.	4.0	1,700	1,200	90	Gr.	ES	ES	15/-

STEEL SCREENS FOR 3in. TUBES .... 5/- P.P. 9d.
*Twin Gun.
**Complete with mu-metal screen.
Packing and carriage 2/- in £ subject to a minimum of 2/6.

KLYSTRONS

Type	V_h	V_{res}	P_{res}	Output	Freq.	Price
417A	6.3	1,600	50W	25mW	9.1-11.3cm	40/-
723A/B	6.3	330		20mW	8,702-9,548mc	50/-
CV129	4.0	1,600	10W	75mW	9,375mc mean	80/-
CV238	4.0	250	8W	100mW	3,030mc mean	40/-
CV35	4.0	1,250	10W	100mW	3,033mc mean	100/-
CV217	4.0	1,350	10W	15mW	9,738mc mean	40/-

MAGNETRONS

5J30, Vh 2.2Va 3,500 peak, 1,500 gauss, output 150 Watst, frequency 375mc mean, liquid cooled, 40/-.
714A/Y, Vh 6.3V, Va 22kV pk., 2250 Gauss, mean frequency 3300mc/s. 200/-.

We have hundreds of other types in stock. Please send s.a.e. for current price list. Please add 2/6 in £ for packing and postage.

WE URGENTLY REQUIRE AND PAY HIGHEST PRICES FOR MODERN TEST EQUIPMENT (e.g., Signal Generators, Oscillators, Microwave Test Sets, etc.). COMMUNICATIONS RECEIVERS (especially U.H.F. and E.H.F. Ranges), AIRCRAFT RADIO COMMUNICATION AND RADIO NAVIGATION EQUIPMENT, SPECIAL VALVES, MAGNETRONS, KLYSTRONS, ETC.

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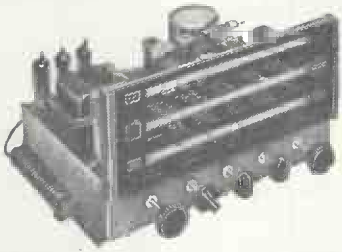

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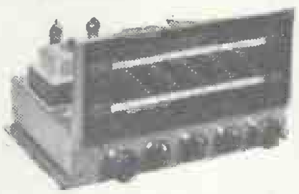

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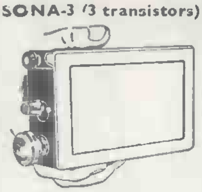

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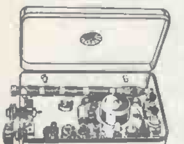

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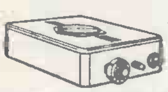

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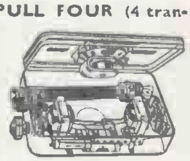

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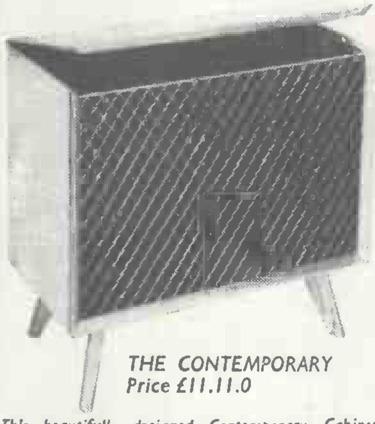

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