

APRIL 1960

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Wireless World

ELECTRONICS

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FIFTIETH YEAR OF PUBLICATION

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Wireless World

ELECTRONICS, RADIO, TELEVISION

APRIL 1960

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VOLUME 66 No. 4

PRICE: TWO SHILLINGS

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Offices: Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager,
or Publisher, as appropriate

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PUBLISHED MONTHLY (4th Monday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. Telephone: Waterloo 3333 (65 lines). Telegrams: "Ethaworld, Sedist, London." Annual Subscriptions. Home and Overseas, £1 15s. 0d. Canada and U.S.A., \$5.00. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: BIRMINGHAM: King Edward House, New Street, 2. Telephone: Midland 7191. COVENTRY: 8-10, Corporation Street. Telephone: Coventry 25210. GLASGOW: 26b, Renfield Street, C.2. Telephone: Central 1265. MANCHESTER: 260, Deansgate, 3. Telephone: Blackfriars 4412. NEW YORK OFFICE: U.S.A.: 111, Broadway, 6. Telephone: Digby 9-1197.

FRAME GRID VALVES FOR TELEVISION



ADVANTAGES OF THE FRAME GRID VALVE

This series of advertisements started with a discussion of the advantages which frame grid valves bring to the television receiver. The four types in the Mullard frame grid television valve range were then looked at in detail, and their application in tuners and i.f. stages was illustrated. Finally, practical valve line-ups for the r.f. and i.f. stages of standard and fringe receivers were given, and it was shown that the extra gain per stage (about 6dB) which is provided by the frame grid valve can be used in either of two ways. A very sensitive receiver can be designed with no increase in the number of i.f. stages; or a completely satisfactory performance can be obtained in the normal service area with one fewer i.f. stage than in a receiver designed round conventional valves.

SLOPE

Reduction of the grid-to-cathode spacing in a valve is the readiest way to increase slope. The alternative is to increase the area of the electrodes and the length of the cathode. However, this conflicts with the trend towards miniaturisation; and, further, a small structure with reduced spacing provides other advantages as well as high slope, such as short transit time, low noise, and low capacitances. For these reasons the frame grid structure has been used to achieve high slope in the new television valve series. Magnified cross-sections and grid-cathode spacings of television valves are shown in the illustration. The EF184 frame grid valve is the latest development.

A type-for-type comparison of the frame grid range and its predecessors shows that in each instance the slope has been doubled.

GAIN

The consequence of this increased slope is that in each r.f. or amplifier stage the gain obtainable is also doubled. In practical circuits the gain advantage given by each frame grid valve is about 6dB (under certain operating conditions the advantage is as much as 8dB). It is obvious that with twice the gain in each stage, a frame grid receiver can have a far greater sensitivity than its conventional counterpart; or as good a performance as before can be obtained with the saving of an i.f. stage.

CIRCUITS

The tuner and i.f. amplifier circuits used with frame grid valves are substantially similar to those in established usage; but, of course, the detailed design of each stage has to take into account the correct operating conditions for the new types. Frame grid valves are not simple plug-in replacements for their predecessors. Some minor refinements of circuit technique are necessary if full use is to be made of the high-gain potentialities of the new types.

RANGE OF VALVES

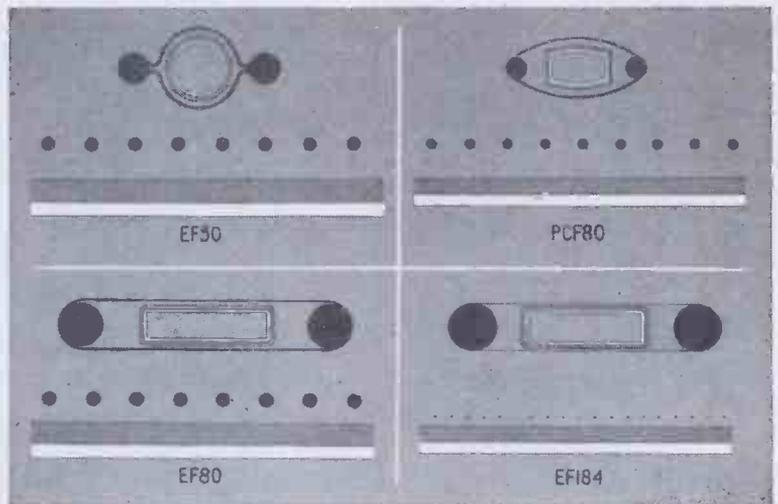
The four valves in the Mullard frame grid television range are:

PCC89: double triode for cascode r.f. amplifiers.

PCF86: triode-pentode frequency changer.

EF183: variable-mu pentode for a.g.c.-controlled i.f. amplifiers.

EF184: straight pentode for i.f. amplifiers where little or no control is required.



LINE-UPS

Two types of receiver will meet all U.K. requirements: a standard receiver for normal service areas, and a very sensitive receiver for the fringe. In both receivers the same low-noise high-gain tuner, with PCC89 and PCF86, can be used.

A fringe receiver giving satisfactory reception at all usable signal levels will need one frame grid stage after the tuner—preferably a common i.f. stage using the EF183. This is followed by separate sound and vision stages, in both of which the conventional EF80 is retained. A conventional receiver would need *three* vision i.f. stages to provide comparable performance.

For normal service areas the common i.f. stage is omitted, and the separate sound and vision stages use the EF183. More gain would be obtained with the EF184, but at some cost in signal-handling ability.



MULLARD LIMITED, MULLARD HOUSE, TORRINGTON PLACE, LONDON, W.C.1

How Many Councils?

"The formation of an Electronics Industry Council is announced in London by the Electronic Engineering Association, who, with the Radio and Electronic Component Manufacturers' Federation and a number of other bodies, has been discussing this for some time.

"The new Council will be concerned with electronic instruments, sound and television transmitters, radio communication equipment, radar and radio navigational aids, computers, industrial electronic control equipment and industrial television and the electronic components used therein.

"Its constitution will provide for the adherence of associations or federations of manufacturers concerned wholly or partly in the manufacture in the United Kingdom of electronic components, apparatus and equipment except for those used in the broadcast radio and television receiving industry and for public telephone services."

THIS news item impels us to redirect attention to the rift which appeared last year in the higher organization of our affairs when the E.E.A. decided to withdraw from the Radio Industry Council. As we see it, the situation at that time might be summarized as follows. Electronic engineering, which began as the application of radio-like methods and devices in fields other than communications, and was nurtured by the radio industry, had grown in stature until it equalled the domestic receiver industry in the gross value of its output and considerably exceeded it in the value of its exports. No doubt, like many a lusty youth, it thought its parents were at times dragging their feet when asked to support or partake in new adventures, and as often happens in such situations it finally decided to cut the apron strings and leave home. It is now flexing its muscles and proving its maturity and independence by forming a Council of friends of its own choosing.

But some of these friends, and in particular the R.E.C.M.F., still maintain close relations with both parties. Is there, in fact, any fundamental reason for the continued existence of two camps now that E.E.A. has asserted itself and, we hope, worked the hidden dissatisfactions out of its system?

Let us look a little more closely at the criteria which were advanced to differentiate the sheep from the goats when the breakaway took place last year. Essentially they were capital goods as distinct from consumer goods and entertainment as distinct from, let us say, utility.

Can a clear dividing line be traced on this basis? We think not. Television and sound broadcast transmitters are capital goods, but they also form an essential part of the domestic entertainment industry. Radar comes under the aegis of the E.E.A., but in our view inexpensive radar sets in quantity production for small vessels are consumer durables and no more capital goods than television sets.

In announcing the formation of the "Electronics Industry Council," the E.E.A. specifically excludes

manufacturers of public telephone equipment. But are not telephone exchanges looking to electronic rather than electromechanical methods for the future?

Why this tendency on the part of the E.E.A. to hive off sections of the industry? Surely it is as easy to find community of interest with those outside its fold as it might be to discover divergence among its present members and indeed between the sectional interests inside individual firms. There would seem to us to be fewer situations when common interest is likely to be evoked between the makers of radar equipment and broadcast transmitters than, say, between broadcast transmitter and receiver manufacturers. When any new system of transmitting stereo sound or colour television is being assessed the estimates of feasibility and cost of the receiver manufacturers are likely to carry more weight than those of the transmitter manufacturers. Already a community of interest between R.I.C. and E.E.A. (and presumably of E.I.C.) is admitted in negotiations involving frequency allocation and the siting of broadcast transmitters. Why must the Industry speak with two voices and expose a chink in its armour when opposed by skilful negotiators in matters affecting any part of its livelihood or the interests of its customers?

On the occasion of the initial split between R.I.C. and E.E.A. we took the view that the processes of association and dissociation are as fundamental to the growth of industrial organizations as they are to living organisms, and that such processes are often accompanied by growing pains. It is to be hoped that the phase of dissociation is now nearing its end and that the formation of the Electronic Industry Council in its present restricted form may be remembered as the turning point in the transition from dissociation to a wider association.

It may be a portent that Mr. L. T. Hinton, Chairman of the E.E.A., in speaking of the gross production of the Industry, was proud to give the figure of £475M, which includes the output of the makers of broadcast receivers and telecommunications equipment as well as the £200M accounted for by the capital goods side.

If B.R.E.M.A. and E.E.A. will stand together once again, and, with their many friends and relations, speak with one voice in all matters affecting the Industry, the title of its Council will be immaterial. But we hope the title will not be too long! In America there has always been only one association, which has remained cohesive while assimilating change. In 1957 its title had grown to the Radio-Electronic Television Manufacturers Association (R.E.T.M.A.), and would no doubt have added more letters as time went on had it not been then renamed the Electronic Industries Association (E.I.A.) to make it "more indicative of our expanding industry."

Further Thoughts on

Stereophonic Sound Systems

I.—RECENT EXTENSIONS OF BASIC THEORY

By D. M. LEAKEY,* Ph.D. (Eng.), B.Sc. (Eng.), D.I.C., A.C.G.I., Grad. I.E.E.

IN a previous article^{1,2} on stereophonic sound systems, experimental results were presented on which a practical stereophonic system could be based. Unfortunately, the results were rather limited and no theoretical justification was given. The purpose of the present article is to attempt to remedy this situation by briefly describing some of the results obtained during a more recent study of the subject†. Further accounts of the work can be referred to elsewhere^{3, 4, 5, 6, 7}. A brief analysis of present day two channel stereophonic systems is also included.

Before describing the results, it is first necessary to define the more important terms used. This is best done with the aid of what will be called a component signal diagram. Consider a subject listening to a single source as shown in Fig. 1(a). Unless the sound source is directly in front or directly behind the listener, the time of arrival of sounds at one ear will be different from the time of arrival of similar sounds at the other ear. This difference is referred to as the interaural time difference and can be depicted on a component signal diagram as shown in Fig. 1(b). The time axis is shown as going from left to right and the signals represented as arrows spaced by the appropriate interaural time difference T_a . If the sound source is assumed to be at an infinite distance away from the listener, and the influence of the head on the sound field is neglected, then the interaural time difference is given by:

$$T_a \approx \frac{h}{v} \sin \alpha \quad \dots \quad (1)$$

h = separation of ears
 v = velocity of sound.

In practice this equality becomes only an approximation, but is still sufficiently accurate for most purposes. More accurate expressions can be derived if required, but unfortunately, as the accuracy is increased, the equations become more cumbersome to handle. Note that interaural time difference can only be defined relative to features which are common to the signals at each ear. Thus, if the signals had not originated from the same source, or virtually identical sources, T_a could not be defined.

Besides the arrival time difference of the sound at the ears, the sound level at one ear is liable to be different from that at the other ear. This difference is termed the interaural intensity difference and is most significant at the higher audio frequencies, where the shadowing effect of the head becomes appreciable.

Paired source listening is depicted in Fig. 2(a). If the sound sources are radiating independent sounds,

a value of interaural time difference and interaural intensity difference can be assigned to each source separately, but little more. If, however, both sources are radiating the same sound, or practically the same sound, then further differences, termed interchannel differences, can be defined. In Fig. 2(b) is shown the component signal diagram for two sources, as shown in Fig. 2(a), radiating the same sound. Note that there are now effectively two signals to each ear, the "direct" signals A_L and B_R , and the "crossed" signals A_R and B_L , which are delayed by an amount T_a given by:

$$T_a \approx \frac{h}{v} \sin \theta \quad \dots \quad (2)$$

Three modifications to the diagram shown in Fig. 2(b) are important. Firstly, the effect of a difference in the signal levels from the two sources at the listening position can be illustrated as shown in Fig. 3. This difference is termed the interchannel intensity

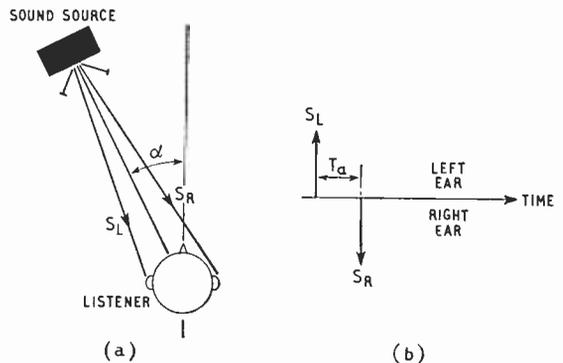


Fig. 1. (a) Single source listening. (b) Component signal diagram.

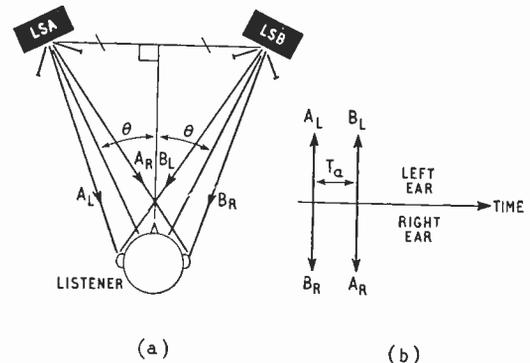


Fig. 2. (a) Paired source listening. (b) Component signal diagram.

*Research Laboratories of The General Electric Company Limited, Wembley, England.
 †This article includes material taken from a thesis by D. M. Leakey approved for the Ph.D., University of London.

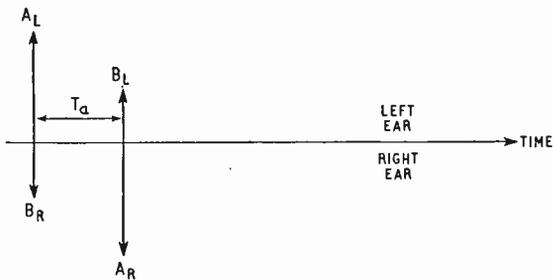


Fig. 3. Effect of interchannel intensity difference ($A > B$).

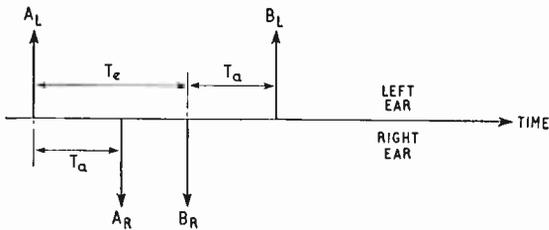


Fig. 4. Effect of interchannel time difference T_e .

difference and can be produced by adjusting the relative sound output levels from the sources. Note that an interchannel intensity difference does not produce simply an interaural intensity difference unless the "crossed" signals are absent. Secondly, there can be a difference in the time of arrival of similar sounds at the listening position from the sources. This difference is termed the interchannel time difference and can be represented as shown in Fig. 4. The time difference can be produced either by an electrical delay line, by staggered heads on a magnetic tape, or by actual movement of one of the loudspeakers radially away from the listener. The last method introduces an additional interchannel intensity difference. Again, an interchannel time difference does not produce only an interaural time difference unless the "crossed" signals are absent. The third effect is that due to a head rotation, that is, if the listener turns so that he is no longer facing the centre of the loudspeaker base line. The result of this movement is shown in Fig. 5. The new time differences T_M and T_N are given by:

$$T_M \approx \frac{h}{v} \sin \theta \cos \psi \quad \dots \quad (3)$$

$$T_N \approx \frac{h}{v} \cos \theta \sin \psi \quad \dots \quad (4)$$

where ψ = angle of rotation of head (+ve clockwise).

The approximations arise for the same reasons as those mentioned in connection with eqn. (1).

Other effects can be represented as combinations of the above three cases. For example, movement by the listener to an off-centre position produces an effective interchannel intensity difference, an effective interchannel time difference and an effective head rotation.

Although only two channel systems have been used to describe the terms employed, the system of representation is applicable to any number of channels. Reverberation and echoes can be represented as subsidiary sources with appropriate time delays, etc.

Throughout the article, almost exclusive use will be made of the term time difference, with little mention of the term phase difference. As has been stated previously¹, the term time difference has more direct application to normal complex sounds encountered in everyday life, whereas the use of the term phase difference is best limited to the more "ideal" waveforms such as single sine waves and other simple repetitive signals.

Test Procedure.—The experimental arrangement used was very similar to that employed previously¹, although the method of measurement was modified considerably^{3,6}. Basically, the listener was asked to compare the position of the stereo sound image with the sound image produced by a single reference loudspeaker, which could be placed in any of the positions V1 to V7 as shown in Fig. 6. The reference and stereo sound images were presented sequentially and the same sound was used for both sources. The listener was asked to decide whether the stereo sound image appeared to the left or to the right of the reference sound image. Many results were taken for each listener and for a given reference loudspeaker position, but with various values of interchannel intensity difference. From the analysis of the resulting left-right judgments, the particular value of interchannel intensity difference, for which the stereo sound image position was coincident with the reference sound image position, was determined. The test was repeated for each reference source (V1 to V7) and for each of several listeners.

Interchannel time difference could be introduced by moving one loudspeaker away radially from the listening position as illustrated in Fig. 6. To compensate for the reduced sound intensity level at the

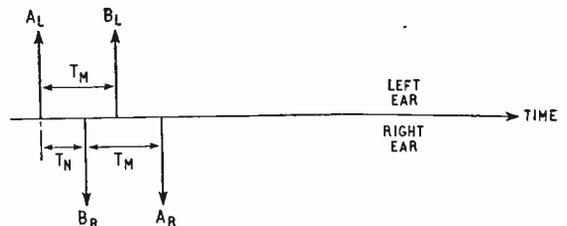


Fig. 5. Effect of head rotation.

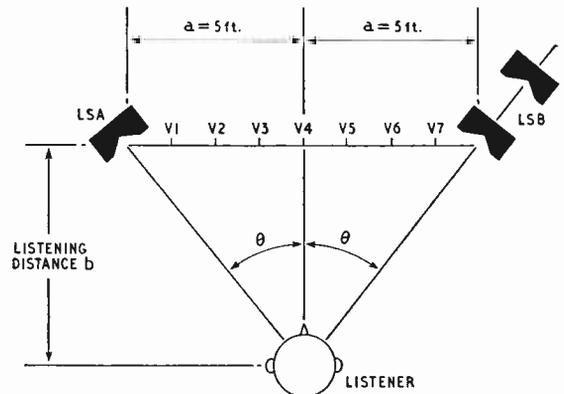


Fig. 6. Experimental arrangement showing method of introducing time difference.

listening position from the delayed channel, the gain of the amplifier in the delayed channel was suitably increased.

The types of sound used for the measurements included single- and two-component tones, wide-band speech, random noise, pulses, and speech, noise and pulses passed through octave wideband limiting filters.

Experimental and Theoretical Results.—The experimental results can be divided into two sections, as follows:

(1) Results obtained with the listener seated centrally. No interchannel time difference. Sound image controlled by interchannel intensity difference only.

(2) Results obtained with an interchannel time difference present, either as a result of off-centre listening, or as produced by radial movement of one of the loudspeakers.

Effect of Interchannel Intensity Difference Only.—In Fig. 7 is plotted a mean curve of sound image displacement against interchannel intensity difference, for low-frequency sounds in the range 250-500 c/s. The sounds used included band-limited noise, band-limited speech, band-limited pulses, single-component tone and two-component tones. The general results can be summarized as follows. The sound image displacement, for a given interchannel intensity difference, was, to a first approximation, independent of the nature of the sound, the sound level, and of the listener under test. The results were, however, very sensitive to a small displacement

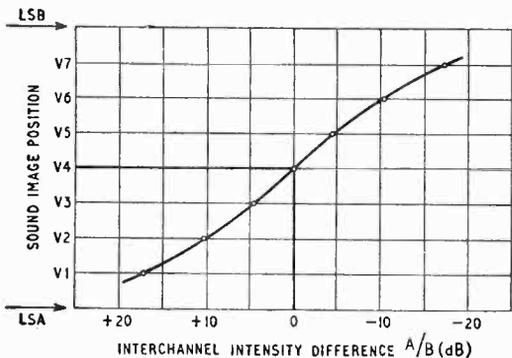


Fig. 7. Mean curve for sound image displacement with interchannel intensity difference. Low-frequency signals. Central listening position at a listening distance of 8ft.

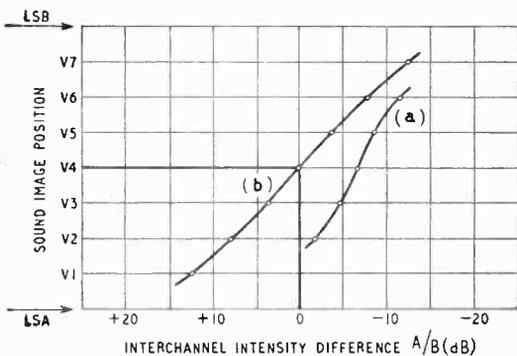


Fig. 8. (a) Effect of 6-in movement off-centre by the listener. (Curve plotted for movement to the left.) (b) Result obtained if listener only nominally central.

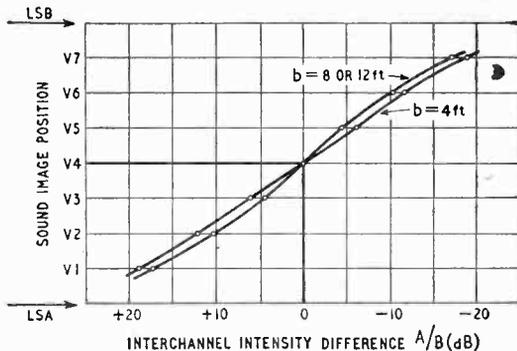


Fig. 9. Effect of variation of listening distance. (Note: curves for $b = 8\text{ft.}$ and $b = 12\text{ft.}$ are virtually identical.)

off-centre by the listener. The curve shown in Fig. 7 was for results when a headrest was in use, which limited side-to-side head movement. The result of a 6-inch head movement off-centre is shown in Fig. 8 together with a typical result obtained if the listener's head is only nominally central, but actually free to move randomly by quite a considerable distance off-centre. The curves in Fig. 8 were taken using band-limited noise. Different results are obtainable depending on the sound, the sound level, and the listener under test. Results which are independent of these factors, are obtainable *only* for "on-centre" listening.

The result of a variation in the listening distance is shown in Fig. 9. With small listening distances it was noted that the sound image appeared to become elevated to well above the level of the loudspeakers⁴.

Theoretical expressions can be derived which are in reasonable agreement with the practical results^{6, 7}. With reference to Fig. 3, the analysis for low frequency signals proceeds as follows. As shown in the Appendix, the two component signals, say at the left ear, can be considered to combine to form a single resultant signal, providing the component signal spacing T_a is small compared with the periodic time of the highest frequency component present. The resultant signal is in magnitude approximately equal to the sum of the individual components, but is in time delay relative to the first arriving component by an amount T_L such that:

$$T_L \approx \frac{B_L}{A_L + B_L} \cdot T_a \quad \dots \quad (5)$$

The approximation becomes more correct as T_a is reduced. At the right ear a similar result is obtained. The single resultant is in magnitude approximately equal to the sum of the separate component signals, and is in time delay relative to the first arriving component by an amount T_R such that:

$$T_R \approx \frac{A_R}{A_R + B_R} \cdot T_a \quad \dots \quad (6)$$

From eqns. (5) and (6) the value of the *interaural* time difference between the resultant signals at each can be calculated. To simplify the result, it is convenient to neglect the effect of the increased attenuation of the "crossed" signals relative to the "direct" signals, and to write:

$$A_L = A_R = A \\ B_L = B_R = B$$

With this approximation included, the resultant

interaural intensity difference is zero, and the resultant interaural time difference becomes:

$$T_B = T_B - T_L \approx \frac{A - B}{A + B} \cdot T_a \approx \frac{A - B}{A + B} \cdot \frac{h}{v} \sin\theta \quad (7)$$

To calculate the position of the resultant stereo sound image, the interaural time difference T_s is equated with the interaural time difference that would be produced by a single source at an angle α , as given by eqn. (1). Hence:

$$\frac{h}{v} \sin\alpha \approx \frac{A - B}{A + B} \cdot \frac{h}{v} \sin\theta$$

or

$$\sin\alpha \approx \frac{A - B}{A + B} \cdot \sin\theta \quad \dots \quad (8)$$

Although the agreement between eqn. (8) and the practical results is reasonable, the equation does not account for the apparent elevation of the sound image. Closer agreement, and an explanation for the apparent elevation, can be obtained if it is assumed that the brain is sensitive to interaural time difference and to the variation of interaural time difference with head rotation. This approach provides the modified result⁶:

$$\tan\alpha \frac{A - B}{A + B} \cdot \tan\theta \quad \dots \quad (9)$$

$$\cos^2\beta \approx \frac{A^2 + B^2 + 2AB\cos2\theta}{(A + B)^2} \quad \dots \quad (10)$$

where β = angle of elevation of sound image.

The foregoing practical results apply only if the loudspeakers are driven in phase. If the connections to one loudspeaker are reversed, the stereo sound

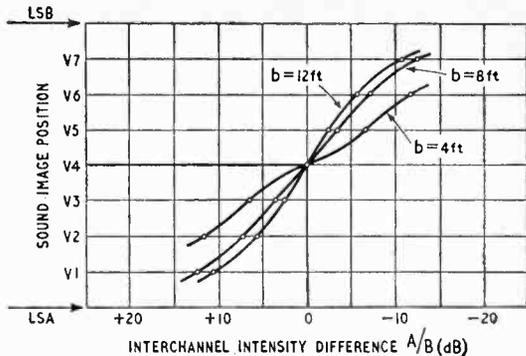


Fig. 11. Effect of interchannel intensity difference at high frequencies.

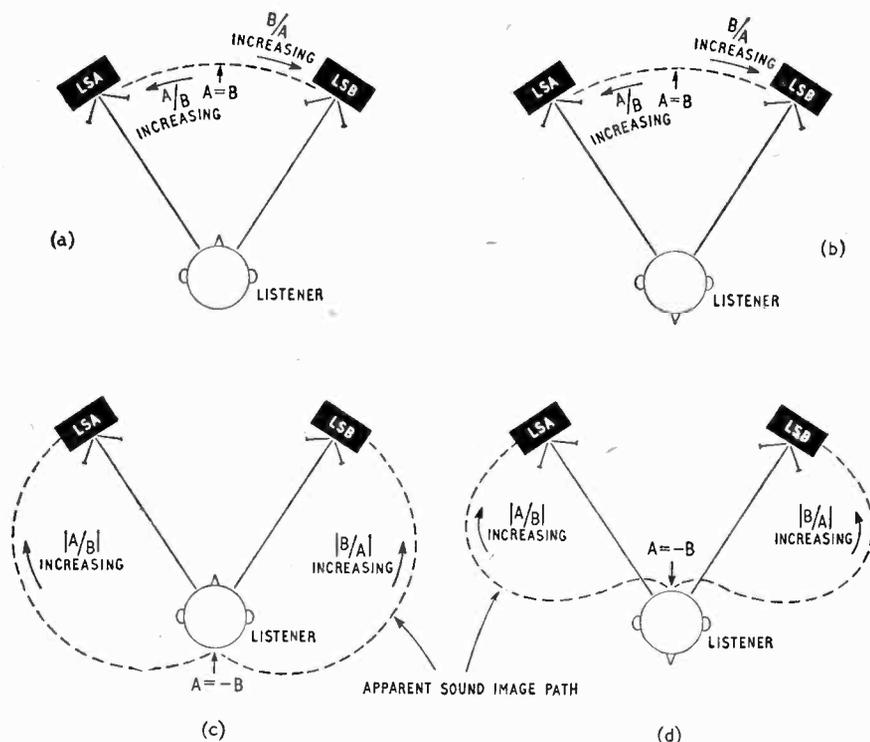
image no longer appears to move between the loudspeakers, but rather to move outside the loudspeaker base line. This is illustrated in Fig. 10 where the interesting modification resulting from a reversal of the listening direction is included. It is important to note that usually this effect is observed only with low-frequency signals, "on-centre" listening and in relatively echo-free conditions.

At high frequencies the curves shown for low-frequency sounds no longer apply. Again, however, the sound image displacement, for a given interchannel intensity difference is, to a first approximation, independent of the type of sound, and of the sound level, provided the sound is sufficiently complex. Single high-frequency tones give rise to results which vary widely and are not repeatable.

However, five closely spaced tones do provide a sufficiently complex signal to produce similar results to band-limited speech, noise and pulses. The mean curves for high frequency complex sounds, band limited to 2 kc/s to 4 kc/s are shown in Fig. 11.

The analysis as previously described cannot be extended unmodified to include the high-frequency case, as, in general, the component signal spacing is not small compared with the periodic time of the highest component frequency present. However, at high frequencies, the analysis still assumes that the brain is sensitive to interaural time difference, but the time difference of interest is that of the slowly varying "envelope" function of the sound waveform, rather than that of the fine detail^{3, 6, 7, 8}. The theory assumes that the fine detail of the component signals at an ear

Fig. 10. Effect of interchannel intensity difference. Low-frequency signals. (a) and (b) Loudspeakers driven in phase. (c) and (d) Loudspeakers driven out of phase.



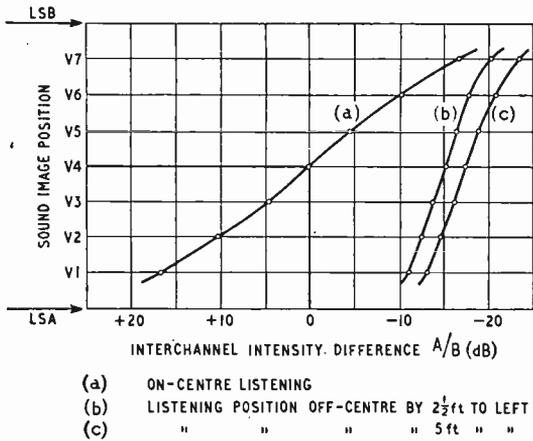


Fig. 12. Effect of off-centre movement by listener. Wide-band speech signal, $b = 8ft$.

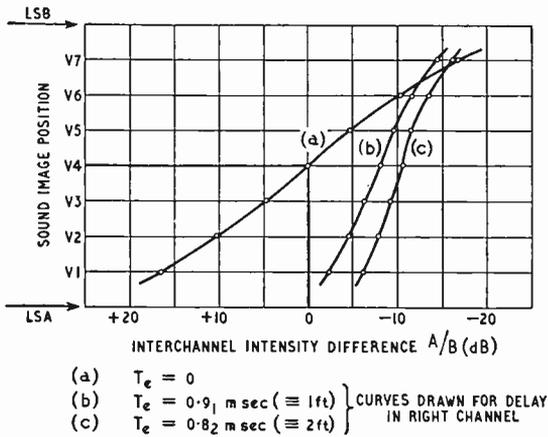


Fig. 13. Effect of interchannel time difference. Wide-band speech signal, $b = 8ft$.

add on an r.m.s. basis. Again, by using the Taylor Expansion Theorem, a single resultant is derived such that in magnitude it is equal to the r.m.s. sum of the individual components, and is in time delay relative to the first arriving component by an amount T_L (or T_R) such that:

$$T_L \approx \frac{B_L^2}{A_L^2 + B_L^2} \cdot T_a \quad \dots (11)$$

$$T_R \approx \frac{A_R^2}{A_R^2 + B_R^2} \cdot T_a \quad \dots (12)$$

Due to the appreciable shadowing effect of the head at the head at high frequencies, the increased attenuation of the "crossed" signals cannot be neglected. Providing the listener is seated symmetrically with respect to the loudspeakers (as in Fig. 2), then it can be assumed that the increased attenuation of the "crossed" signals is the same. Allowing for this attenuation by including a factor "m" so that:

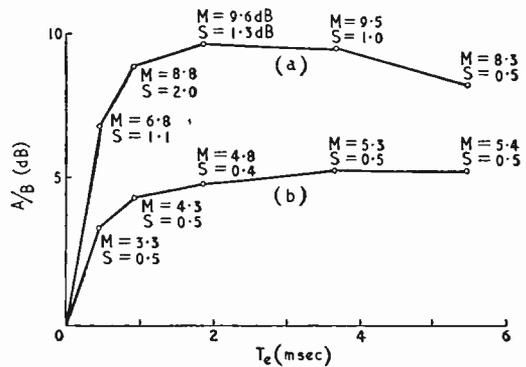
$$A_L = A, A_R = mA \quad (m < 1)$$

$$B_R = B, B_L = mB$$

then:

$$T_s = T_R - T_L \approx \frac{m^2 A^2}{m^2 A^2 + B^2} \cdot T_a - \frac{m^2 B^2}{m^2 B^2 + A^2} \cdot T_a$$

$$\approx \frac{m^2(A^4 - B^4)}{(m^2 A^2 + B^2)(A^2 + m^2 B^2)} \cdot \frac{h}{v} \sin \theta \quad (13)$$



M = MEAN (dB)
 S = STANDARD DEVIATION (dB) FOR 6 MEASUREMENTS
 (a) ON SUBJECT 1
 (b) ON SUBJECT 2
 250-500 c/s BAND-LIMITED NOISE
 Fig. 14

Figs. 14, 15 and 16. Examples of numerical equivalence between interchannel time difference and interchannel intensity difference.

Equating this time difference to that produced by a single source at an angle, gives the final result:

$$\sin \alpha \approx \frac{m^2(A^4 - B^4)}{(m^2 A^2 + B^2)(A^2 + m^2 B^2)} \cdot \sin \theta \quad (14)$$

If the increased attenuation of the "crossed" signals is neglected (i.e. $m = 1$) then:

$$\sin \alpha \approx \frac{A^2 - B^2}{A^2 + B^2} \cdot \sin \theta \quad \dots (15)$$

Equations (14) and (15) correspond with eqn. (8) in the low-frequency analysis. High-frequency equivalents to eqns. (9) and (10) can be derived, but the analysis is tedious and the result too cumbersome for normal use.

It will be noted that in eqns. (8) and (9) the sound levels from the loudspeakers occur only in the "squared" form. This would suggest that phase reversal of one channel would have little effect on the results. This conclusion is found to be correct, providing the listening angle θ is large, or the phase matching of the loudspeakers is poor. These conditions ensure virtually r.m.s. addition of the fine detail of the sound waveforms at the ears. With the listening angle θ small and with very accurately matched loudspeakers, the results tend to be similar to those obtained at low frequencies.

Effect of Interchannel Time Difference.—The effect of off-centre movement by the listener is illustrated in Fig. 12 for wide-band speech. The results are very dependent on the type of sound, the sound level, and the listener. Also, the sound image position becomes very badly defined, although consistent results can still be obtained for a given listener and a given sound at one level.

A simple computation indicates that in most cases the changes in the curves produced by off-centre movement are due largely to the effect of interchannel time difference thereby introduced. This can be seen by noting the similarity of the curves with those shown in Fig. 13, where the effect of introducing only an interchannel time difference is shown. The curve with no interchannel time difference is shown for comparison.

As the interchannel time difference is increased beyond about 2 millise., the measurement tends to

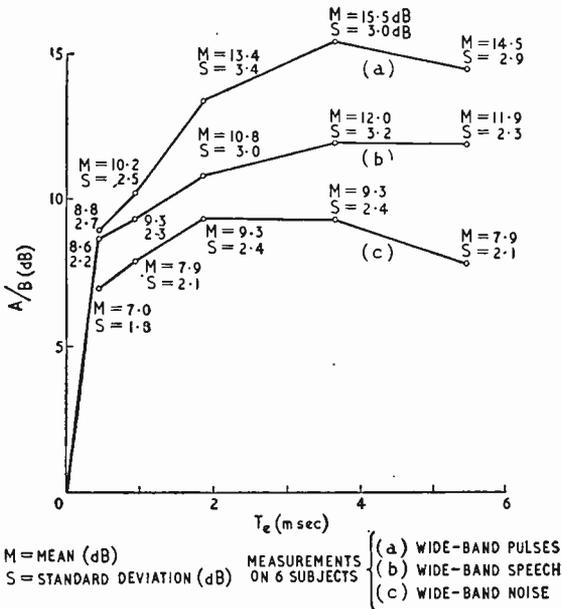


Fig. 15

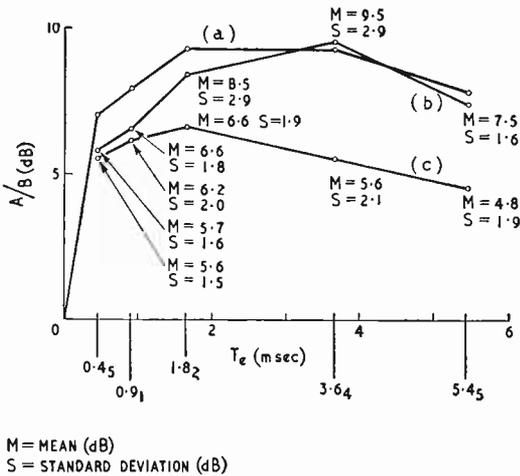


Fig. 16

degenerate into deciding which loudspeaker is radiating the louder sound. Hence, although curves of the form shown in Fig. 13 can be plotted for any value of interchannel time difference, the significance of the results becomes increasingly uncertain as the interchannel time difference is increased. In view of this fact, the method of presenting the results is best modified as follows. If a given interchannel time difference is introduced, the sound image tends to move towards the time leading channel. By means of an opposing interchannel intensity difference the sound image can be returned to a central position. Hence an equivalence of the interchannel time difference with interchannel intensity difference can be defined. This equivalence, besides being of importance in the evaluation of stereophonic sound

systems, is also of interest in the design of sound reinforcement systems.:^{9, 10.}

For the present purposes, only interchannel time delays of up to about 5 millisecc. are of interest, as beyond some 5-10 millisecc. the impression of a single locatable sound image as distinct from some "etherial" source, is almost entirely lost. Some typical results for this type of measurement are shown in Figs. 14, 15 and 16. The general findings can be summarised as follows:

(a) For a given sound level and given listeners, the necessary interchannel intensity difference, to compensate for a given interchannel time difference, is very dependent on the nature of the sound, being greatest for sounds with transient characteristics, such as pulses, and almost zero for single component tones.

(b) For a given sound and given listeners, the necessary interchannel intensity difference, to compensate for a given interchannel time difference, is very dependent on the sound level above the ambient noise level, and decreases as the overall signal level above threshold decreases.

(c) For a given sound at a given level, the necessary interchannel intensity difference, to compensate for a given interchannel time difference, varies widely between listeners, although it appears to stay constant for a given listener.

(d) The equivalence is hardly effected by the listening angle θ especially for interchannel time delays of about 2 millisecc. or more.

(e) The equivalence is virtually unaffected by a phase reversal of one channel especially for interchannel time delays of about 2 millisecc. or more.

(f) The necessary compensating interchannel intensity difference reaches a maximum for a value of interchannel time difference of about 2 millisecc.

It is important to note that the above equivalence is not the only possible one. Another equivalence arises as follows. The position of the stereo sound image can be controlled by interchannel time difference only as illustrated in Fig. 17. Unfortunately, the curve is rather uncertain as it depends on the sound level, the listener under test, and the type of sound. However, an equivalence can be postulated by equating those values of interchannel time and intensity difference for which the same sound image

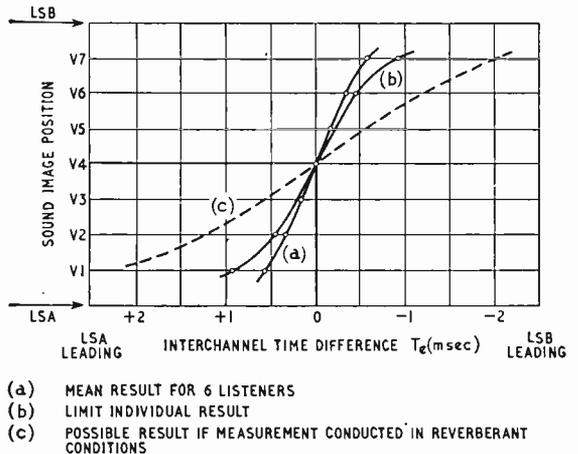


Fig. 17. Movement of sound image by interchannel time difference. Wide-band speech signal.

AUDIO FAIR

Exhibitors and Convention Speakers

A RECORD number of exhibitors are participating in this year's London Audio Fair which opens at the Hotel Russell, Russell Square, W.C.1, on April 21st for four days. As will be seen from the list of exhibitors below, there are a number of overseas audio manufacturers who have taken space. All but nine of the 74 exhibitors have booked rooms for demonstration purposes in addition to exhibiting in the main hall. The Fair is open daily from 11.0 to 9.0, but on the first day admission up to 4.0 is limited to the trade.

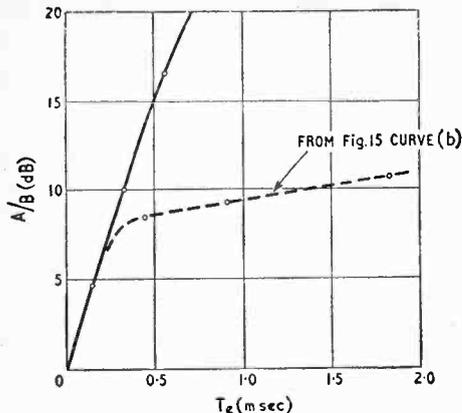


Fig. 18. Alternative interchannel time—intensity equivalence.

displacement is obtained¹¹. This equivalence is very different from that previously defined as is shown in Fig. 18.

APPENDIX

With reference to Fig. 3, express the signals at the left ear as:

$$A_L f(t) \text{ and } B_L f(t - T_a)$$

where A_L and B_L are the amplitude terms, and $f(t)$ represents any function of time. The resultant signal at the left ear S_L is given by:

$$S_L = A_L f(t) + B_L f(t - T_a) \quad \dots \quad (16)$$

By the Taylor Expansion Theorem:

$$S_L = A_L f(t) + B_L f(t) - B_L T_a f'(t) + \frac{1}{2} B_L T_a^2 f''(t) \dots \text{etc.} \quad \dots \quad (17)$$

Neglecting the terms involving T_a^2 and higher powers of T_a (this is reasonable providing T_a is small compared with the periodic time of the highest component frequency present), then:

$$S_L \approx (A_L + B_L) \left[f(t) - \frac{B_L}{A_L + B_L} T_a f'(t) \right] \quad \dots \quad (18)$$

But $f(t) - \frac{B_L}{A_L + B_L} T_a f'(t)$ are the first two terms in the

Taylor expansion of: $f \left[t - \frac{B_L}{A_L + B_L} T_a \right]$

Hence:

$$S_L \approx (A_L + B_L) f \left[t - \frac{B_L}{A_L + B_L} T_a \right] \quad \dots \quad (19)$$

REFERENCES

- 1 Brittain, F. H. and Leakey, D. M., 1956, *Wireless World*, Vol. 62, No. 5 (May 1956).
- 2 Brittain, F. H. and Leakey, D. M., 1956, *Wireless World*, Vol. 62, No. 7 (July 1956).
- 3 Leakey, D. M. and Cherry, E. C., *J.A.S.A.* Vol. 29, p. 284 (1957).
- 4 Leakey, D. M., *J.A.S.A.*, Vol. 29, p. 966. (1957).
- 5 Leakey, D. M., Sayers, B.McA., and Cherry, E. C., *J.A.S.A.*, Vol. 30, p. 222 (1958).
- 6 Leakey, D. M., *J.A.S.A.*, Vol. 31, p. 977 (1959).
- 7 Leakey, D. M., B.S.R.A. Stereo Symposium Oct. 1959.
- 8 Licklider, J. C. R. and Webster, J. C., *J.A.S.A.*, Vol. 22, p. 191 (1950).
- 9 Haas, H., *Acustica*, Vol. 1, p. 49 (1951).
- 10 Parkin, P. H. and Scholes, W. E., *Wireless World*, Vol. 57, No. 2 (Feb. 1951).
- 11 de Boer, K., *Philips Technical Review*, Vol. 5 (1940).

(To be concluded)

- AKG (Austria)
- Acoustical Mfg. Co.
- Amateur Tape Recording
- Ampex International (Switzerland)
- Armstrong Co.
- Audio Fidelity (England)
- BASF (Germany)
- B.B.C.
- B.S.R.A.
- Beam-Echo
- Brenell Engineering Co.
- British Ferrograph
- Butoba K.G. (Germany)
- Celestion
- Challen Instrument Co.
- Chapman (Reproducers)
- Chitnis, Gopal (Germany)
- Cole, E. K.
- Cosmocord
- Decca
- Design Furniture
- Dynatron
- E.A.P. (Tape Recorders)
- E.M.I. Records
- E.M.I. Sales & Service
- Electronic Reproducers
- Fi-Cord
- G.E.C.
- Garrard Engineering
- Goldring Manufacturing Co.
- Goodmans Industries
- Gramophone Co.
- Gramplan Reproducers
- Grundig (Great Britain)
- Hi-Fi News
- Jason Motor & Electronic Co.

- Leak, H. J. & Co.
- Lowther Mfg. Co.
- Lustraphone
- M.S.S. Recording Co.
- Minnesota Mining & Mfg.
- Mullard
- Multimusical
- Orr Industries (U.S.A.)
- Pamphonic Reproducers
- Pye
- Pye Records
- Rank Cintel
- Record Housing
- Recording Devices
- Redifon
- Resolound
- Rogers Developments
- S.T.C.
- Shure Brothers (U.S.A.)
- Simon Equipment
- Specto
- Sugden & Co.
- Tannoy Products
- Technical Suppliers
- Telefunken (Germany)
- Teppaz (France)
- The Gramophone
- Trix Electrical Co.
- Truvox
- Veritone
- Vortexion
- W. & N. Electronics
- Walter Instruments
- Wellington Acoustic Labs.
- Wharfedale Wireless
- Whiteley Electrical
- Wireless Trader
- Wireless World

Tickets admitting two to the Fair are obtainable free from audio dealers, exhibitors and *Wireless World*. Postal applications to this office for tickets should include a stamped addressed envelope.

The British Sound Recording Association is organizing a technical convention in conjunction with the Audio Fair. It opens on Friday, April 22nd with an evening meeting at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2, at which J. Moir (Goodmans) will speak on sound radiation from loudspeaker cabinets. On Saturday the 23rd, there will be a whole day's meeting starting at 10.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. At the morning session Peter Ford, honorary historian of the Association, will speak on the evolution of stereophonic techniques and Herrmann K. F. Juncke (Telefunken, Hanover) on progress in tape recording. In the afternoon from 2.0 G. D. Browne (Mullard) will read a paper entitled "A new system of stereophonic broadcasting" and Fritz Ph. Sippl (AKG, Vienna) will deal with new microphone developments. In the evening at 7.0 at the Tower, Hammersmith Broadway, London, W.6, a lecture demonstration on stereophonic sound in the cinema will be given by RCA (Great Britain). The registration fee for the convention for non-members is 10s. Applications should be sent to S. W. Stevens-Stratten, Greenways, 40 Fairfield Way, Ewell, Surrey.

At the Audio Fair the B.S.R.A. is organizing a display on the theme "Sound in the Service of Man."

Long-Distance Communication

Possible Use of Earth Satellites

By R. J. HITCHCOCK,* M.A., A.M.I.E.E.

ALTHOUGH the frequency allocation table in the new Geneva Radio Regulations covers nearly 40,000 Mc/s, little more than one two-thousandth of this is suitable for world-wide communications at present. With two relatively minor exceptions (long waves and ionospheric scatter) it is within the high-frequency portion of the spectrum, between 3 and 30 Mc/s, that the commercial operators, Armed Forces, broadcasting authorities, ships and aircraft stations of all nations must find allocations if they are to provide and maintain world-wide services by radio. For this, with the exceptions mentioned above, is the only portion of the spectrum where ionospheric reflections support long-distance propagation.

The astonishing growth in the number of world-wide telecommunication circuits since the end of the second world war has been partly due to a natural increase in consumer demands, viz. telex, customer-to-customer leased channels, etc., and partly to the decentralization of global communications following the emergence of new countries. This increase in the utilization of frequencies has had its greatest effect in the bands allocated to the Fixed† services and broadcasting. In the 50 kc/s between 9100 and 9150 kc/s (Fixed services) there were, in 1939, fewer than 40 registrations; by 1952 this number had grown to nearly 340, and by 1959 to over 540. Although there is less numerical congestion in the higher part of the h.f. band the proportional increase has been scarcely less startling. In the 15 Mc/s Fixed service bands, for instance, there are now 7 registrations for every one in 1939. This, however, is only part of the story, for in the last decade multichannel techniques have become commonplace in both telegraphy and telephony, and although such techniques offer much greater traffic-carrying capacities, they also demand greater bandwidths. Broad-band registrations, therefore, constitute a considerable portion of the present International Frequency List.

For the Fixed services in particular the process of finding a place in the spectrum has virtually degenerated into a struggle in which power and

continuity of transmission are all important and, although some vestiges of order continue to be maintained through the International Telecommunication Union, it would be pure idealism to expect the spectacular from a body with no supra-national authority. In fact, so concerned were the delegates at the recent Geneva conference at the congestion in this part of the spectrum that they resolved to set up an international Panel of Experts with the task of devising "ways and means of relieving the pressure on the bands between 4 and 27.5 Mc/s." In drawing up this resolution the delegates were not unaware that the true effects of the congestion have yet to be seen. In fact, they will not be apparent until the next sunspot minimum, some three or four years hence, when a reduction in the reflecting properties of the ionosphere at higher frequencies will still further increase the congestion in the lower part of the h.f. band.

The question facing telecommunications operators, therefore, is how are long-distance services to be maintained and new ones provided for, if the only section of the radio-frequency spectrum *naturally* suitable to them is virtually saturated. At present, the answer is found by looking to systems other than radio and, in the Commonwealth in particular, great emphasis has been placed on the potentialities of the coaxial submarine telephone cable. Although expensive in initial capital outlay, and not immune from physical interruptions, such cables can provide numerous speech channels of far higher quality than can be obtained with conventional radio techniques where ionospheric propagation introduces distortion and fading. However, it is not intended here to discuss the relative merits of radio and cable systems, but to see how, when one radio resource is nearing exhaustion, a new one capable of carrying the vast world-wide traffic potential may be built up.

If the general propagation characteristics of the main radio communication techniques now available are considered in simplified relation to one another, it is evident that no single one is capable of meeting all the essential requirements.

Rough though the classification in Table I is, it is apparent that, with present techniques, range is only

TABLE I
LONG DISTANCE COMMUNICATIONS

Technique	Range	Bandwidth	Reliability
H.F.	Yes	No	Insufficient
Line-of-sight v.h.f.	No	Possibly insufficient	Yes
Ionospheric scatter	Insufficient	No	Yes
Line-of-sight u.h.f.	No	Yes	Yes
Tropospheric scatter	Insufficient	Yes	Yes
s.h.f. etc.	No	Yes	Yes

* Cable & Wireless Ltd.

† A radiocommunication service between specified fixed points.

obtainable when using frequencies below 30Mc/s and bandwidth on frequencies above 300Mc/s. Little can be done to increase available bandwidth in the lower frequency bands, and even if this were practicable the quality afforded by ionospheric propagation is probably inadequate for many future telecommunication needs. It is, therefore, towards increasing the transmission ranges at higher frequencies, where the ionosphere plays little or no part, that efforts must be directed. With propagation in this part of the spectrum limited to "line of sight" we must look for possible means of extending this to extend the communication range. Extra terrestrial relay points provide the solution.

Much has been said and written recently, particularly in the United States, on the use of earth satellites for world-wide communications, but it was in this journal nearly fifteen years ago that A. C. Clarke¹ first drew attention to the potentialities of such systems. Clarke, in fact, suggested what is still regarded by many to be the ultimate in communication satellites, one in 24-hour "stationary" orbit carrying both receiving and transmitting equipment. In the intervening years developments in rocket techniques and space conquest have produced other ideas, and it is proposed here to consider all such possibilities with their relative advantages and disadvantages from the communications point of view.

An extra terrestrial relay point may be either natural or artificial, active or passive. The first, of course, is the moon, and successful intercontinental transmissions, using that body as a passive relay point, have already been made. There are, however, obvious disadvantages. Not only does the great distance earth/moon/earth result in relatively high path losses and excessive transmission time for two-way telephony, but the moon's transit across the sky makes continuous transmission between any two earth locations impossible. The main advantage is, of course, that the moon is already in orbit—permanently we presume—and, therefore, the problems are confined to radio engineering rather than to space techniques and rocketry.

There are three general ways in which artificial satellites may be used to further communications:

- (1) Storage in low-level orbits (active).
- (2) Direct communication in higher orbits, say, 3,000 miles (active or passive).
- (3) Direct communication in "stationary" or 24-hour orbits (active or passive).

Of these the simplest but probably the least potentially useful for the future is the first. Here the information is received and recorded by the satellite as it passes over one earth station and retransmitted as it passes over another. This is, so far, the only method to have been proved experimentally. It will be recalled that a "talking" satellite carried President Eisenhower's 1958 Christmas message to the world. A few watts from a non-directive aerial is all that is necessary to transmit the message to receivers on the ground and a few hundred watts on the ground is sufficient to interrogate the satellite. Although there is only limited enthusiasm for this particular technique it is worth recording that under the U.S. project "Courier" it is proposed to launch, in the course of the year, a 500lb storage or delayed action satellite with a capacity of twenty 100-word-per-minute teleprinter channels. The storage satellite is essentially a relatively low-level body and to achieve worth-while *direct* trans-oceanic communication, satellites at much higher altitudes would be needed. The second of the three ways, i.e., higher level orbiting offers this possibility.

With an orbit height of, say, 3,000 miles (an orbit time of 3 hours) a satellite would "see" a substantial part of the earth's surface, but communication between specific earth points could only be intermittent as the duration of visibility at any terminal would be little more than 30 minutes at the most. If, however, a sufficient number of satellites could be provided at this height a virtually continuous service over a 2,500-mile earth path could be achieved (Fig. 1).



Fig. 1. Round-the-world communication by passive satellites in 3,000-mile polar orbits.

¹ A. C. Clarke, "Extra-Terrestrial Relays," *Wireless World*, October, 1945.

Theoretically, of course, such bodies could be either active, i.e., contain their own relay stations, or passive, acting merely as reflectors. To be economic any active system would need to provide linearity over a wide bandwidth and years of continuous operation.

Current hopes are therefore being placed in the passive system on which Pierce² has done much theoretical work. The simplest reflector is a metallized balloon and Pierce has calculated that, with 28 such bodies randomly spaced in 3,000-mile polar orbits, communication could be achieved over a transatlantic path between Newfoundland and the Hebrides with a continuity of service of 99.9%. The first experiments along these lines are also due to begin this year when, under U.S. project "Echo," a 100ft inflatable satellite of 0.0005in-thick Mylar plastic coated with vapour deposited aluminium will, it is hoped, be put into orbit. §

What are the advantages and disadvantages of such a system? In the first place the repeaters or relay points are themselves simple, as they carry no electronic equipment and should be capable of a relatively long life even in the face of micrometeorite perforations. While a passive orbiting system has the advantage of using less frequency space than an active one—and, of course, it might well be used by any number of organizations, each with its own operating frequency—it has the disadvantage that, compared with an active system, more powerful and complex ground stations equipped with large steerable aerials and maser amplifiers are essential. Furthermore, as each satellite must be found and tracked, these very large aerials would need to switch rapidly from one satellite to another if a continuous circuit were to be maintained. The most intriguing prospect, therefore, and the third of the possible methods, is the relay satellite which remains stationary, i.e., in 24-hour orbit, over one point of the earth's surface. The major problem facing such a system is that of attitude and altitude stabilization, for to be completely stationary relative to the ground a satellite needs to be 22,300 miles above the earth's surface and in a circular equatorial orbit. Theoretically, it could be either an active or passive body but, in practice, the latter technique would require a sphere several thousands of feet in diameter and weighing many tons. Although passive reflectors other than spheres may be developed, the relatively long transmission distances involved suggest that an active satellite carrying its own receiving and transmitting equipment would be preferable.

As to the number of such satellites required for world-wide communications, three equally spaced would be visible from some 98% of the earth's surface with the north and south limits of visibility at 62° of latitude for a 5° ground horizon (Fig. 2).

This, then, is the ultimate system and the one envisaged by Clarke 15 years ago. It has the one disadvantage that the transmission distance produces time delays of the order of a quarter of a second which would be noticeable, and possibly objectionable, in two-way telephony conversations. Such a system, however, would be ideal for providing other forms of world-wide broad-band communi-

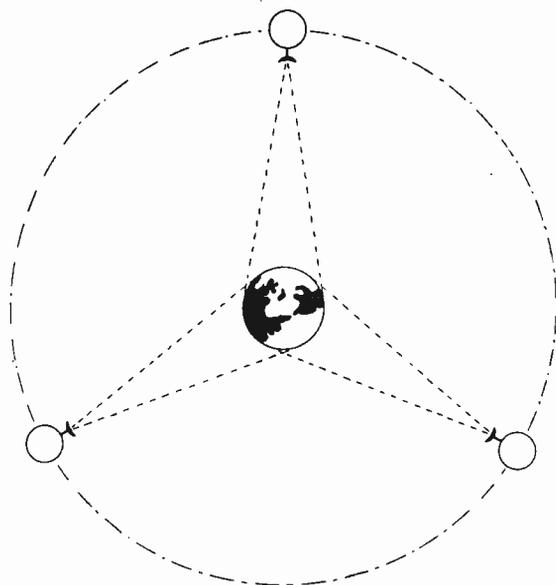


Fig. 2. World-wide communication by active "stationary" 24-hour satellites in equatorial orbits.

cations, including, of course, television broadcasting.

Having started with the frequency problems of the h.f. band it is probably fitting to make some mention, at this stage, of the frequency problems facing commercial communication satellite systems. From a propagation aspect the usable frequency range must be such as to avoid the effects of both the ionosphere and cosmic noise at the lower end of the spectrum, and of atmospheric absorption and radio noise from oxygen and water vapour at the upper end of the spectrum. This leaves a usable frequency range extending from approximately 1,000 to 10,000 Mc/s with the optimum, according to Pierce, between 2,000 and 6,000 Mc/s. Of equal importance is the question of allocations for practical satellite systems within the optimum band. For the first time the International Frequency Allocation Table includes allocations for space and earth-space systems, but as yet these are relatively narrow bands intended for research purposes only. However, one of the recommendations of the Geneva Conference was that a further Extraordinary Conference should be called in 1963 to examine the progress in space communications, and if necessary to make broad-band allocations for world-wide communications.

With the move towards very wideband and high-quality communication systems, long-distance operators, both civil and military, can no longer expect conventional h.f. radio to provide the medium of transmission. The future can only lie in the higher bands of the spectrum. The first break through into truly long-distance commercial u.h.f./s.h.f. propagation is likely to be achieved in the relatively near future with passive reflectors circling the earth in orbits of a few thousand miles allowing communication between interlinked ground stations. Finally, the ultimate system of stationary, 24-hour satellites with their own receiving and transmitting equipment acting as world-wide repeaters, navigational aids, etc., although obviously further away, is already in the project stage.

² J. R. Pierce and R. Kompfner, "Transoceanic Communications by Means of Satellites," *Proc.I.R.E.*, March, 1959.

§ As a prelude to this project balloons have been used as passive reflectors to relay transmissions from the Bell Telephone Laboratories, at Holmdel N.J., to the Massachusetts Institute of Technology.—Ed.

WORLD OF WIRELESS

Unfair Competition?

THE possibility that Government support for the reorganized civil aircraft industry, which has recently shown a tendency to diversify into electronics, might be construed as indirect and unfair competition with the established electronic industry, was mentioned by L. T. Hinton, chairman of the Electronic Engineering Association at their annual luncheon.

The principal guest, the Rt. Hon. Duncan Sandys, Minister of Aviation, in his reply, said that Government policy was to maintain an efficient capacity for aeronautical equipment production and that while it was not his policy to encourage airframe constructors to go into electronics, neither would he do anything to prevent them, provided that they did so at their own risk and expense. The Government's objective was to obtain equipment at the lowest cost, and this would determine the placing of contracts.

Technical Writing Awards

UP to six premiums of 25gn each are awarded by the radio and electronics industry each year for published technical articles to encourage a greater flow of material from within industry and thereby to make more widely known technical progress in this country. The scheme is now jointly sponsored by the Radio Industry Council and the Electronic Engineering Association, and the members of the present panel of judges are:—Professor H. E. M. Barlow, B. C. Brookes, P. D. Canning, A. H. Cooper, The Hon. John Geddes, F. Jeffery and Dr. R. C. G. Williams.

A total of 63 articles published during 1959 were submitted and premiums have been awarded to the following authors:—

A. E. Karbowiak ("Waveguide as a Long-distance Communication Medium," *Electronic Engineering*).

T. G. Thorne and J. A. Billings ("The Performance of Doppler Navigation Systems," *British Communications and Electronics*).

C. M. Cade ("Infra-red Navigation Aids," *British Communications and Electronics*).

R. Rowland ("Printed Circuits Applied to Broad-band Microwave Links," *Electronic Engineering*).

D. A. Wright ("Compound Semiconductors," *Electronic Engineering*).

R. J. D. Reeves ("The Recording and Collocation of Waveforms," *Electronic Engineering*).

A.P.A.E. Exhibition

MORE than twenty firms supported the exhibition of equipment which took place at the King's Head Hotel, Harrow-on-the-Hill, on March 9th. This was the occasion of the 10th annual luncheon of the Association of Public Address Engineers, at which the guest of honour was the Rt. Hon. Ernest Marples, Minister of Transport, who is the first recipient of the Association's Gold Microphone (donated by L. W. Murkham) for the "best microphone user of the year."

At the general meeting which followed, Haydon Warren was elected president for 1960. Mr. Warren, who is also hon. librarian of the Association and has many U.S. contacts, arranged an interesting historical collection of early p.a. equipment and literature from both sides of the Atlantic.

B.B.C. Income

UNDER a three-year agreement (1957-60) the B.B.C. receives annually 87.5% of the receiving licence revenue after the deduction of a sum by the Post Office for the service it provides in collecting licence fees and investigating interference. The remaining 12.5%, plus the £1 excise duty on the combined sound/television licence, is passed to the Treasury. There is a proviso in the agreement under which additional sums can be paid to the B.B.C., if the Treasury is satisfied that the income is "insufficient for the adequate conduct of the home services"*

In response to representations by the B.B.C., the Treasury reduced to 7.5% the proportion of the licence income it is retaining in the financial year 1959/60 leaving 92.5% for the B.B.C. The P.M.G. announced in the House of Commons on March 11th that the Corporation's income will be still further increased to 95% in 1960/61 and in 1961/62 to 100% of the net licence revenue, that is, after the Post Office deduction and the Treasury's retention of the excise duty. The following figures, taken from the "B.B.C. Handbook 1960," show how the gross licence revenue of £42M in 1958/59 was apportioned—B.B.C. (£27M), Treasury (duty £9M, 12.5% retention, £4M), Post Office (£2M).

* External services are financed by grants-in-aid from the Treasury, which in 1958/59 totalled some £6M.

Receiving Licences.—During January the number of combined television/sound licences throughout the U.K. increased by 105,448, bringing the total to 10,219,867. Sound-only licences totalled 4,679,755, including 415,230 for sets fitted in cars. Recently announced figures for other European countries are: Holland: sound, 2,612,000; television, 610,000; and subscribers to wired services, 489,737. Norway: sound, 1,008,000; television, 10,000, although the Norwegian television service does not officially open until later this year.

Boston Television Relay.—Multisignals (Boston) Ltd. have put into operation a "wired aerial" service for television and v.h.f./f.m. in Boston, Lincs., serving initially some 700 subscribers. Using E.M.I. equipment, the installation is being extended to cover the major part of Boston. This is the first installation under the aegis of the parent organization, Multisignals Ltd., which is sponsored by three companies, Ekco, Thorn and Ultra, in co-operation with the R.T.R.A.

Standards for Audio Connectors have been published by the Audio Manufacturers' Group of B.R.E.M.A. in a free booklet entitled "Recommended Standard Practice for Plugs, Sockets & Connectors for use with Audio Amplifying Equipment." The suggested standards are designed to facilitate the interconnection of units made by different manufacturers and apply only to equipment in which the chassis is isolated from the mains by a double-wound mains transformer.

Home Construction.—Entries from non-members as well as members are invited by the British Sound Recording Association for this year's Home Constructors' Competition. Apparatus submitted for the competition should be associated with the recording and reproduction of sound, including appropriate test equipment. Exhibits will be judged on May 21st on the score of technical originality, suitability of purpose, design and finish. Application forms may be obtained from the B.S.R.A., 40 Fairfield Way, Ewell, Surrey.

Education and Training.—Reference was made at the annual luncheon of the Electronic Engineering Association to the formation of the Electrical and Electronic Manufacturers' Joint Education Board, which replaces what was previously known as the Electrical Industries' Education Board. The founder members are: B.E.A.M.A., B.R.E.M.A., B.V.A., E.E.A., R.E.C.M.F., S.I.M.A. and T.E.M.A. The secretariat is being provided by B.E.A.M.A. and Colonel B. H. Leeson has been elected chairman.

I.F.A.C.—The first international congress on automatic control will be held in Moscow from June 27th to July 7th under the auspices of the International Federation of Automatic Control. Twenty countries are participating and in all nearly 300 papers will be presented. Twenty-eight papers have been selected as the British contribution. They will be read again in this country in September. The U.K. delegation is to be led by John F. Coales, of Cambridge University, who is a member of the executive council of the I.F.A.C.

Moscow Exhibition.—Thirty-four British scientific instrument manufacturers are holding a collective exhibition in Moscow from June 18th to 29th. It is being organized by the Scientific Instrument Manufacturers' Association.

Electronic Equipment Reliability.—Methods of assessing and predicting the reliability of electronic equipment, as well as experience gained in the use of equipment, will be covered during a one-day symposium to be held in London on May 18th. Further details and registration forms are available from the I.E.E., Savoy Place, London, W.C.2.

Components and Materials.—Preliminary details of a conference on components and materials used in electronic engineering to be held next year from June 12th to 17th have been announced by the Electronics and Communications Section of the I.E.E. The scope of the conference falls under three main headings: (a) materials, their preparation, properties and applications; (b) components, excluding thermionic and semiconductor devices; and (c) assembly techniques.

Audio Shows.—Independent exhibitions are being staged by two manufacturers during the London Audio Fair (see page 160). Sound Sales Ltd. will be in the Club Room, Imperial Hotel, Russell Square, W.C.1, and Daystrom (Heathkits) at the Grand Hotel, Southampton Row, W.C.1.

B.V.A. and V.A.S.C.A. Move.—The offices of the British Radio Valve Manufacturers' Association and the Electronic Valve and Semi-conductor Manufacturers' Association have been transferred from Jermyn Street to Mappin House, 156-162 Oxford Street, London, W.1 (Tel.: Langham 8562).

"How Long Will a Transistor Live?"—In case it may not have been obvious from the footnote on p. 108 of this article in our March issue we would point out that the author, Ralph Brewer, is with the Research Laboratories of the General Electric Company Limited, Wembley, England.

E.E.A. Officers.—L. T. Hinton (S.T.C.), and R. R. C. Rankin (Mullard) have been re-elected chairman and vice-chairman, respectively, of the Electronic Engineering Association.

C. & G. Radio Society.—Group Captain E. Fennessy, C.B.E., managing director of Decca Radar, has been elected to succeed L. H. Bedford, C.B.E., of English Electric, as president of the City and Guilds College Radio Society.

Ferrites.—A course of six lectures on the principles and applications of ferrites is being given by J. Roberts, of Imperial College, at the Norwood Technical College, Knight's Hill, London, S.E.27, on Tuesdays at 7.0 from May 10th.

A three-day course dealing with semiconductors will be held at the Portsmouth College of Technology on May 26th, 27th and 28th. The lecturers are members of the staff of the G.E.C. Research Laboratories.

"Trader Year Book."—Features such as the buyers' guide, manufacturers' addresses, condensed specifications of current sound and television receivers and tape recorders, receiver i.f.s, etc., which have been found to be invaluable for the radio dealer and serviceman, are retained and brought up to date in the 1960 edition of the "Wireless and Electrical Trader Year Book." A new section of 14 pages covering television and f.m. transmitters in the U.K. incorporates field-strength contour maps of B.B.C. and I.T.A. television stations. This 448-page reference book, which is published by Trader Publishing Co. Ltd., Dorset House, Stamford Street, London, S.E.1, costs 15s.

Scottish TV.—A permanent television transmitter at Thrumster, near Wick, Caithness, where temporary equipment has been in use since December, 1958, was brought into service by the B.B.C. on March 1st. It radiates in channel 1, using vertical polarization, and its directional aerial gives an e.r.p. of from 0.25 to 7kW, according to direction. On the same date a three-programme v.h.f. sound service was started from the same station. The transmitters radiate on 90.1, 92.3 and 94.5Mc/s with horizontal polarization. The directional aerial gives an e.r.p. varying from 0.1 to 10kW.

Radio Emergency Networks.—Dr. Arthur C. Gee (G2UK), the chairman of the Radio Amateur Emergency Network Committee in this country, is endeavouring to compile a world-wide list of emergency radio organizations to facilitate the work of the Red Cross in such disasters as have occurred recently at Mauritius and Agadir. Overseas readers are invited to send details of local organizations to Dr. Gee, c/o this office.

Personalities

E. D. Whitehead, M.B.E., B.Sc., M.I.E.E., has been appointed Director of Electrical Inspection in the Ministry of Aviation in succession to Brigadier C. A. Zweigbergk whose tour of duty in the Ministry ends at the beginning of April. Mr. Whitehead, who is 49, graduated from London University in 1930. After a few years in industry, first with G.E.C. and then Pye, he joined the Government service in 1937. In 1940 he began work on radar at R.A.E., Farnborough, and for five years from 1943 was technical assistant to the Director General of Communications Equipment. He then transferred to work on telemetry, and later (in 1952) became assistant director electronic component production in the Ministry of Supply. Since 1957 Mr. Whitehead has been in charge of a division of the Electrical Inspection Directorate responsible for the inspection of electronic equipment.

Sir Ian Jacob, K.B.E., C.B., director-general of the B.B.C. from 1952 until his retirement at the end of last year, has joined the board of Electric and Musical Industries, Ltd.

E. M. Whitaker, B.Sc., A.M.I.E.E., has joined A.E.I. (Woolwich) as assistant to the commercial director, J. W. Ridgeway. He joined B.T.H. at Rugby in 1931 as a school apprentice and in 1932 went to Leeds University for a three-year degree course in electrical engineering, after which he rejoined B.T.H. Since his demobilization in 1946 after war service with R.E.M.E., he has held various overseas appointments with B.T.H. and in 1958 became personal assistant to Lord Chandos.

K. R. Sandiford, B.Sc.(Eng.), has joined Hagan Controls, Ltd. (one of the Plessey group of companies) as general manager. Since 1954 he has been chief instrument engineer of the development and engineering group of the U.K. Atomic Energy Authority.

John Guy has been appointed chief planning engineer of Measuring Instruments (Pullin), Ltd. He was for 13 years with Sifam Electrical Instrument Co.

Captain Walter R. Wells, D.S.C., R.N., was recently appointed deputy chairman of the British Joint Communications and Electronics Board and deputy director of the Joint Communications Electronics Staff. He entered the Royal Naval College, Dartmouth, at the age of 13 in 1933 and after service at sea qualified in communications in 1943. From 1945 to 1947 he was Communications Officer to the First Destroyer Squadron. Capt. Wells held various staff appointments overseas and for two years from May, 1949, was on the staff of the Director of Radio Equipment at the Admiralty. He then became Staff Communications Officer, Far East Station, and for five years from 1953 served in the Admiralty Signal Division.

Brigadier J. D. Haigh, O.B.E., M.A., M.I.E.E., has been appointed divisional manager of Plessey's capacitors and resistors division at Swindon. Brigadier Haigh was, from 1939 until 1941, a radar instructor at the School of Anti-Aircraft Artillery. In 1946 he joined the Ministry of Supply where, until 1950, he was responsible for the development of Army radar equipment. In 1953, on his return to the U.K. from Singapore where he had commanded an Air Formation Signals Regiment, Brigadier Haigh rejoined the Ministry of Supply and in the following year was appointed Director of Electronic Research and Development. He joined the Plessey Company in 1958.



Brig. J. D. Haigh



A. P. Castellain

Alfred P. Castellain, B.Sc.(Eng.), A.C.G.I., D.I.C., chief engineer of A.E.I. Sound Equipment, Ltd. (formerly B.T.H. Sound Equipment, Ltd.) has been appointed an executive director whilst retaining his former position. Mr. Castellain, who was on the editorial staff of *Wireless World* in the early 1920's, was a lecturer in communications engineering at Queen Mary College, London, from 1924 to 1929. He joined Sound Equipment, Ltd., which later became B.T.H. Sound Equipment, in 1930 as its chief engineer. From 1941 to 1946 he was seconded to B.T.H., Rugby, for development work on 3-cm radar and in 1948 was put in charge of sound reproducer sales at Rugby. Mr. Castellain returned to London in 1956 as chief engineer, B.T.H. Sound Equipment. **Reginald Oulton**, acting secretary and general manager of A.E.I. Sound Equipment since 1956, has also been appointed an executive director. He joined Sound Equipment in 1934 and has been general manager since 1940. **Ernest V. Bowers, M.B.E.**, formerly managing director, A.E.I. Sound Equipment, Ltd., has resigned from his executive duties to join A.E.I. Lamp and Lighting Co., but retains his directorship.

P. W. Blick, author of the article on page 169 describing a transistor tape recorder amplifier, has been on the research staff of Belling & Lee for the past three and a half years. Prior to joining Belling & Lee he was an apprentice with the Electrical Research Association at Perivale. He is 25.

G. C. F. Whitaker, who was assistant superintendent of the Admiralty Signal and Radar Establishment from 1952 until 1955 when he became Fleet Electrical Officer on the staff of the Flag Officer Commanding Reserve Fleet, has been appointed assistant controller of programmes (technical operations) for Associated-Rediffusion. He will be in charge of the company's engineering activities. Mr. Whitaker joined Associated-Rediffusion from the television broadcasting department of Central Rediffusion Services, Ltd. Prior to his retirement from the Royal Navy, he was on loan to the Royal Australian Navy as Director of Electrical Engineering.

C. O. Stanley, C.B.E., chairman and managing director of the Pye group of companies, is to have the honorary degree of Doctor of Laws (LL.D.) conferred upon him by the University of Dublin.

Major E. A. Stuart, T.D., Assoc.I.E.E., has joined Colben Electronic Engineering Co. (until recently Colben Radio and Engineering Co.), of Dartford, Kent, as a director. Retiring from the regular army (R.E.M.E.) in January he went to Canada where he has since been associated with E.M.I./Cossor Electronics, Ltd. Major Stuart was for some time adviser to the G.O.C. Pakistan Army and responsible for the technical control of radar and other electronic equipment being introduced for the Pakistan Forces. For three years immediately prior to his retirement he was Deputy Asst. Director Electrical and Mechanical Engineers (Radar) at the Headquarters of Eastern Command.

Air Commodore B. Ball, C.B.E., has been appointed Deputy Chief Signals Officer at Supreme Headquarters Allied Powers Europe (S.H.A.P.E.). Since December, 1956, he has been Command Signals Officer, Bomber Command. He was at one time Commandant and Chief Inspector of the R.A.F. Signals Division at Debden.

Group Captain J. A. Robinson, O.B.E., who since 1957 has been Senior Technical Staff Officer at Signals Command, R.A.F., has succeeded Air Commodore B. Ball as Chief Signals Officer, Bomber Command, and has been granted the acting rank of Air Commodore. From 1955 to 1957 he was Chief Signals Officer at Far Eastern Air Force headquarters.

Major General Sir William A. Scott, K.C.M.G., C.B., C.B.E., Director of Communications at the Foreign Office from 1955 until his retirement from the Army in 1959, has joined the board of Southern Instruments, Ltd. Sir William, who was knighted in the 1959 New Year Honours, was previously Director of Signals, War Office (1949-1952); Director of Weapons and Development, War Office (1952-1955) and was at one time during the war Chief Signal Officer to the 8th Army. Originally commissioned in the Royal Engineers he transferred to Royal Signals in 1920.

OBITUARY

Baden John Edwards, M.B.E., M.I.E.E., a director and at one time chief engineer of Pye, Ltd., which he joined in 1935, died on February 16th at the age of 47. For his war-time services, part of which was as an adviser to Bomber Command Headquarters on the applications of radar, he was appointed an M.B.E. in 1945. In 1953 Mr. Edwards became a member of the technical sub-committee of the Government's Television Advisory Committee.

James Nelson, M.I.E.E., Hon. M.Brit.I.R.E., who died on January 31st at the age of 78, was a founder member of the British Institution of Radio Engineers and was its third president. It was in a letter in the August, 1925 issue of our sister journal *Experimental Wireless* (now *Electronic Technology*) that he stressed the need for the formation of a "really technical society" for wireless men and proposed that it should be called the British Institute of Radio Engineers. For most of his professional career Mr. Nelson was associated with B.I. Callender's Cables, from which he retired in 1953.

Time Multiplex Stereophonic Broadcasting

NEW MULLARD SYSTEM

THE left and right stereo signals (after the usual pre-emphasis) are sampled alternately for half-cycle periods at a frequency of 32.5kc/s and the resultant complex signal used to frequency modulate a v.h.f. transmitter in the usual way in a new system developed by G. D. Browne of the Mullard Research Laboratories.

In the transmitting equipment (shown in Fig. 1), the pre-emphasized left and right stereo signals are sampled by multiplicatively mixing them with two 32.5-kc/s sine waves of opposite phases, alternate half cycles of each sampled signal removed

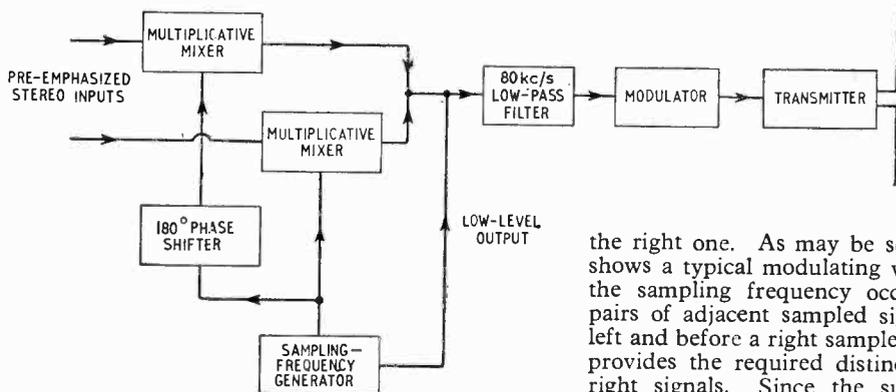


Fig. 1. Block diagram of transmitting equipment.

practice up to the discriminator output. The low-level signal at the 32.5-kc/s sampling frequency is then separated out and used to phase lock an oscillator at this frequency. The output from this oscillator is phase-shifted by plus and minus 90° to form two further sine waves in phase with the sampled signals. These phase-shifted sine waves are then multiplicatively mixed with the discriminator output to recover the two stereo signals. Extra equipment needed at the receiver thus consists of one oscillator and two mixers, apart, of course, from the second audio amplifying chain and loudspeaker.

The low-level signal at the sampling frequency and 90° out of phase with the two sampled signals is added to avoid any ambiguity as to which stereo signal is the left one and which is

the right one. As may be seen from Fig. 3, which shows a typical modulating waveform, the signal at the sampling frequency occurs between alternate pairs of adjacent sampled signals, i.e., only after a left and before a right sample or vice versa, and thus provides the required distinction between left and right signals. Since the sum of the two stereo signals directly modulates both the main carrier and also the sub-carrier at twice the sampling-frequency, this sub-carrier carries redundant stereo information. It is, however, retained both in order to avoid having to consume an appreciable fraction of the transmitter power in radiating a high-level signal at the sampling frequency and also in order to simplify the circuitry required in the receiver to synchronize the recovery of the stereo signals with the sampling process at the transmitter.

The normal transmitter deviation is not exceeded in this system, and adjacent-channel interference is very low. It is compatible in that a listener with

by half-wave rectification (not shown) and the left and right sampled signal added together. A sine wave at 32.5kc/s, 90° out of phase with both the sampled signals, is also added at a low level. The resultant complex signal can be shown to be equivalent to the combination of the sum of the two stereo signals, a suppressed sub-carrier at the sampling frequency (double-sideband amplitude modulated by the difference between the two stereo signals), a sub-carrier at twice the sampling frequency (double-sideband amplitude modulated by the sum of the two stereo signals) and other modulated sub-carriers at still higher frequencies. All these higher frequencies above 80kc/s are filtered out and the final complex signal thus obtained is used to frequency-modulate the transmitter in the normal way.

The receiver (see Fig. 2) follows normal

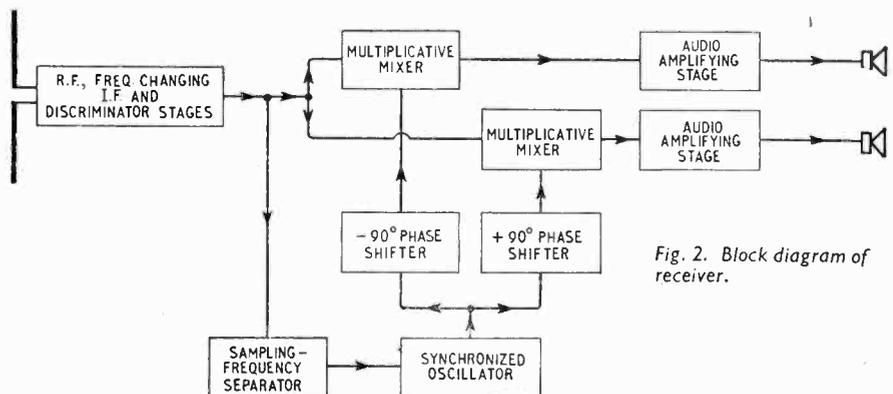


Fig. 2. Block diagram of receiver.

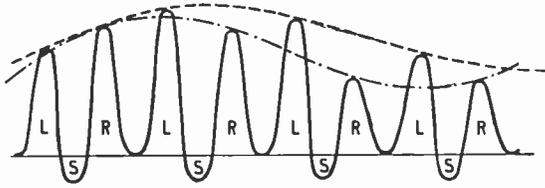


Fig. 3. Example of a typical modulating signal waveform: the left sampled-stereo, right sampled-stereo and sampling-frequency signals being indicated by the letters L, R and S respectively. The left and right audio waveforms are shown dotted. For clarity the audio signals have been shown sampled over only part of each half cycle. The rounding of the samples is produced when modulating frequencies above 80kc/s are filtered out.

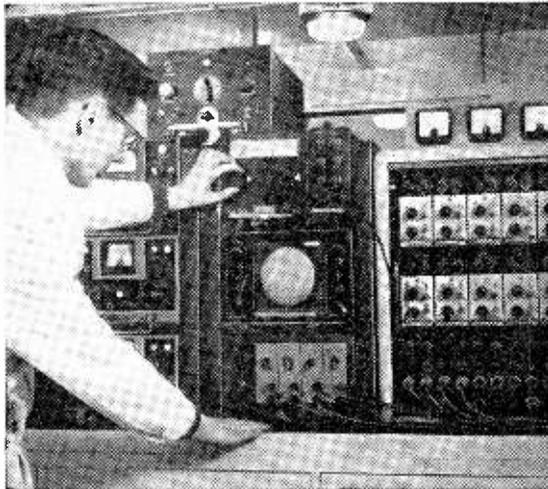
an ordinary unmodified signal-channel receiver will obtain the sum of the two stereo signals, and reverse compatible in that a single-channel transmission will

be reproduced by a stereo receiver in both outputs at the same level.

In this system the theoretical crosstalk is -45dB . This is low enough to offer possibilities of transmitting two independent signals. In all stereo systems, since the transmitter has to carry an extra signal, there is inevitably a loss of effective power. This produces a deterioration in the signal-to-noise ratio relative to the ratio obtained from a single-channel transmission and single-channel receiver. In this system this deterioration in the signal-to-noise ratio is different according to whether a single-channel or stereo receiver is in use and whether the transmission is single-channel or stereo. In the case of a stereo transmission and single-channel receiver this deterioration in the signal-to-noise ratio is 5dB , and in the case of a stereo transmission and stereo receiver the deterioration is 20dB . In the case of a stereo receiver and single-channel transmission the deterioration is normally 15dB , but in this case the deterioration can be eliminated by switching off the sampling-frequency oscillator in the receiver.

RADIO TELEMETRY CAR TESTING

WITH new mobile equipment developed by Armstrong Whitworth, physical factors such as stress, strain, pressure, vibration, temperature, etc., are continuously monitored at up to 23 different points on a vehicle while in motion, using strain gauges, force transducers, thermocouples and other familiar telemetering devices.



(Above) fixed station equipment; (right) mobile set.

The electrical outputs from these devices are sequentially sampled, amplified where necessary, combined and transmitted as a coded signal by u.h.f. radio to a laboratory or a fixed receiving station, which can be several miles away. Here the data is extracted from the coded signal in the same sequence as it was applied to the car's radio transmitter, monitored by a cathode-ray oscilloscope and permanently recorded for detail study. At the same time meter readings and graphs provide continuous information on the performance of the car and engine undergoing test to design staff technicians and enable advice or early warning of impending trouble to be radioed to the driver in the distant car.

In one of the illustrations is shown part of the com-

plex monitoring and recording equipment installed at the fixed receiving point and it is obvious that no equipment as comprehensive as this could possibly be installed, let alone used effectively, in a car under test conditions.

Apart from the various transducers already mentioned all that has to be carried in the car is a small d.c. amplifier, sequentially sampling switch assembly, coding circuits and a compact u.h.f. radio transmitter. The second illustration shows the compact "black box" containing this equipment on the front passenger's seat.

The technique and equipment illustrated here were evolved in the electronic research department of Sir W. G. Armstrong Whitworth Aircraft Ltd., Coventry.



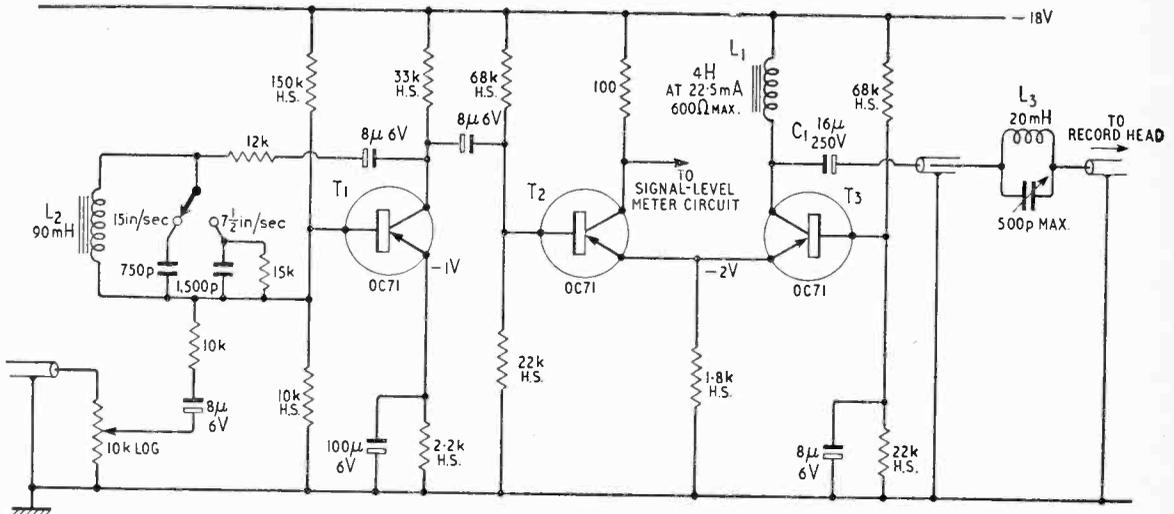


Fig. 1. Recording Amplifier. All resistors should be $\pm 5\%$. The two $68k\Omega$ and two $22k\Omega$ resistors in the long-tailed pair circuit should be matched to within 5%. The $750pF$ and $1500pF$ capacitors should be $\pm 5\%$ and mica.

Transistor Tape Recorder Amplifier

PLAYBACK, RECORD AND BIAS CIRCUITS

By PETER W. BLICK

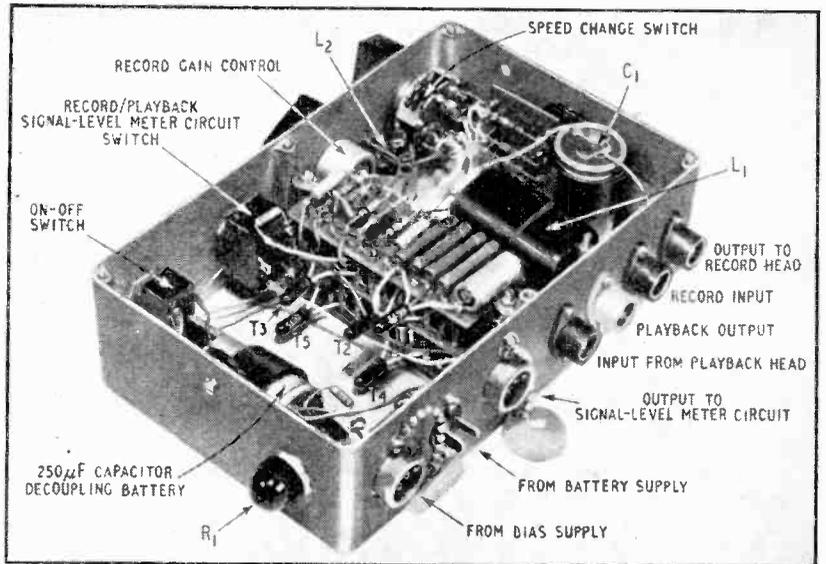
MOST of the published transistor amplifier circuits for use with tape recorders have only been for bias oscillators and replay amplifiers. The recording section has been given very scant regard. This is probably due to the supposed difficulty in obtaining the constant-current source for the recording head. If valve practice is followed, this is no doubt true. A solution to this problem is given in this article. It departs from the usual valve practice in that the high-value resistor in series with the recording head is omitted. A detailed description is given in the section dealing with this part of the amplifier.

With a suitable tape deck and tape, high-quality results may be obtained, results which are in fact better than with valves. The tape deck used is a "Wearite" 2B/H, which is a three-head deck with tape speeds of $7\frac{1}{2}$ in/sec and 15 in/sec. The record and replay chains are entirely separate. The tape used was the new B.A.S.F. LGS26 double-playing tape. The overall response obtained at $7\frac{1}{2}$ in/sec was flat within plus or minus 1.5 dB from 40 c/s to 14 kc/s and at 15 in/sec flat within plus or minus 1.5 dB from 30 c/s to 18 kc/s. This good response is due partly to the fact that the tape is

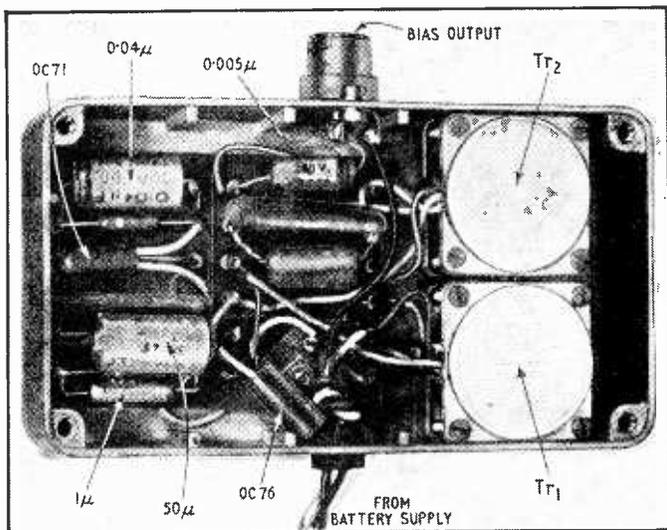
polished on the oxide side, i.e. a more intimate contact is obtained with the head gap. In fact the pressure pad on the playback head is not needed.

The whole amplifier together with a level meter consumes only 17 mA at 18 V on record and 7 mA on playback. The replay pre-amplifier gives an equalized output of the order of 50 mV, sufficient to drive a Mullard 5-10 amplifier to its full output.

The amplifier is stable over the temperature



Recording and playback amplifiers. (The bias rejection filter is separately mounted under the tape deck.)



Bias oscillator and amplifier.

range that is liable to be encountered in this country.

Recording Amplifier.—The purpose of this amplifier is to provide the recording head with a constant-current source and to compensate for losses in the head and tape at the higher audio frequencies.

As can be seen from Fig. 1, the last stage is a transistor T3 in the common-base configuration. This can have a high output impedance, in this instance several times higher than 20 kΩ, the head impedance at the highest audio frequency. The constant-current source is effective up to about 30 kc/s.

The collector load consists of the head and a 4H inductor L_1 in parallel. As the head is also inductive, a constant fraction of the constant current will flow via the head. At a low audio frequency the output capacitor C_1 together with the head and the inductor form a series-tuned circuit. The value of the capacitor must be large enough to place the peak outside the audible range, i.e. lower than 30 c/s. For example, with a 16 μF capacitor the rise at 30 c/s is about 1 dB. (This output circuit is the subject of patent application number 7512/59.) This capacitor must have a leakage current of less than about 0.3 μA to avoid polarization of the recording head. The last two transistors T2 and T3 form a direct-coupled long-tailed pair. An output from the first collector of the pair is used to drive the metering circuit. The high frequency pre-emphasis is obtained by frequency-selective negative feedback over the first transistor T1. The values of the feedback components vary with different speeds, heads and tapes. The sensitivity at 1 kc/s is such that 10 mV input is needed for 150 μA r.m.s. current in the head.

Playback Pre-amplifier.—The circuit diagram is shown in Fig. 2. The design is fairly straightforward but has one special point of interest. As is well known, the input impedance of a transistor in the common-emitter configuration is quite low, namely of the order of a few kilohms. This could cause quite a considerable reduction in the input current at high frequencies, because of the increasing head impedance with frequency. The first OC75 transistor T4 has some current negative feedback

in the emitter. This increases the input impedance to about 18kΩ, giving a loss of about 3 dB at 18 kc/s, which can be easily compensated for.

Bass lift is obtained by applying negative feedback over the second OC75 transistor T5. The time constant at 7½in/sec is 100 μs and at 15in/sec is 35 μs. If any treble lift is needed on playback, the feedback may be reduced at the higher frequencies by by-passing it to earth. This can be accomplished by splitting the 5.1 kΩ and 1.8 kΩ feedback resistors and connecting capacitors from the junctions to earth. However, it has been found that with the B.A.S.F. tape and Wearite deck used there is no need for this treble lift.

Bias Oscillator.—This operates at 60 kc/s and, as can be seen from Fig. 3, it takes the form of a master oscillator followed by a power amplifier. This was chosen because it was easier to obtain the necessary frequency stability and controllable output than with a single transistor. The maximum output is about 150 mW, which is ample for most tapes. An erase oscillator is not included, but an output transistor may be driven from the 800-Ω bias output stage to give an output of about 1W.

In the bias oscillator it is of course necessary to tune the two transformers to the same frequency of 60 kc/s. A bias filter in the form of a parallel-tuned circuit is connected in series with the recording head lead.

Level Meter.—The circuit of Fig. 4 will indicate the peaks if a suitably-damped meter is obtained. The level meter may be switched to either the record amplifier or, for bias adjustment purposes, to the playback pre-amplifier. The 2.2kΩ and 33kΩ resistors at the input of the meter circuit are to reduce the signal level to give a suitable reading on the meter. They may need altering to suit different heads and tapes. The meter may also be used whilst the bias filter is being tuned.

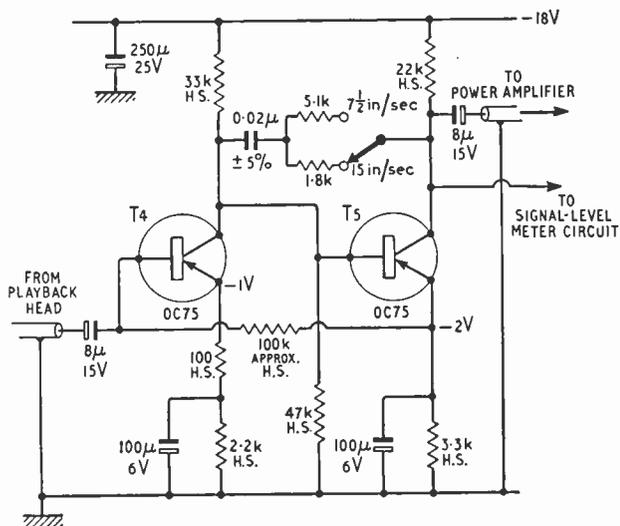


Fig. 2. Playback pre-amplifier. All resistors should be ±5%.

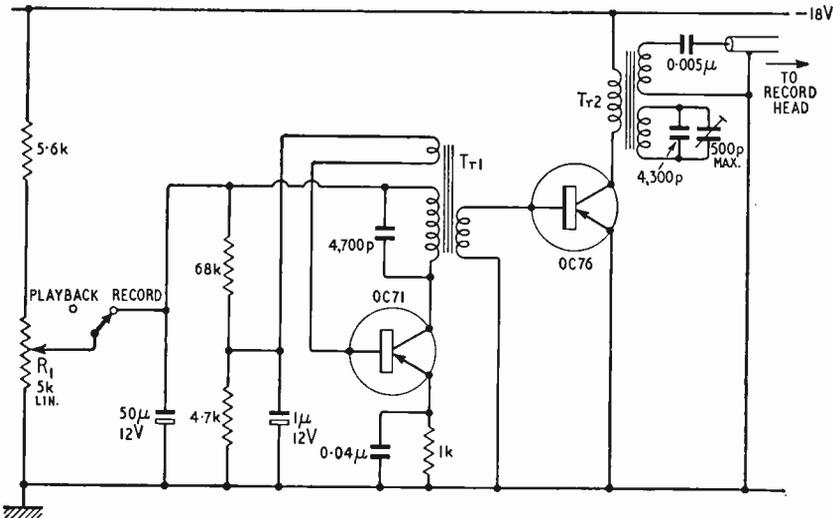


Fig. 3. Bias oscillator and amplifier. All resistors should be $\pm 10\%$. The 4700 and 4300pF capacitors tuning the transformers should be $\pm 5\%$ and mica.

Setting-Up and Testing Procedure.—With the bias oscillator off and the heads disconnected, the d.c. conditions should be checked with an Avo Model 8 or similar meter if possible. The two OC71 transistors in the long-tailed pair T2 and T3 should be matched for base current at 1 mA collector current. The only resistor that may need adjustment is the 100 k Ω bias resistor for the first OC75 transistor T4 in the playback pre-amplifier. The voltages should be as indicated on the circuit diagrams.

Before connecting the recording head, the leakage current of the 16 μ F output capacitor C₁ should be measured. If it is greater than 0.3 μ A at 18 V, then it should be re-formed for several hours at 250 V. The leakage current in the sample used in this amplifier was, after re-forming, 100 μ A at 250 V. At 18 V it was too low to be measured on the 50 μ A range of an Avo 8. It has shown no tendency to increase even after one year's use. On the Wearite

deck it is possible to have the recording head earthed for all positions except record, so that if the function switch is not on record when the amplifier is switched on, the head will not become magnetized.

The heads are now connected to the amplifier and the a.c. tests may be performed. If a test tape is available, such as the E.M.I. Type TBT1, the playback pre-amplifier may be checked for conformity with the C.C.I.R. playback curve at 7 $\frac{1}{2}$ in/sec. Similarly, if a 15in/sec test tape is available, the playback characteristic can be checked at 15in/sec. The level meter cannot be used for these tests as it has a poor frequency response. The meter used for checking the frequency response should be linear over the whole of the audio-frequency band.

The bias amplifier transformer Tr2 should now be tuned to the same frequency as the oscillator transformer Tr1 by adjusting the 500pF trimmer until the output voltage shown by the level meter on record is a maximum. It may be necessary to detune the bias filter when making this adjustment.

The recording amplifier can now be checked. With the deck on record, but with the tape stationary and the bias set at maximum, the bias filter is adjusted for a minimum indication on the level meter.

The bias can now be set. With a 1 kc/s signal applied to the record amplifier the bias should be adjusted by varying the 5k Ω potentiometer R₁ to give maximum output on the meter on playback. The tape speed does not affect the result materially. The level for this and the following tests must be such that the output from the playback pre-amplifier does not exceed 10 mV.

The top peaked frequency for the head and tape used is 14 kc/s at 7 $\frac{1}{2}$ in/sec and 18 kc/s at 15in/sec. The amount of peaking needed can be determined by checking the overall response.

The noise level of this amplifier is very low and, to obtain full advantage of this, it is recommended that a bulk tape eraser be used. When an 18 V battery is used for the amplifier, there is no audible hum.

Winding Details for Inductors and Transformers.—All are wound with enamelled copper wire on Mullard Ferroxcube cores.

Recording amplifier

Treble-boost inductor L₂, 90 mH: 600 turns 38 s.w.g. on LA 42

Bias filter L₃, 20 mH: 100 turns 30 s.w.g. on 2 FX1073

Bias oscillator

Oscillator transformer Tr1:

Tuned winding: 75 turns 32 s.w.g. } Side by side
Output winding: 20 turns 30 s.w.g. } on LA2
Feedback winding: 1 turn 24 s.w.g. }

Output transformer Tr2:

Tuned winding: 75 turns 32 s.w.g. } Side by
Collector winding: 30 turns 26 s.w.g. } side on
Output winding: 27 turns 30 s.w.g. } LA2

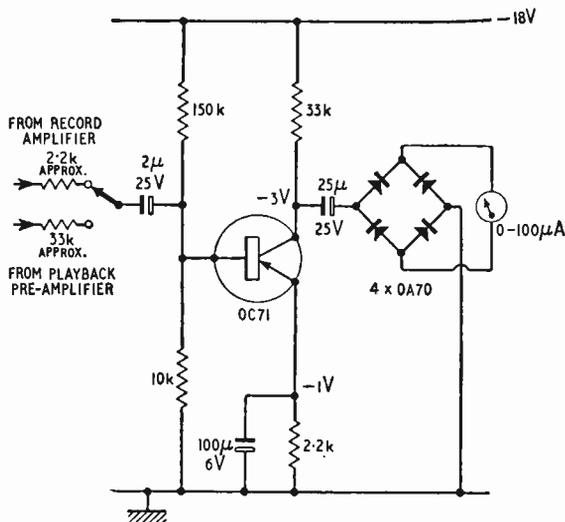


Fig. 4. Signal-level meter circuit. All resistors should be $\pm 10\%$.



INTERNATIONAL COMPONENTS EXHIBITION

SOME IMPRESSIONS FROM THE 1960 SHOW IN PARIS

REGULAR visitors to the Salon International de la Pièce Détachée Electronique, now in its third year, have probably got used to the idea that it is as much an exhibition of test gear and audio equipment as of ordinary radio components. Such multiplicity of purpose is not, however, as confusing as it might seem, for the different sections are segregated in a very orderly fashion, and this, combined with the general spaciousness and airiness of the layout, makes the exhibition a pleasure to visit. This year the Salon was the biggest ever. There were over 400 exhibitors, including 60 or more non-French firms (it was also the 23rd French components show). An interesting innovation was the provision of a separate section for the international technical press. *Wireless World* was represented here, along with its European and American contemporaries.

Semiconductor devices are tending to overshadow valves now that transistors are showing themselves capable of operating at unexpectedly high frequencies, even up to the u.h.f. region. The French firm C.S.F., for example, were demonstrating a small portable transmitter which used an experimental germanium diffused-base "mesa" transistor to produce signals at 500Mc/s. This company also had silicon diffusion-type transistors with cut-off frequencies of 50-100Mc/s, and demonstrated their "Alcatron" field-effect device (July/August 1959 issue, p. 350) as the oscillator in a transmitter working at 110Mc/s.

The possibilities of using transistors for domestic television receivers are, of course, well known. It was, nevertheless, interesting to see, on the Thomson-Houston stand, a demonstration of a working 819-line television set which used transistors throughout

(26 in all) except for one line deflection valve. It covered the band 174-188Mc/s and had a signal-frequency circuit consisting of an oscillator and mixer using tetrode transistors with 70Mc/s cut-off frequencies.

In the sphere of semiconductor power devices, several exhibitors had silicon diodes for rectification of up to 500mA for television-receiver h.t. supplies. C.S.F. showed a power transistor capable of carrying 2 amps which also had the remarkably high cut-off frequency of 10Mc/s.

As for the glassware on show, a great deal of interest was excited by a television cathode-ray tube announcing itself as having a 114° deflection angle—the Westinghouse 23FP4. It has a 23½-inch screen, a depth of 13¾ inches and operates with an e.h.t. of 14kV. There were, of course, a good many examples of the 110° tube on view. One interesting development, exemplified by the Sylvania 23DP4 and others, was the use of an integral tinted glass protective panel sealed round the front face of the normal tube envelope. This eliminates the need for a separate protection panel and dust seal in television receivers. There are four glass mounting-lugs at the corners of this integral protection panel, intended for clamping to the receiver chassis.

Amongst cold-cathode tubes, the Swiss firm Elesta had an interesting decade counter tube of miniature-valve size, the EZ10B, which was notable for its high maximum counting speed of 1Mc/s. It was a unidirectional type and contained hydrogen gas. On the same stand was a cold-cathode trigger tube, the ER21A, which could be directly powered by the 220-V a.c. mains supply and directly triggered by photocells, etc., thereby making possible very simple industrial control circuits. Other new Elesta trigger

tubes, using molybdenum electrodes, were claimed to have expectations of life in excess of 25,000 hours.

The term "microminiature" now seems to be generally accepted and understood and there were plenty of components on show which fully justified this description. L.C.C. had a range of flat ceramic decoupling capacitors for 30V operation, of which the smallest measured only 1.5mm square and had a capacitance of 1,000pF. Slightly larger ceramic types had capacitances up to 2 μ F and measured only 25mm long and 12mm maximum diameter. One of the smallest variable capacitors (air dielectric) in the Salon measured 6mm cube. Displayed by Arena, it had a capacitance of 1.5pF and could be operated at up to 220V. Variable capacitors can be reduced in size for a given performance by replacing the air dielectric with liquid filling. National showed examples of this technique with capacitors from 50 to 2,000pF and working voltages from 4kV to 15kV, which were claimed to give a hundredfold advantage in size reduction. Control of the rotor through the sealed metal container is achieved by a magnetic drive system.

An unusual form of construction was the feature of a series of fixed tubular polystyrene capacitors shown by Capa. They are built round a rigid axial rod or wire which forms one connection and is used for mounting, while the other connection is a thin wire emerging at the same end of the cylinder. This system is intended for strength in conditions of vibration, and is designed for mounting on printed circuits.

Delay lines made in the form of small rods up to 100m long and 8mm diameter were displayed by Steafix. The ceramic rod has a metallized surface over which an insulated inductive winding is laid to give the distributed inductance and capacitance. They give a delay of 1 μ sec and have a pass band of 4Mc/s, with impedances of 1k Ω or 2k Ω .

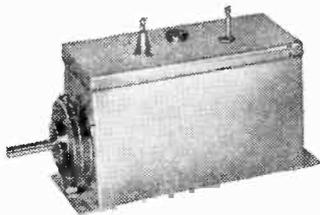
The Société Orega specialize in making sub-assemblies, coil-packs, tuners, etc., for all types of domestic receivers. This year they offered a whole range of printed-circuit modules, completely tested

and aligned, for transistor receivers—r.f., frequency changer, i.f. and audio units. Some of these incorporated a very neat miniature two-button wave-change switch, designed for pocket receivers. Another miniature item was an i.f. transformer of only 10mm diameter and a Q factor of 150. Orega, with other firms, also showed the flat-bar type of ferrite aerial, which has a space-saving advantage over conventional cylindrical rods in small receivers.

A particularly sensitive subminiature relay shown by Le Prototype Mécanique operates with a power of only 5mW and has a response time of less than 2msec. Its sealed container measures 25mm long by 10mm diameter. The sensitivity depends on the precise balancing of a cranked armature, which is actuated by magnetic pulls from opposite directions (from the centre pole of the solenoid and from the magnetic return path). The magnetic circuit is also carefully designed so that magnetic forces on the armature pivot cancel out; consequently friction during movement of the armature is reduced to a minimum. With an energization of 8mW the relay will withstand accelerations up to 30g. On the stand of C. P. Clare, relays with mercury-wetted contacts were demonstrated. The technique is notable for giving constancy of operating time, lack of contact bounce, and low and consistent contact resistance (25-50 milliohms range). Mercury is fed continuously to the contacts by capillary action from a reservoir of mercury under gas pressure.

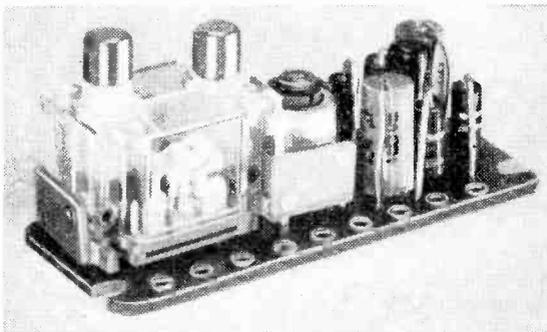
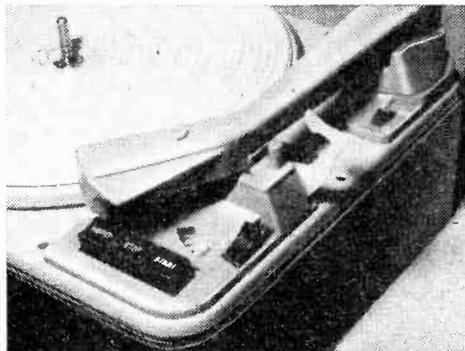
Piezoelectric filters are, of course, well known for their high Q and sharp cut-off properties. Intermetall were showing filters of this type based on ceramic discs of zirconium titanate. Operating at frequencies in the region of 450kc/s, they have Q factors of about 400 and are notable for their small size and high stability with time and temperature. Working frequencies up to 1Mc/s are possible.

Looking at the wide range of gramophone turntables and pickups on view it was very noticeable that the Continental manufacturers had a definite category of equipment labelled "semi-professional". It lies, in fact, half-way between the professional transcription units and the ordinary domestic record changers in both quality and price. As an example the transcription unit shown by Thorens had a speed fluctuation of $\pm 0.07\%$, wow figure of 0.1% and turntable rumble of -40dB (N.A.R.T.B.), while their semi-professional model had corresponding figures of $\pm 0.12\%$, 0.2% and -38dB. Incidentally, Dual presented a new turntable with the unusual

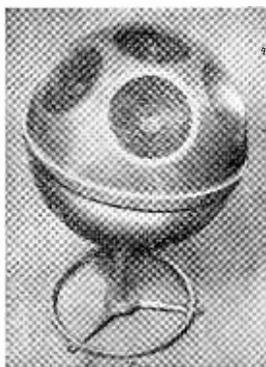


Left: Liquid-dielectric variable capacitor by National.

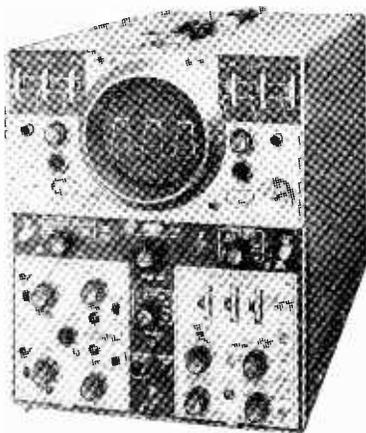
Below: Turntable by Dual with indicator for the weight of the arm (behind the right-hand control button).



Transistor frequency-changer module (Orega) showing "Tom-Thumb" wavechange switch on the left and 10-mm i.f. transformer in the centre.



Left: The Gogny "sphère pulsante" loudspeaker.



Above: Du Mont oscilloscope with digital read-out.



Left: Audax loudspeaker with eccentric diaphragm.

feature of a pointer indicator which registers the weight of the pickup arm.

Stereophonic equipment was, of course, very much in the forefront. A new introduction from Philips is a four-track stereo tape recorder—that is, it provides two double tracks for stereo recording, or allows two single-channel programmes to be recorded simultaneously through the two 4-watt amplifier chains. There are three tape speeds and the frequency response on the highest speed (19cm/sec) extends to 20kc/s. A stereo microphone is provided, and two loudspeakers, one in the main unit and one in the detachable lid. Kodak, the film people, are now in the magnetic tape business and the examples on their stand included tapes as long as 4,000 ft.

Flat loudspeakers, with magnets and speech-coils inside their cones, seem very popular in France, and this year the Audax people had a new 7-inch model which achieved a depth of less than an inch (24mm). The magnet has a field of 8,000 gauss. This firm also displayed an eccentric loudspeaker—the driving unit being offset from the centre of the elliptical cone with the object of obtaining an oblique radiation of sound. The main application is in television sets. Another unusual configuration was the Gogny "sphère pulsante" which gives all-round radiation by grouping six small loudspeakers on the top half of a 10-inch diameter sphere.

Going to the other end of the sound reproducing chain, Brüel & Kjær showed a new condenser microphone, intended for measurements, with a diameter of only $\frac{1}{2}$ inch. With sound waves impinging perpendicularly on the diaphragm the frequency response is flat within 2dB from 20c/s to 40kc/s. The microphone is normally fitted on the top of a tubular housing, which contains a cathode follower. Another new and small microphone, shown by Lem and measuring about 1-inch in diameter, was an omnidirectional electrodynamic type intended for reporting, and was fitted with a useful clip enabling

it to be propped on a table or hung on the hand.

Outstanding in interest amongst the test equipment was a new oscilloscope by Du Mont which offers the unusual facility of digital read-out—that is, it enables voltage and time-interval measurements of the waveforms displayed on the screen to be presented directly on digital dials. The system is a kind of "electronic graticule" based on two movable light spots generated on the c.r.t. screen. One of them, the "index dot" is positioned at some suitable reference point on the waveform by a joystick type of control. The other, the "scaling dot" is then moved horizontally and vertically by two sets of controls until it is positioned on the part of the waveform to be measured relative to the reference point. The horizontal-movement controls (top right of picture) are digitally calibrated in microseconds, milliseconds and seconds, while the vertical-movement controls (top left) are calibrated in volts and millivolts. The two measuring spots are actually produced from a Lissajous figure generated by two sets of square waves, which are applied to the X and Y plates by time sharing with the normal X-sweep and Y-signal deflection voltages. A special facility is included for rise-time measurements.

The main idea of the digital read-out system is to save time and reduce the inaccuracies due to parallax, scale interpolation and other types of reading error which can occur with conventional oscilloscopes. The instrument is built on the plug-in unit principle, has a Y-amplifier response of 0-35Mc/s and generally offers all the normal facilities of a high-quality professional oscilloscope.

Another useful aid to reading c.r.t. traces was seen in the latest wobulator-plus-c.r.o. for television frequencies shown by Ribet-Desjardins. It enables one to see the frequency at every point along the response curve by providing a continuous sequence of frequency markers along the sweep between 0 and 250Mc/s. The marker signals are at 1Mc/s intervals with multiples at 10Mc/s intervals. They are generated by a 10Mc/s crystal oscillator to which a 1Mc/s oscillator is coupled and locked. The 10Mc/s oscillator is deeply modulated with short, almost rectangular, pulses by the 1Mc/s signal, and the result is to generate a whole spectrum of signals, at ± 1 , ± 2 , ± 3 Mc/s, etc., relative to the 10Mc/s oscillation and relative to all its harmonics. These marker signals are applied to the wobulator circuit so that they appear on the response curve trace as a sequence of short vertical deflections—bigger ones for the 10Mc/s intervals than for the 1Mc/s intervals. The wobulator has a saturated-ferrite frequency modulation system and will operate in the three bands, 0-80Mc/s, 80-160 Mc/s and 160-320Mc/s.

"Mobile-receiver Alignment Equipment," by J. F. Golding (February, 1960, issue, p. 75). The author has asked us to point out that, although some 100-kc/s channel spacing equipments are still in use, the channel spacing of 100kc/s ascribed in Table I to the police, fire and ambulance services, has been reduced officially to 50kc/s.

Elements of Electronic Circuits

12.—PRINCIPLES OF TIMEBASES

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

IN the next few articles we shall be dealing with some of the means of generating a triangular-shaped waveform, otherwise known as a sawtooth or linear waveform. Two of the principal uses are:

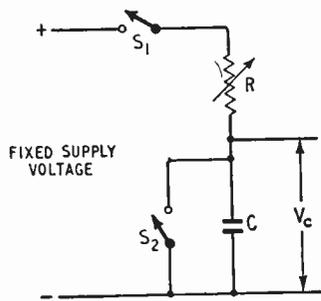


Fig. 1

(a) The measurement of time intervals. The linear sweep is the most widely used timebase for display purposes.

(b) The derivation of other basic voltage waveforms. A rectangular wave is obtained by

differentiation and a parabolic wave is the result of integration.

Basic circuits for generating linear waveforms usually make use of the charging or discharging of a capacitor, ideally at a constant rate, e.g., the change in voltage across a capacitor from its value at $t=0$ is:

$$V_c = \frac{1}{C} \int_{t=0}^{t=t} i dt$$

where C is the capacitance in farads. If i is maintained constant $= I_0$, then $V_c = (I_0/C)t$, which represents a linear relationship between the voltage appearing across the capacitor and time.

The apparent complexity of some circuits is due to the precautions taken to ensure that a constant

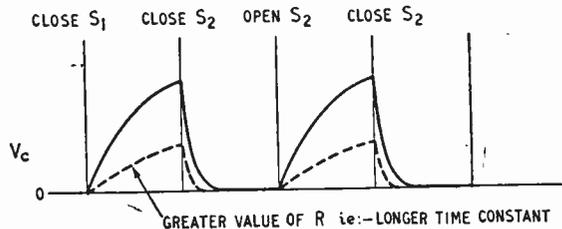


Fig. 2

charging current is available to produce the required linearity. The capacitor may be charged or discharged in one of the following ways:

(i) From a constant-voltage source through a series resistor. One arrangement uses a CR circuit in combination with a simple thyatron switch.

(ii) From a constant-voltage source through a pentode operated in the so-called "constant-current"

region of its anode voltage/current characteristic.

(iii) From circuits employing both positive and negative feedback. The "bootstrap" cathode-follower type of circuit falls into this class.

(iv) From circuits employing negative feedback only. The family of circuits which depend for their action on the Miller effect come into this category.

Let us consider the operation of the circuit shown in Fig. 1. Assuming a constant supply voltage, with S_1 closed and S_2 open the capacitor C charges exponentially through R . Closing S_2 causes C to be short-circuited and to discharge rapidly. Opening S_2 enables C to charge once more, and so on, thus producing the waveform in Fig. 2.

Although the output waveform taken across C is an exponential sweep, if the first portion of the rise is made use of then an approximately linear sweep can be obtained. If the total time taken

to generate the sweep is small compared with the time constant CR then the capacitor charging current will be nearly constant during the charging period. The best linearity with this type of simple circuit can be achieved by restricting the sweep amplitude to a small fraction of the supply voltage. In practice S_2 in Fig. 1 can be a thyatron operated by a switching pulse.

Fig. 3 shows an alternative simple arrangement using a hard valve in preference to the slower operating thyatron. Initially V_a is low when the valve is

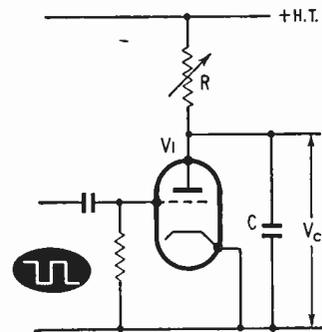


Fig. 3

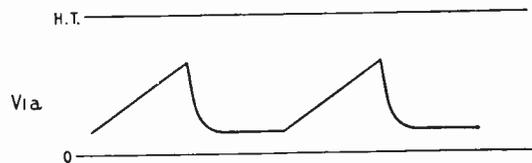
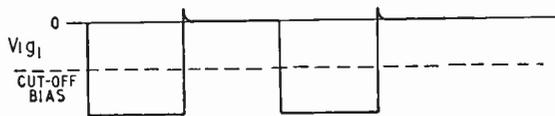


Fig. 4

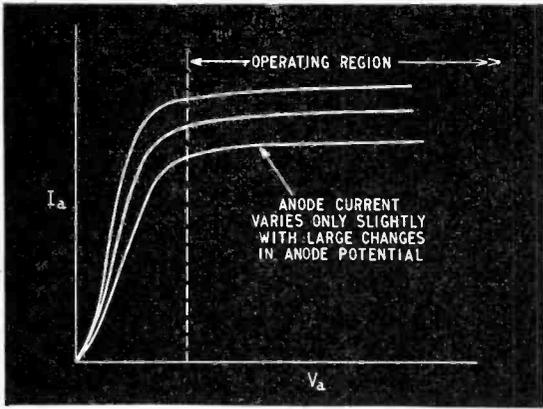


Fig. 5

conducting and C is charged to a low value. The square wave input to the grid of V_1 is clamped to zero (grid clamping) and the negative excursion cuts off the anode current. This would normally have caused V_a to rise to h.t. immediately, but due to the action of C charging through R, the rise towards h.t. is gradual. Subject to the limitations mentioned above, this rise can be made approximately linear. Fig. 4 shows the resultant anode voltage waveform.

We have seen that the voltage developed across the capacitor is proportional to the charge on the capacitor. If the charge increases linearly with time, i.e., the current flowing into the capacitor is kept constant, then the voltage across the capacitor will also increase linearly with time. In other words, if the timebase voltage is to be linear then the capacitor must be fed from a constant-current source.

A suitable constant-current device, as already

mentioned, is a pentode operated above the knee of its $I_a V_a$ characteristic, which can be substituted for the charging resistor R (see Fig. 5). It will be seen that at this operating point the anode current varies only slightly with large changes in anode potential.

Fig. 6 shows a typical constant-current pentode, the high anode impedance of which replaces R in Fig. 3. The cathode bypass capacitor has been

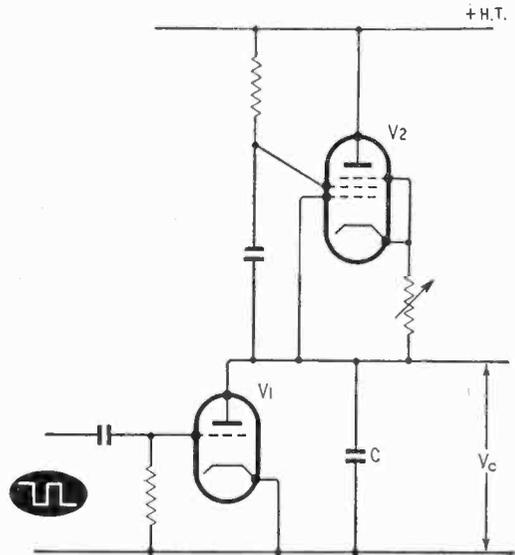
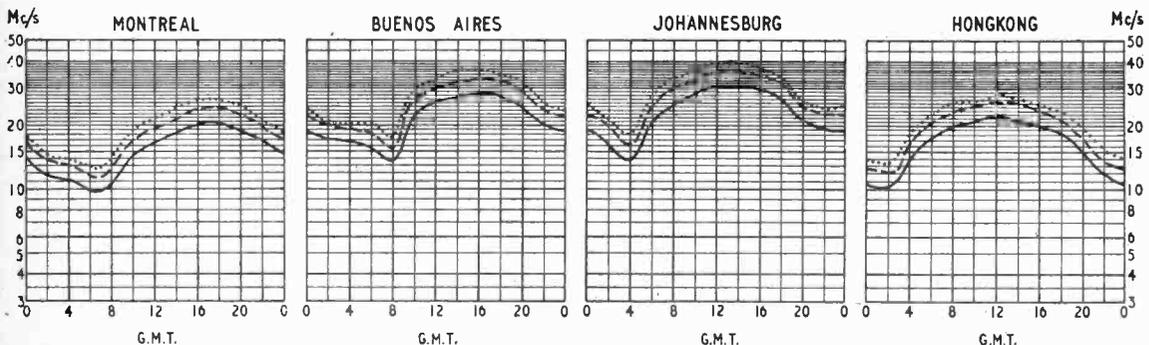


Fig. 6

omitted, thereby introducing current negative feedback, which serves to increase the effective I_a/V_a slope still further. The greater the slope resistance the closer is the approach to linearity of the voltage across the capacitor C.

SHORT-WAVE CONDITIONS

Prediction for April



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 April.

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

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

Hardwood Instrument Cases

SIMPLE CONSTRUCTION USING MODERN GLUES

By GEOFFREY I. LILLEY

THE natural elegance of hardwood can impart to a well-made cabinet an impression of quality unparalleled by any other material. The arts of complex joinery and expert finishing are by no means easy to master; but the age of "plastics" has made possible the production of well-finished cabinet work with the minimum of special skill.

It is no longer essential to use dovetailed joints for carcass and box-frame construction. Where, pre-

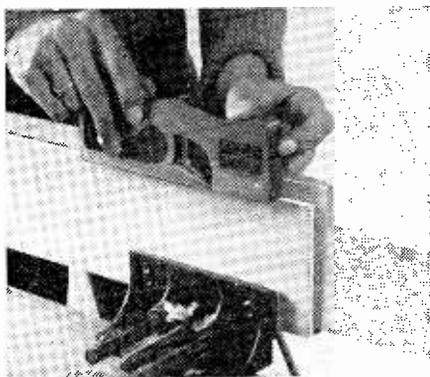


Fig. 1. Rebate plane in use.

viously, end-grain joints had to be avoided owing to their lack of strength, modern resin glues are capable of bonding firmly wood across any plane and, in fact, they have shifted the limiting factor in the strength of a wooden article from the glued joints to the wood itself. Modern synthetic finishes have made easy the production of a fine, lustrous surface.

One disadvantage of timber is its movement with changes in humidity. Contrary to the widely held belief, however well-seasoned a piece of timber may be, it will always exhibit this property of swelling and contracting: this, however, is no problem if the design is right. The golden rule is to avoid joints in which the grain of the two parts is mutually perpendicular across the width. This means in practice that, for instance, if a box lid is to be made, the wooden frame cannot be covered with a board of solid timber since the latter would always form a cross-grained joint with either the sides or the back and front. Plywood may be used for such an application, and the simple construction method outlined below incorporates the use of cloth-covered plywood panels which can, if necessary, be made detachable.

The timber used will depend largely upon personal preference, but it is advisable to use one of the more stable hardwoods such as agba, abura, or African mahogany. These are most often available in 1-in thickness, which can be deep-cut at the yard to give one piece about $\frac{1}{2}$ -in thick, the other being about $\frac{3}{8}$ in; these two thicknesses are convenient sizes

for small-cabinet work. Some timber yards have sawn drawer-side material which is usually $\frac{3}{8}$ -in thick. This is ideal for the present application and is sometimes available in fairly good widths.

The one tool required over and above the ordinary basic range of woodworking tools will be some form of rebate plane, a small model being preferable on account of its lightness and cheapness: Fig. 1 shows a plane of this type in use. To prevent any possibility of splitting when planing-off the waste wood from corner-joint rebates it is a good plan to bevel off the ends (using a chisel) down to the marked-out line. Alternatively with wide pieces of wood, it is often possible to plane towards the middle from both sides.

Method of Construction

The basic system of construction is to make the rebated joints at the corners and the front and back rebates for the panels all to the same depth (Fig. 2). Thus the housings for the front and back panels are simply provided. The width of the individual rebates is determined by what they are to accommodate. If the timber used is $\frac{1}{2}$ -in thick, all rebates may be, say, $\frac{1}{4}$ -in deep, and the top and bottom housings in the sides will be $\frac{1}{2}$ -in wide. The front and back rebates will be the same width as the thickness of the panel material, and this will generally be either $\frac{1}{4}$ in or $\frac{3}{8}$ in.

Fig. 3 shows the parts of a simple square-shaped cabinet rebated for front and back panels. Of course,

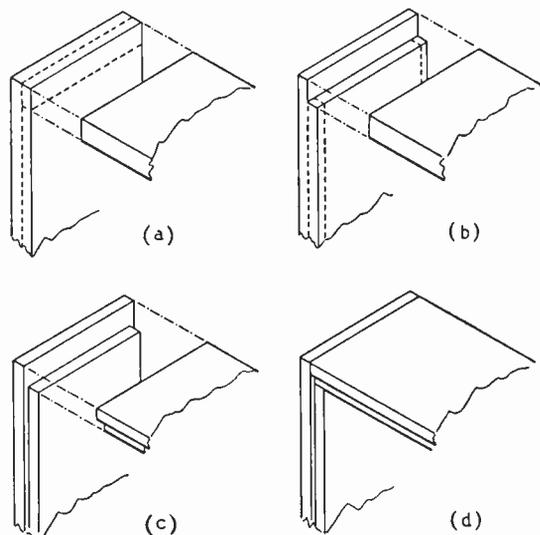


Fig. 2. Steps in construction of corner joint: (a) marking out for rebate, (b) end rebate cut to depth of top members (c) side rebates cut to receive panels and (d) assembled joint.

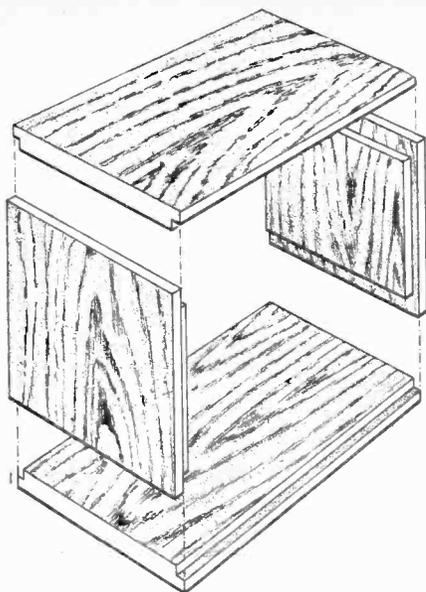


Fig. 3. Sides, top and bottom of case having inserted front and back panels.

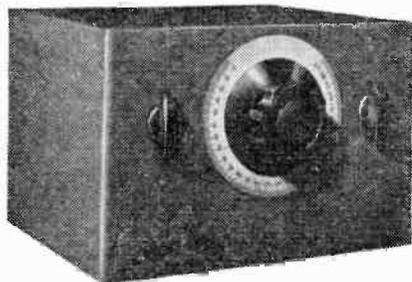


Fig. 4. Electronic timer unit using panels at top and bottom. Controls are mounted on wooden "side".

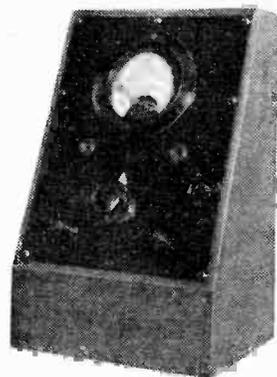
it would be a simple matter to change the proportions somewhat so that the plywood panels were at the top and bottom positions, then the "front" would be one of the hardwood sides. This is illustrated by the timer-unit cabinet shown in Fig. 4.

It will be noticed in Fig. 3 that the sides ready for assembly have a rebate cut all round. It is a good plan, therefore, to gauge in this rebate round all four edges before starting to cut. The end rebates are then marked in and cut first, as shown in Fig. 2(a), the other two rebates being cut afterwards.

Design Adaptations

This basic square-shaped cabinet may be adapted to a more complex design, such as that of the meter case shown in Fig. 5. Here the sides are shaped first and the other parts cut to fit. The top member, for instance, will be cut to the required width and rebated for front and back panels in the usual way. Although the front panel slopes, the top and bottom rebates need not necessarily do so; they may be cut square, the front edges being sloped off with the plane after assembly. It will be found in practice, however, that working with the rebate plane held

Fig. 5. Meter case with sloping front panel.



at an angle will be hardly any more difficult than when holding it square, and the angle required may be judged very easily by holding one of the side members up against the work as a guide. The small, bottom, front wooden member seems to break the rules regarding cross-grained joints; this is permissible, however, in such a narrow piece as this.

Assembly presents few problems, the frame being held with a G-cramp placed across the side members at top and bottom. Just two G-cramps should be sufficient even for the more complicated assemblies, for these will invariably be based upon a square frame which may be cramped up first, the other members being glued and pressed in place. Cramping every part is not essential when using resin glue¹ as it tends to fill any small gaps: provided each part makes a good press fit and will hold in place good joints are assured.

When the glue has set the panels may be fitted. The front panel may be of $\frac{1}{8}$ -in metal or paxolin, in which case it would probably be easier to trim the joints of the wood members before assembly until the panel is a good fit in the recess. However, if the panels are made of plywood, they may be readily cut to size after the cabinet is made.

A very smart finish may be imparted to plywood panels by covering them with a grained leather-cloth, this being cemented down with a non-tacky type of rubber-resin adhesive.² The panel is then fitted to the cabinet with raised-head chrome screws, the holes and countersinks for these being made before the panel is covered with the leather-cloth.

Some workers may wish to finish off the wood surfaces of the cabinet with french polish, or perhaps one of the new plastics finishes that are available today. A good durable finish, which is easily applied and very attractive, consist of a few coats of a synthetic varnish³, rubbed down with an abrasive paste. The varnish is wiped on with a cloth, rather than brushed, and very lightly rubbed down with fine sandpaper between coats. The final coat is rubbed down with fine pumice powder used wet, or even better, the ready-mixed rubbing paste sold for finishing brushing cellulose. This is used upon a small piece of baize or thick cloth wrapped over a small wood block. Care must be taken, of course, to keep the rubbing strokes in line with the grain.

After this process it will be found that a quick rub over with a wax polish will give the surface a final burnish and bring up a really good quality smooth gloss. Those who prefer the more subdued egg-shell finish, however, may leave this last stage out, for the surface left by the abrasive rubbing is very fine and quite suitable as a semi-matt finish.

¹ Two suitable resin glues are "Caseamite" and "Aerolite 306."
² Boscotex 5/S adhesive is obtainable direct from the makers, the B.B. Chemical Co. Ltd., Ulverscroft Road, Leicester.
³ Valspar "Clear" is one such suitable varnish.

LETTERS TO THE EDITOR

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

Negative Impedance

IN HIS article in the February issue, "Cathode Ray" says that his subject is controversial—how right he seems when members of the I.E.E. argue and "Cathode Ray" and myself have differences of opinion.

Let us start with the definition of resistance, $R=E/I$. Then when a voltage is applied the current will flow in one of two directions giving I , R and power EI , or $-I$, $-R$ and $-EI$. The first case obviously applies to a passive positive resistance which absorbs power, the second to negative resistance which gives out power, and in which the current is the same as in the first case except that it flows in the reverse direction. By changing R to Z the above may apply word for word equally to an impedance, except that since the power flows alternatively into and out of an impedance the average power must be taken. The average power for a pure reactance is zero, and this is the boundary case between a practical positive impedance and a negative one.

If $Z=R+jX$, then $-Z=-R-jX$. Here then is Dr. Myers' negative reactance, and I expect that since writing the last section of his article "Cathode Ray" has realized that this is short for the reactance of a negative inductance or capacitance, e.g. $-jX=j\omega(-L)$ or $1/j\omega(-C)$.

These reactances act in the normal way except that the current flows in the reverse direction. In a circuit with steady cisoidal voltages and currents, a reversed current is equivalent to one 180° out of phase. In this case the current of a negative inductance is in phase with that of a positive capacitance, but this, it may be considered, is a confusing coincidence.

It may be shown by simple formulae and diagrams that when a d.c. generator is connected to a series RL or RC circuit with normal components, the current changes rapidly at first and then becomes steady.

If both components are made negative, in each case, the current varies as before but flows in the opposite direction. If however one component only is made negative, the time constant becomes negative, and the current increases indefinitely. In these cases of transients the inductance never behaves as capacitance with any combination of positive or negative components. The above does not take into account any practical difficulties in simulating the negative components.

If the real part only of an impedance is negative, the impedance is equivalent to a negative resistance plus a normal impedance of which the resistance is zero.

In the section "Principles of Dependency", "Cathode Ray" limits the definition to cisoidal voltages and currents in order to find the phase angle for the equivalent impedance, but this is not necessary for ϕ is defined by

$$\begin{aligned} \cos \phi &= \text{True Power} / \text{Apparent Power} \\ &= \text{True Power} / EI. \end{aligned}$$

$\cos \phi$ is positive for leading or lagging ϕ , i.e. with the current in the first or fourth quadrant. With negative true power $\cos \phi$ is negative, which means that the current is in the second or third quadrant, i.e. it is reversed as we saw before.

In the text concerning Fig. 5 "Cathode Ray" applies "Ohm's Law" not to a resistor but to a generator. This gives a very peculiar resistor, for, apart from being negative, the resistance varies with current, and the back e.m.f. (or should it be forward e.m.f. for a negative resistance?) remains constant even when the current is switched off or reversed. It says in W.W. for August 1953, referring to the application of "Ohm's Law" to a circuit containing an e.m.f., "even a beginner would have to be rather dim to fall into the trap."

"Cathode Ray" must have read that—he wrote it. Further explanation is wanted here.

Binley,
nr. Coventry.

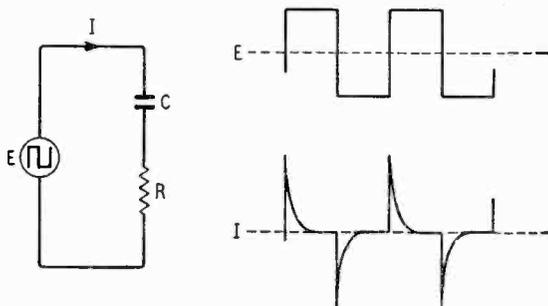
D. L. CLAY.

The author comments:

Mr. Clay has convinced me that it is time I wrote on the meaning of the word "negative". Meanwhile, I must repeat that the long-accepted understanding of "negative reactance" (which fits consistently into the larger subject of complex numbers) is the quantity which is set off vertically downwards in an Argand impedance diagram. Since the only passive circuit element that has negative reactance is capacitance, "negative reactance" normally means "capacitive reactance". It is true that with the aid of feedback amplifiers one can simulate negative inductance, and its reactance is also negative. Except perhaps in very specialized contexts, however, one would be wise to refer to it as "negative inductive reactance".

But the subject, after all, was impedance. If instead of retracing the ground of my penultimate paragraph Mr. Clay had explained to me what he or Dr. Myers means by negative impedance I would have been grateful. Is it any impedance in which both resistance and reactance are negative? Or only if the reactance involves negative inductance or capacitance? Is an impedance comprising negative resistance and negative capacitive reactance (i.e., the reactance of a positive capacitance) negative or positive? And how about a negative resistance and positive inductive reactance, involving negative capacitance? And, in any case, what is to be gained (except confusion) by whatever convention of this kind is adopted with regard to impedance, seeing that the signs of the real and imaginary parts are determined on quite different principles?

Mr. Clay seems to have a novel definition of phase angle: The phase angle (as commonly understood) between the cisoidal voltage and current having the same r.m.s. values and conveying the same true power as the voltage and current in question. But a glance at the current and voltage waveforms for the circuit shown,



in which CR is small compared with a period, will show that this "phase angle" (of the order of 80°) is not easily identifiable.

Whatever gave Mr. Clay the idea that I was applying Ohm's law to Fig. 5? Not only did I not say I was, but (lest anyone should mistake silence for consent) I added to the caption the exclamation "... resistance (not an ohmic one in this case!)"

"CATHODE RAY"

THE quotation "Omnis definitio periculosa est" (from Erasmus) which heads "Cathode Ray's" article on im-

pedance in your February issue is very apt: all definitions are dangerous, because the question as to whether a particular idea is or is not a proper concept or vehicle of thought cannot be properly settled by mere information, or by appeals to establish custom or to definitions (as in "Cathode Ray's" article). It is necessary instead to review radically and critically ideas we have always known (or have thought we knew, and have taken for granted). Without such a fundamental, critical review our intelligence may be bewitched by the words or symbols used.

At least one can agree with "Cathode Ray" in condemnation of negative impedance, even if he regarded a certain letter to the *Journal I.E.E.* as incomprehensible. It will perhaps help the readers of *Wireless World* to appreciate the real point at issue if we simplify the subject under discussion somewhat, and consider, instead of "negative impedance", the notion of "negative" alone. The ideas involved should then be universally understood even by professors (for whom it is difficult to achieve the unbiased ignorance necessary for clear fundamental thinking).

We first meet the minus sign at school as equivalent to an order to reduce the number preceding the minus by the number following the minus, which is always less. If at this stage our teacher asks us to subtract 8 from 6, the correct answer is the natural one: it cannot be done. Robinson Crusoe, for example, could not have a debt or a minus quantity of any kind. The teacher may try to explain that a negative answer (like -2 , the result of trying to subtract 8 from 6) implies a debt, or legally or socially agreed contract to deliver the corresponding positive quantity (here 2) at some future date. The more docile and obedient children simply accept this idea, but the more intelligent children are right to regard it as not simple, and accept it unwillingly. Indeed, the minus sign affixed to a result (as opposed to an item legitimately subtracted during the course of a calculation leading to a positive final result) is a mere social convention, devoid of inherent and independent capacity to exist as a logical concept.

On the other hand when the signs $+$ and $-$ are applied to spatial or geometrical relations, there is no difficulty: the sign $+$ then indicates a move to the right (or up) while the sign $-$ indicates a move to the left (or down) and the final result may have any direction relative to the origin. The directions of the axes are arbitrarily chosen, and are not essentially different from other directions. However, because numbers represented along (say) the x -axis and to the right of the origin can be handled in a manner very like the positive numbers of early childhood, we are apt to think that they are identical, whereas we should be careful to state the kind of universe in which we are working. Is the "positive" universe of Robinson Crusoe or the "geometrical" universe appropriate to the problem under consideration?

The obedient student tends to regard the ideas "minus" and "negative" as universally applicable and "obvious" concepts instead of only applicable where a "geometrical" universe is appropriate. Thus the adjective "negative" applied to mass, energy, horse, shilling, etc., is correctly regarded as a mere verbalism indicating that the quantity specified is to be subtracted.

The existence of the phrase "negative horse" does not imply that a corresponding physical entity exists in the world, or even that it could exist in any world. Likewise, negative resistance, negative inductance and negative capacitance exist only in the purely verbal sense of terms in a mathematical formula which will at some later stage of the calculation be subtracted from greater positive terms.

Kingswood Warren,
Surrey.

J. W. HEAD.

The author comments:

Having stated that fundamental, critical review is the only proper way of settling whether a particular idea is or is not valid, and that appeals to custom or definition

are no good for this purpose, Mr. Head proceeds to demonstrate this point on the idea of "negative."

He begins by appealing to a definition of the meaning of the minus sign. I suppose if I raised a point of order here he would appeal to the other forbidden thing—established custom—by claiming that his definition is a widely accepted one. However, I don't want to be awkward so soon, so let it pass.

Having shown that according to this definition a negative quantity as an independent entity is an impossibility, he goes on to say that when a minus sign is applied to geometrical relations there is no difficulty. One might have expected that the fundamental and critical review on which Mr. Head was engaged would have caused him to boggle at the spectacle of something just declared to be impossible suddenly becoming not merely possible but devoid of difficulty.

Since he regards the minus sign as an instruction relating to numbers, presumably he would justify its geometrical application by regarding it as an instruction to subtract a number of units of length measured to the right (or upwards). If so, the reason one can be left with a negative answer in this case is that a zero has been arbitrarily fixed somewhere inside space. A sufficiently clear-minded review ought, however, to have shown that if this is allowed there is no difficulty with the school problems either. 0°C , for example, is a zero arbitrarily established inside the possible range of temperature, so -5°C is an actual physical (not geometrical) state. It would have been easy for Robinson Crusoe to have had a negative number of breadfruit for dinner, if he had established his zero level as the amount required to give him a pleasantly full feeling.

The distinction between Mr. Head's "geometrical" and "positive" universes, therefore, seems quite artificial and personal.

Mr. Head is good enough to say that one can at least agree with me in condemning negative impedance. But if his discourse on "negative" has any relevance, it is difficult to see why. He mentions resistance, but not impedance, among the things having no existence except as a term in a formula which will have to be subtracted from greater positive terms. From the context, however, it seems reasonable to assume that he would put it in the same class. Are we to infer, then, that negative impedance is permissible in the same sense? If so, his measure of agreement with me is very small.

I now give warning (but not in Latin) of another danger: that of the mathematician's armchair review. The basis of science is experiment and observation, before which many critical reviews have had to give way. Certain circuits have been observed in which the *net* resistance, at least for a brief time, is negative. There would seem to be no valid logical objection to students of such circuits making use of a parameter "facilitance" for negative resistance. Logically, negative facilitance would be classed by Mr. Head among the things existing only in the sense of temporary terms in a mathematical formula; nevertheless, in most circuits it would emerge as the final answer.

And how does electric charge fit into Mr. Head's philosophy?

Summing up: One is unlikely to disagree either with the meaning Mr. Head gives to the minus sign or with his immediate observations thereon. It is a pity he then fouls his own nest by bringing in a "geometrical universe" as an unexplained contradiction. And it is a pity he offers all this as a help to answering the question of negative impedance, dismissing with contempt the one thing on which it really turns—definition. As a mathematician he should know that signs and terms mean what they are made to mean, and that without established custom there would be chaos. There is general acceptance of what "negative resistance" means. There is not general acceptance of what "negative impedance" means, or that it has any meaning at all that is in keeping with related concepts.

Confusion does sometimes result from failure to dis-

(Continued on page 181)

tinguish between negative quantities and negative values. One often denotes the voltage of a valve grid relative to the cathode by the symbol V_g . It usually turns out to have a negative value. But one could define V_g as the negative voltage of the grid relative to cathode. In that case it would usually have a positive value. Other writers say: "Let $-V_g$ be the voltage of the grid relative to cathode." In that case too V_g is usually positive.

I understand Mr. Head to be making the proposition: "That in any self-contained system no non-geometrical quantity can have a net negative value."

The question I actually raised was what meaning, if any, can logically be given to negative values of the quantity "impedance." Certain American writers attach a defined meaning to them. I deprecated the practice on the ground of liability to clash with established practices. It is (*pace* Mr. Head) a question of definition and custom.

"CATHODE RAY."

A.F. Amplification

I WOULD like to clear up a few points that have arisen in correspondence in the March issue:—

First, I appreciate Mr. Tily's comments and agree that two pentodes with negative feedback will give similar results to the circuit I use. More components will be needed, however, and the cost of a pentode valve exceeds that of half of a double triode by an appreciable amount. With regard to the low phase shift obtained, this is restricted to 90° , as Mr. Tily correctly states, and enables feedback circuits of exceptional performance to be obtained*.

Regarding Mr. Short's letter, I have a suspicion that I did not state my case as clearly as I should have done. A triode in a conventional circuit can admittedly give a gain of some 40 times, but due to Miller effect the input capacitance will be over 100 pF (allowing for strays). This restricts the effective anode to earth impedance of the previous stage to less than 160 k Ω under which conditions the gain in V1 will be considerably less than 200 times.

I really cannot agree with Mr. Short on his figure of merit. If one is going to use such a unit then it should be on a logarithmic amplification basis. For instance, a cascaded amplifier of two valves each having a gain of 100 times and having 10 components would have a

figure of merit of $\frac{100}{10} = 10$ per stage, but $\frac{100 \times 100}{20} =$

500 overall. An amplifier that is 50 times cheaper per component, if you double its size, is certainly rather peculiar. The output stage is a cathode follower as it is driven on its grid between grid and earth as reference.

I do agree that its output impedance is not $\frac{1}{g_m}$ as

might be expected, but this applies to all cathode followers driven from a high source impedance. I cannot agree that the input capacitance of the triode is increased due to action of the triode. The effective input capacitance is C_{ea} (between grid and earth) plus the very small effect of C_{ek} as in all cathode followers. The triode was treated as a bootstrap purely for convenience in explanation; it is still a cathode follower: a leopard does not change his spots just because you look at him from the other side!

With regard to the high gain-bandwidth comment of Mr. Short, I entirely agree you cannot do more than nature will allow.

Regarding Mr. Mansfield's letter, all I can say is that this particular circuit, or modifications of it, has been operating in no fewer than 10 pieces of equipment over the last four years with no valve failures. One answer to this point would be to raise the heater chain to about +50 volts which would even out the heater/cathode stresses to less than 100 volts in any valve, the cathode voltage of the triode being normally less than 120 volts above earth potential.

In conclusion, the author would like to state that in

all the versions that have been used of the circuit (in oscillators and selective amplifiers as well as those described), it has always worked as it should, with never any trouble from parasitic oscillations, which is more than can be said for many two-stage amplifiers.

Bradford, 7.

A. R. BAILEY
Bradford Institute
of Technology

* "Low Distortion Sine Wave Generator"—Arthur R. Bailey, *Electronic Technology*, February, 1960, p. 64.

I WAS interested to see the article on "Economical High Gain A.F. Amplification" in your January issue. I modified the circuit, given by E. Jeffrey (*Wireless World* Vol. 53, page 274, August 1947), to single-ended working, shortly after his article appeared, and have used it single-ended in an audio-frequency amplifier since then.

I communicated the circuit to a number of people in August 1948, and subsequently to several technical journals, but until now I have not known many show interest in the matter. I have been informed that the use of a pentode as anode load for a pentode amplifier valve was suggested by Vance. I saw an article many years ago where E.M.I. used a valve as anode load but this was complicated by a deliberate use of phase-shift to obtain reactive effects. I believe linear time constants have been obtained using a basically similar circuit. The low output impedance would have advantages in pre-amplifiers feeding into lines and when feeding some grid input circuits. The poor high-frequency response is a definite advantage with regard to stability in negative feedback amplifiers.

Allerton, Bradford.

A. WOMERSLEY.

Circuit Conventions

AT the age of four I was taught to draw circuit diagrams as exemplified by Fig. 1. Even at this age it did not

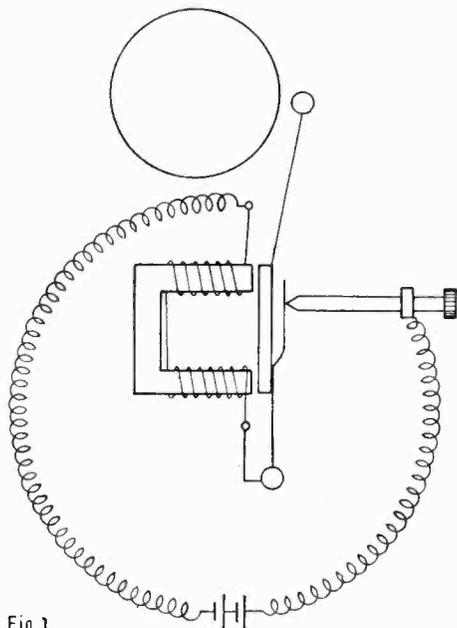
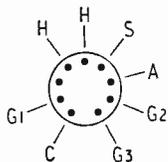


Fig. 1

take me long to appreciate that from the point of view of the circuit the literal depiction of the elegant green silk-covered wire, neatly helixed round a pencil, was not absolutely imperative. I was therefore glad when at the age of five I was taught the "straight wire and loop" convention now current in your journal, and it took me very little time to accustom myself to this new standard. Some years later, on being introduced to the



R18	47k	C19	5,000pF
R19	100k	C21	50pF
R20	2.2M	C22	5,000pF
R21	47k	C23	200pF
R22	100k	C24	0.05μF
R23	100k	C26	50μF, 275V wkq
R24	10k	C29	1,000pF
R25	470k POT.	V4	EF 80
R26	270k	V5	EF 80
R27	47k	D1	0A 31
		D2	0A 31

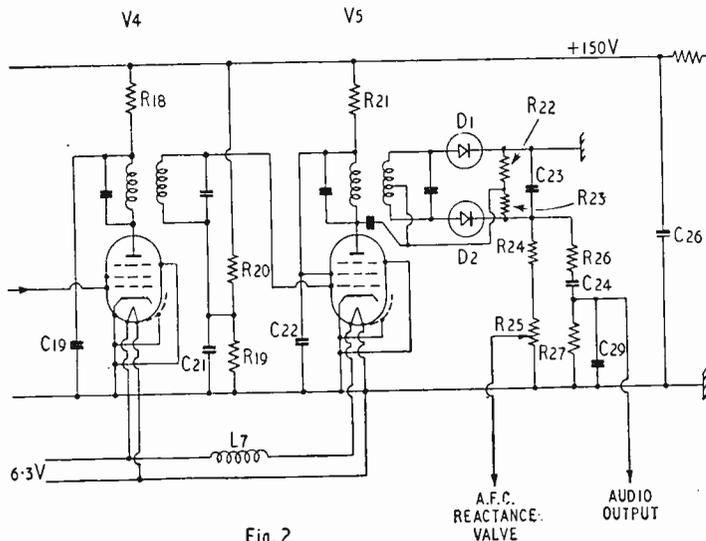


Fig. 2

wiring diagram of a telephone switchboard, I made the acquaintance of the "straight through" wiring convention. I resisted this only so long as it took me to see that the loops would be nearly impossible to draw, and totally impossible to read. This major change of convention took me rather longer to absorb into the mental system; perhaps half an hour.

This somewhat frivolous preamble is only to indicate that a change of convention is not quite such a formidable proposition as is often supposed. When a "new" convention is notably superior it will be accepted easily enough; it only needs to be given the chance.

This letter refers primarily to the continuance in your journal of the "loop" wiring convention which I regard as indefensible. Perhaps I may be allowed to add my ideas on circuit conventions generally, all this belonging to the greater subject of "notation," which I have long learnt and taught to be "more than half the battle."

My thesis is that the composer of a circuit diagram should not work to a rigid and comprehensive book of rules but to a few cardinal principles freely interpreted. I suggest that the following are such principles:

1. Information should be so expressed as to be unambiguous, and to minimize interference to thought sequences.

2. Since a circuit diagram has much to express it should not be cluttered with redundant information.

3. Cross referencing is to be avoided whenever direct referencing is admissible.

In the light of these principles, consider the diagrams of Figs. 2 and 3 which express the same circuit with different conventions:—

(a) Fig. 2 uses the loop convention which infringes two of the principles. First of all (1) is infringed because the loops interrupt the mental process of following a straight run. Secondly, the loops infringe (2) because the loops show the absence of a join. To show the absence of something is redundant.

(b) There is a minor difference between Figs. 2 and 3 in the conventions for T junctions. Some standards favour a "blob" on T junctions. However the T junctions of Fig. 3 can have only one meaning, so the blob, essential at an X junction, is redundant at a T. Therefore I prefer the Fig. 3 convention, though I am prepared to regard it largely as a point of "style." (Another standard avoids the issue by "staggering" so as to use only T junctions.)

(c) We come now to the valve conventions. In the first place the envelope plays no circuit role, nor is it needed to "group" the valve elements. It is therefore redundant in a circuit diagram and should not appear. [Still less is an envelope required round a transistor.]

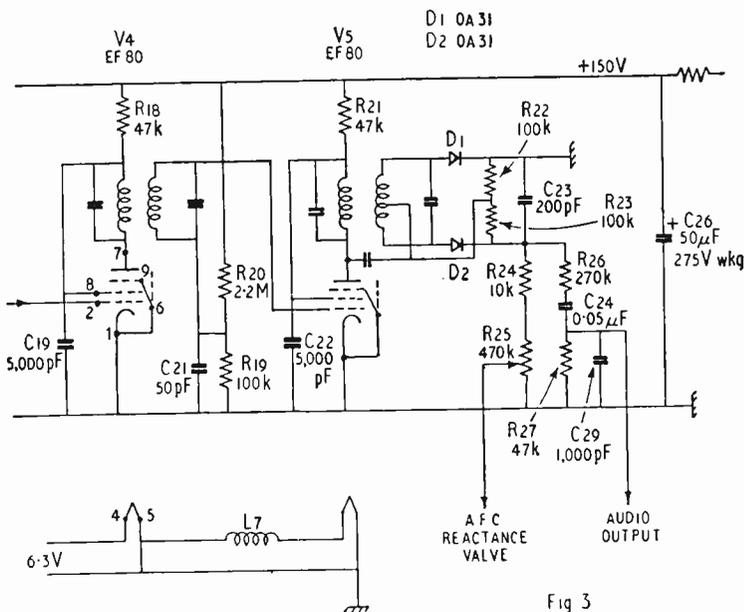


Fig 3

On the subject of pin numbering one must take into account the intended purpose of the diagram. If it is purely theoretical, i.e., if it is not in any sense a practical wiring diagram, the pin numbering is redundant and should be omitted. In any other case the pin numbering is preferably shown *directly*; not indirectly

as in Fig. 2. Direct numbering is more easily possible when the superfluous envelope is omitted.

As a fine point, Fig. 3 omits the pin numbering on V5 because this is shown on the adjacent valve V4 of the same type. Principles (2) and (3) are here in conflict, and the choice is a delicate point of style.

If the above is accepted as a good philosophy of circuit drawing, then it would appear that the loop convention stands condemned. Its continuance in your journal would seem to imply uncomplimentary assessments of your readers; either that they are incapable of assimilating change, or that they are apt to wire with their soldering irons rather than with their brains.

Luton. L. H. BEDFORD

[We welcome Mr. Bedford's criticisms and acknowledge the force of his arguments against looped crossings, particularly in relation to complex wiring diagrams; but the telephone switch-board type of circuit does not often occur in this journal. Long experience has taught us that errors in draughtsmanship and checking are fewer when looped crossings are employed. The formation of the crossover loops is the first deliberate act when inking-in a pencilled circuit; further checks are imposed when ruling in the horizontal and vertical lines. In Mr. Bedford's method the fact that mental processes are not interrupted when drawing a straight run constitutes a potential source of error. The peppering of his circuits with dots would be the last act, which, things being what they are, must often be done against the clock with the blockmakers' messenger waiting to collect the finished product! (Incidentally, in Mr. Bedford's Fig. 3, which has been faithfully reproduced, his draughtsman seems to have given the pot too hard a shake over V5. There is also a mistake in the heater circuit, which does not occur in Fig. 2 where the W.W. convention is used.) With looped crossings and staggered junctions (which have long been the rule in W.W.) you have both belt and braces, and, strange as it may seem, they look nice—or so we think.—Ed.]

"Subjective" Colour Tests

IN reply to C. E. M. Hansel's letter (March issue) I should like to elaborate on the conditions under which Land-colours were obtained using a stereoscope. Rivalry between the two eyes was found to be troublesome. This was minimized by matching the intensities presented to the eyes by using an appropriate neutral filter (N.D. \approx 0.6) in the "white" path.

With most subjects it is only after viewing for some minutes that the colours become fully developed, but these are finally almost as saturated as in the normal Land arrangement.

With inspection times of the order of 5-10 minutes, about 15 out of 20 subjects have reported the usual range of Land colours, the same object in each arrangement being given the same colour name by different observers. Reversal of the filters gives similar results to those reported with Land's usual arrangement.

On the other hand, when the inspection time was limited to 10 seconds it was found that only 2 out of a group of 30 students could see Land colours, although all had previously seen them in the usual projection arrangement.

Pictures of natural objects were used. These contain internal contours, such as shadows and highlights, which would be similar in both eyes. Such a pair of pictures might be expected to fuse (i.e. the internal process of combining the images as distinct from the external process of registration) better than a chart of test patches whose only contours are colour boundaries.

Although negative results are easily obtainable, therefore, these positive results would seem to rule out a purely retinal theory.

London, W.C.2. J. P. WILSON,
Information Systems Group,
King's College.

"Piped TV"

I WAS surprised to note the implication in the paragraph on piped television under "Random Radiations" in your March issue, that wired television systems of the kind operated by the Rediffusion Group require special receivers and do not allow the public a free choice in the selection of a television receiver. This, of course,

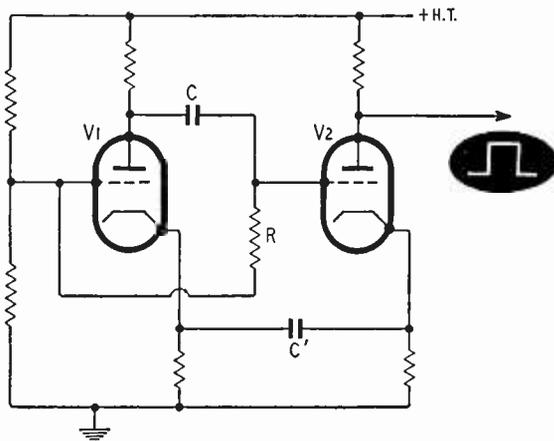
is not the case. Some 35,000 ordinary television receivers supplied by manufacturers other than ourselves are at the present time connected to our wired television systems. There are two methods of connection: in the first and most popular, the front end of the receiver is replaced by an adaptor which takes the signal from our network and delivers it direct to the cathode ray tube and sync. separator of the receiver; in the second, which involves no alteration to the receiver, a separate unit mounted outside the receiver converts the carrier frequencies used on the network to frequencies in Band I which can be accepted by the unmodified aerial receiver.

Of course, if a member of the public wishes to secure the full economy which a system of sound and vision distribution, designed as an integrated whole, can provide, then he will select the receiver which has been designed as part of that system.

London, S.W.1. R. P. GABRIEL,
Rediffusion, Ltd.

Two-State Terminology

J. M. PETERS' article on "Triggered Two-state Circuits" in the February instalment of "Elements of Electronic Circuits" illustrates in Fig. 1 a cathode-coupled flip-flop or relay and *not*, as stated, a cathode-coupled multivibrator for which the basic circuit is:—



In this arrangement the charging and discharging of C' through the potential difference between cathodes mainly determines the period of oscillation in the freely-running state. This action bears little relationship to that of the cathode-coupled flip-flop where the period is partly determined by the time-constant of C and R (Fig. 1); in the multivibrator circuit this time-constant is normally made high compared with the natural period and is not connected with a cumulative action.

H.M.S. Ariel II, S. J. WALTON,
Winchester. C. V. F. C. VELEY.

The author comments:

I do not disagree with Messrs. Walton and Veley that the circuit (Fig. 1) is a flip-flop relay, but I still maintain that it comes under the general classification of multivibrators. It can be argued that any square-wave generating device, either freely-running or triggered, is a "multi-vibrator" because Fourier analysis will show the presence of harmonics up to at least the several hundredth. If the bias voltage applied to one valve of a multivibrator is made sufficiently negative the circuit then becomes a relay, the stable state being that in which the unbiased valve is conducting. To qualify for description under the heading "Triggered Two-state Circuits," the simple basic circuit of Fig. 1 had to provide a relay action. It was therefore necessary to arrange for the current flowing in V2 when V2 was conducting to be greater than that in V1 when V1 was conducting, so

that V1 could be cut off by V2 (by the bias on R_k), hence requiring a positive grid pulse at V1 to continue the action. Asymmetry in the cathode circuit is all-important for this action.

The circuit given by your correspondents is only one type of freely-running cathode-coupled relaxation oscillator, square-wave generator or "multivibrator," which depends for its action on unequal cathode load resistors. The charging and discharging of C through the difference in cathode potentials determines the period of oscillation. I could draw the circuit of another form of freely-running cathode-coupled relaxation oscillator, also termed a cathode-coupled "multivibrator," while a third variation is the bootstrap circuit described in the February article.

J. M. PETERS.

Transistor Stopwatch

IN your November issue the author of "Transistor Stopwatch" states that the OCP 71 phototransistor in Fig. 3 is used as a photodiode. I disagree with this statement and maintain that it is being used as a transistor even though the base is "left floating."

When used in this manner, the light falling on the base of the transistor produces free electrons and holes in the base, the electrons so produced then act as the base current which is normally derived from an external signal source. The usual transistor action now occurs and an amplified version of this "light" current flows in the collector circuit. Therefore the device is being used as a transistor amplifier and cannot possibly be considered as a diode.

The phototransistor could be used as a photodiode by connecting either the base/emitter or the base/collector junction to a reverse bias supply. The light falling on the junction would then merely increase the reverse current.

Hounslow.

R. O. BRADLEY.

THE following circuit of a simple electronic stopwatch using the integrating capacitor method may be of interest to readers, particularly in comparison with the

pulse count method used by D. E. O'N. Waddington in his transistor model (*Wireless World*, Nov., 1959). The two methods form an interesting comparison of computational technique—the pulse method and integrating capacitor method representing the digital and analogue branches respectively. It is also interesting to note that the pulse count circuit was used to measure flight times of a projectile, and the circuit shown here is used extensively in practical dynamics measurements of velocity and distance-time relations in technical college classes.

The circuit is very simple, consisting of an Eccles-Jordan bi-stable switch controlled by miniature germanium photocells, a charging voltage gate, diode one-way gate, charging capacitor and valve voltmeter. Two ranges of time measurement are used, 0 to 0.05 sec and 0 to 0.5 sec. Practically all the parts required are to be found in the surplus Modulator Unit Type 67, and each unit has shown itself to be very reliable and virtually foolproof in the hands of often very inexperienced operators.

Duffield, Derby.

D. M. MELLUISH.

CORRESPONDENCE on photographic timers fails to disclose the one fault of these devices. Unless the timing condenser is a plastic film type (at £2 a microfarad) the timing of the circuit may vary by as much as 20% in a few weeks, since this is the variation of ordinary paper condensers.

Plymouth.

G. G. GARDNER.

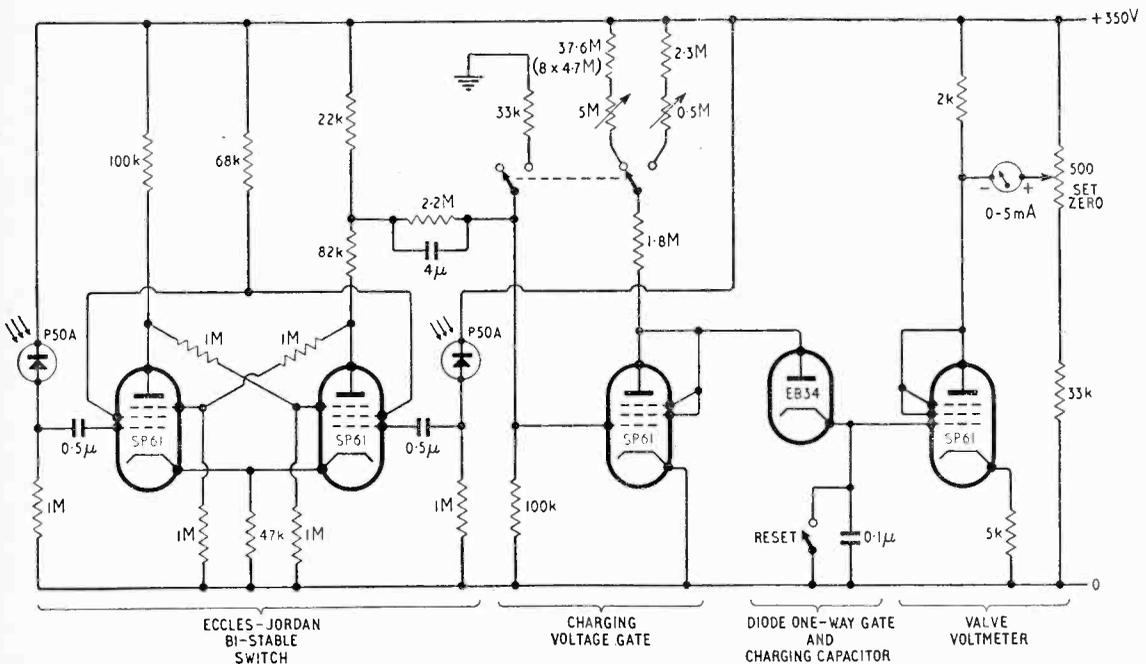
Colour Codes

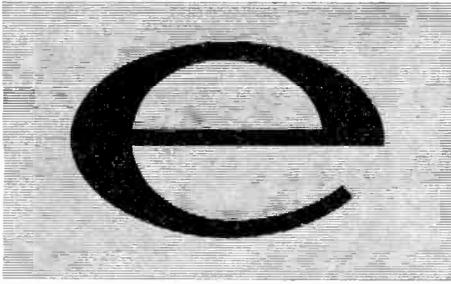
THE problem of wiring codes which do not conform to the usual British standard is capable of being solved quite simply. A legal prohibition of the importation of any equipment which does not conform to the British standard is all that is required, with a rider that the sale of any equipment already imported but not rewired to conform is also prohibited.

Marlborough.

H. J. FENN.

[Electrical and radio equipment imported into other countries, for example, Canada and Sweden, must comply with their "safety" regulations.—Ed.]





By "CATHODE RAY"

REGULAR readers (if any) who have noticed my fondness for terse titles will appreciate the above. I had thought of "e^{ix}", but decided that was needlessly long-winded for the purpose. (Like the Scot who, after three hours of silent fireside fellowship with his brother just back from Australia, so far forgot himself as to remark "Aye . . .")

A recent leader in *The Times* contrasted mathematicians, who delight in tracing the perfect abstract relationships of their subject, with engineers, who work by "rule of thumb." I don't know if the Top Mathematician who wrote this was asserting that engineers are content to use logarithms or sliderules for their calculations without troubling to find out what a logarithm is, and that they apply the formula $E(1 - e^{-t/CR})$ to plot the charging of a capacitor without knowing what e is (except perhaps that it = 2.71828 . . .) and why. Or whether his point was that the whys and wherefores of maths are outside the scope of engineers. There is probably a grain of truth in both, but I'm sure that few engineers are in fact content to use anything without at least trying to understand it, and those that are are bad engineers. For while it is true that they can make good practical use of logarithmic and exponential tables—and Bessel functions—without having the least idea of the principles involved, anything outside the memorized instructions would be completely beyond them. Even for strictly practical purposes one's aim should be to have such a grasp of mathematical principles and their inter-relationships as to see the easiest way—or at least a way—of tackling any new kind of problem.

Two months ago I mentioned that a unit vector (say in an a.c. vector diagram) inclined at any angle θ can be represented mathematically by $e^{j\theta}$, which is the same as $(\cos\theta + j \sin\theta)$. It was quite easy to explain and visualize the lengthier expression, but I excused myself from pursuing the subject of $e^{j\theta}$ any farther just then, on the ground of shortage of space. If you suspected the worst about that, please be more charitable in future, for here it comes!

There is perhaps some excuse for using $e^{j\theta}$ as a mathematical tool in blind faith rather than clear understanding. According to the ordinary rules, it appears to mean a very odd number (2.71828 . . .) multiplied by itself an imaginary number of times. That is not a very helpful or even intelligible concept. The fact that an "imaginary" number, distinguished by the label "j" ($=\sqrt{-1}$), is one measured vertically on graph paper, as distinct from "real" numbers which are measured horizontally, hardly clarifies the matter. Why on earth should a vector of unit

length be based on 2.71828 . . .? Why should θ be rotated anticlockwise through a right angle (that being the accepted significance of j)? And how can one multiply together $j\theta$ factors, each equal to e? And, above all, how can one reasonably interpret the result as a unit vector inclined at angle θ ?

Some books take the line of Humpty Dumpty and tell their readers that mathematical symbols mean just what they are made to mean. In other words, they are purely arbitrary. So they don't have to make sense. Certainly the choice of symbols such as π and e and = is arbitrary, and if they were all shuffled and dealt again it would make no difference provided all concerned remembered the changed meanings. But it doesn't follow that choice of symbols is unimportant. The object of practical maths is to eliminate as far as possible the need for thinking.

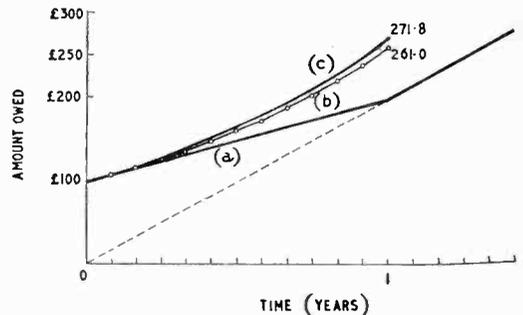


Fig. 1. Growth of a debt due to borrowing £100 at 100% per annum, when the interest is added (a) annually, (b) monthly, (c) continuously.

(That is not just mental laziness; the idea is to give the mind more time for constructive work.) If symbols are appropriate and easily remembered and universally used, that all helps. More important, the rules for their use should be consistent and free from exceptions.

For example, in accordance with the definition that a^n means the product of n factors each equal to a we have $a^2 = a \times a$, and $a^3 = a \times a \times a$, and $a^2 \times a^3 = a^5 = a^{2+3}$. In accordance with the same definition, a^0 , a^{-1} and a^1 are nonsense. But the meanings that have been given to them are not just arbitrary; they are such as to be in the spirit of the definition by conforming to the same rules*. Thus, to obey the addition-of-indices rule, $a^0 \times a$ must be equal to $a^{0+1} = a^1 = a$, so a^0 must be 1. Similarly

*An example of a rule that does have exceptions, against which one must always be on guard, is $a/a = 1$; it fails when $a = 0$ or ∞ .

$a^{-1} = 1/a$ and $a^1 = \sqrt{a}$. But imaginary numbers won't mix with real numbers, so this direct approach fails to give meaning to e^0 . To work out for ourselves a satisfactory meaning, we shall have to go a surprisingly long way round and pass through some unexpected territory.

First of all—and this justifies the sweet simplicity of the title—what is the significance of e ? Why should it crop up so often, even in such simple things as charging a capacitor from a constant voltage? That other ubiquitous number running to unlimited decimals — π — has a quickly explainable and easily appreciated meaning. But too often one is just told that e is the base of natural logarithms. So what?

The rate at which a lot of quantities vary is proportional to the quantities themselves. For example, if you borrow £200 at a certain rate of interest you have to pay twice as much as if you bor-

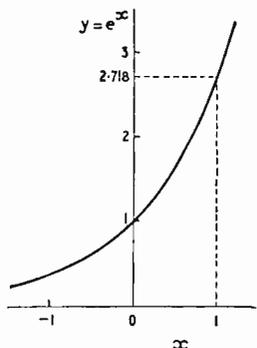


Fig. 2. The graph of e^x is the same as (c) in Fig. 1, divided by 100 to make it start from 1.

rowed £100. In simple interest, the interest is paid as it falls due, so that capital remains constant. In natural events, however, the "interest" is continuously added, so the rate of increase itself increases accordingly; it follows the law of compound interest. Suppose someone (you would have more sense) borrowed from a rapacious money lender who charged 100% per annum compound interest. That would appear to mean that each year the amount owed would be multiplied by 2. At the end of the first year it would therefore be £200, and the rate of increase for the next year would be double, as shown by (a) in Fig. 1. But the lender might be more cunning and specify his rate of interest as 100%/12, or 8.3%, per month. So at the end of the first month a debt of £100 would have risen to £108.3. It would be multiplied by 1.083 every month, so after 12 months would be $\text{£}100 \times (1.083)^{12}$, which is over £261. This figure is reached by a series of 12 straight lines (b), each 8.3% steeper than the last. If the money lender happened to be scientific as well as cunning, he would calculate his interest on the basis that it was being added continuously (c) instead of at monthly or any other finite intervals, and at the end of the year would demand £271.828, or $\text{£}100 \times e$.

For that is what e means. Only of course it applies to any two quantities, one of which varies with respect to the other at a rate proportional to itself; not only money and time.

We arrived at a rough approximation to it (2.61) by dividing the rate of interest by 12 and applying it 12 times. In other words, we evaluated $(1 + \frac{1}{n})^n$ for $n=12$. The larger we make n , the nearer we

approach a continuous curve and the value e . One method of getting as near e as we like or have time for is to use the binomial theorem to express $(1 + 1/n)^n$ as a series, with the result

$$e = 1 + 1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \dots$$

$$\text{or } 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots$$

where " $m!$ " means the first m numbers all multiplied together. As the terms in the series dwindle very rapidly, only a few more are needed to give quite a close approximation.

In Fig. 1, the continuously-rising debt after 1 year is e times what it was at the start. The next year it is again multiplied by e , so after 2 years the total multiplication is e^2 , and so on. So if y_0 is the original debt, the debt y after x years is $y_0 e^x$. Fig. 2 shows a plot of e^x against x . Because (as we have seen) any number to the power 0 is equal to 1, the curve of any number to the power x would pass through the point $y = 1$ at $x = 0$. But e is the only number for which the slope is everywhere equal to y . Note, too, that the same principle works to the left, into the negative values of x . And that e^x has no negative values.

In these days I ought to be safe in assuming that anyone who might be interested in e would know that there is a special and very important place in mathematics for slope; it is usually designated by the composite symbol $\frac{d}{dx}$, meaning "differentiate with respect

to x . So e can be defined by the equation

$$\frac{d}{dx} e^x = e^x$$

Now the method we have just used for approximating to e is available for e^x and gives

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots$$

The rule for differentiating any power of x is to multiply by that power and reduce the power by 1. E.g., $dx^3/dx = 3x^2$. If we perform this operation on the e^x series we confirm that it is like the application of water to a duck's back. For the graph of any constant quantity is a horizontal line, so its slope is

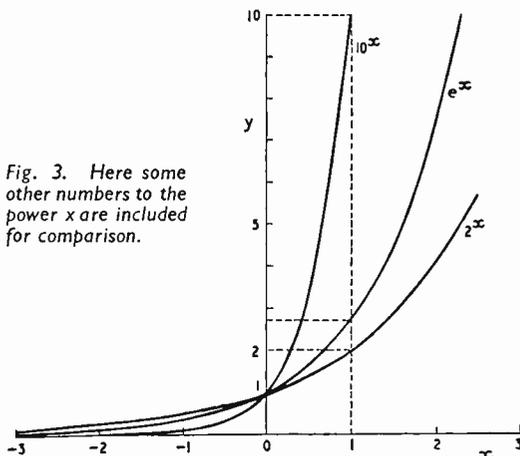


Fig. 3. Here some other numbers to the power x are included for comparison.

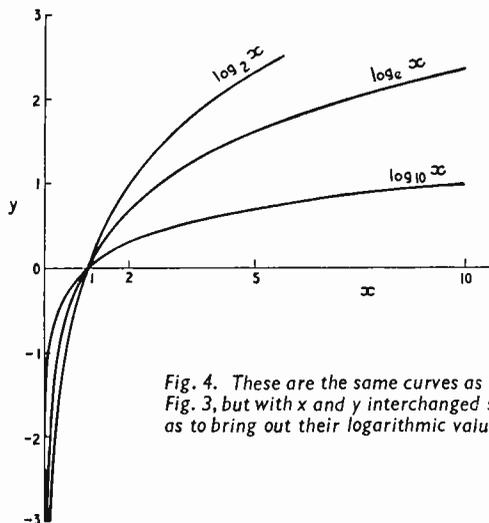


Fig. 4. These are the same curves as in Fig. 3, but with x and y interchanged so as to bring out their logarithmic value.

zero, and therefore 1 goes out; x reduces to 1; $x^2/2$ reduces to x ; $x^3/6$ to $x^2/2$, and so on to infinity. The net effect is therefore nil.

Suppose, however, that we didn't know what the series for e^x was, or anything about $(1 + 1/n)^n$ or the binomial theorem. All we knew was that the slope of e^x was equal to e^x , starting at 1 for $x = 0$; and the rule for differentiating (i.e., finding the slope by algebra). Then, by guessing that a power series might exist for e^x , we could construct it. For the general power series is

$$a + bx + cx^2 + dx^3 + ex^4 + \dots$$

where a, b , etc., are unknown constants. Differentiating this we get

$$b + 2cx + 3dx^2 + 4ex^3 + \dots$$

and equating these two (in accordance with our definition of e^x) we find

$$b = a$$

$$c = b/2 = a/2$$

$$d = c/3 = b/2.3 = a/2.3$$

$$e = d/4 = c/3.4 = b/2.3.4 = a/3.2.4$$

So the series must be

$$e^x = a + ax + \frac{ax^2}{2!} + \frac{ax^3}{3!} + \frac{ax^4}{4!} + \dots$$

We still have to find a . For this we draw on that other fact about e^x which makes it so basic and simple—that its starting value (at $x = 0$) is 1. (Which of course is the same as saying that its starting slope is 1). Putting $x = 0$ in the above series, we find that a must be 1, and so we arrive by another route at the same series.

For the sake of comparison we might like to plot some other number to the power x ; say 10, as in Fig. 3. Or, since digital computers are bringing the binary scale into prominence, 2^x .

Before leaving these graphs we should remember that there is an alternative way of looking at them. If y equals any number to the power x , then x is the logarithm of y to that number as base. Fig. 3 is therefore not only a selection of exponential curves (x being the common exponent or index) but also a selection of logarithmic curves to different bases.

As such, Fig. 3 would normally be shown turned on its side, and left to right, with x and y interchanged, as in Fig. 4; but the curves themselves are exactly the same. Because we count in tens, the most convenient logarithms for ordinary arithmetical computation are to base 10. If we worked in the binary scale, our log tables would be to base 2. As one might guess from Fig. 4, there is a constant ratio between logs to any two bases, so it is quite easy to convert tables of common (i.e., base 10) logs to any other.

However, the only point that concerns us just now is why logs to base e have any special interest. If we turned a hill up on its end, what was previously a gradient of 1 in 3 would be 3 in 1. The distinctive feature of the e^x curve in Fig. 3 is that its gradient at the start ($x = 0, y = 1$) is the simplest possible—1 in 1. So turning it up on end makes no difference here. (The fact that it looks steeper is solely because I used different horizontal and vertical scales, to get the graph on to the page.) Elsewhere along the curve the slope has changed from e^x to $1/e^x (= 1/y)$, in the notation of Fig. 3. In Fig. 4, x and y have been interchanged, so the slope at any point is $1/x$. Therefore, in calculus symbols,

$$\frac{d}{dx} \log_e x = \frac{1}{x}$$

(The tendency nowadays is for " $\log_e x$ " to be written " $\ln x$ " where the n commemorates Napier, the inventor of logs to base e .) With any other base, the sweet simplicity of this formula is marred by a constant factor, usually with unlimited decimals.

In case the purely intellectual appeal of simplicity is not appreciated by all, I will now give one example—out of very many—of the importance of e in practice. Fig. 5 shows a capacitance C charged to voltage V . At zero time ($t = 0$) it is switched across a resistance R . The problem is to depict what happens to the voltage from then on, say by plotting a graph of v against t .

We already know that at $t = 0, v = V$. The charge on a capacitor is always equal to vC , so at

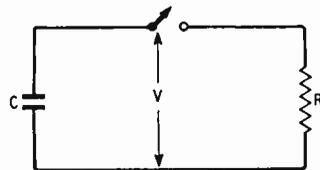
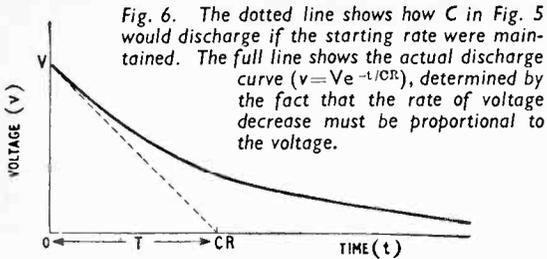


Fig. 5. Very simple capacitor discharge circuit, which is found to involve e^x .

that particular moment is VC . And the current, i , directly the switch is closed, is V/R . If it continued flowing at the same rate until the charge was exhausted, say at time T , then $Ti =$ initial charge $= VC$. So

$$T = \frac{VC}{i} = CR$$

This product, CR , is well known as the "time constant" of the circuit; as we see from the dotted line in Fig. 6, it is equal to the time that would be needed to discharge C through R completely if the starting rate were maintained. But of course, it is not maintained. When C is half discharged its terminal voltage is $V/2$, so the current is half what it was, so the rate of discharge is halved. The slope



of the actual discharge curve is everywhere proportional to its height; i.e.,

$$\frac{dv}{dt} \propto v \text{ or } \frac{dv}{dt} = kv$$

where k is a constant. The discharge curve must therefore have the same shape as those in Fig. 3. Obviously the parts concerned are those that lie to the left of zero—the $-x$ region. If we want to keep things as simple as possible we shall choose the e^x curve, because a line having its slope at $x = 0$ would, if continued, rise from 1 to 2 at $x = 1$. It is clear that if produced in the opposite direction it would fall from 1 to 0 at $x = -1$. Fig. 6 shows that $x = -1$ corresponds to our $t = CR$. We can convert from our t scale to the $-x$ scale by dividing it by CR and reversing the sign. So $e^{-t/CR}$ is the basis of the curve, and this only needs multiplying by V to fulfil the starting condition:

$$v = Ve^{-t/CR}$$

The curve can be plotted from this, using a table of e^{-x} (though in practice it might be easier to manipulate it into the form $2.30 \log_{10} \frac{v}{V} = -\frac{t}{CR}$).

If we haven't time for that we can at least note in passing that just as going from 0 to 1 in Fig. 1 multiplied the starting price by e , going from 0 to -1 (i.e., $t = CR$ in Fig. 6) divides it by e , so that at that point v is 0.368V. Similar methods can be used for showing that a capacitor charged from zero to V volts reaches 0.632V in the first CR seconds. The growth and decay of current in inductive circuits takes place in the same way. But we must press on if we are to reach our "imaginary" destination.

The first step in this trickiest bit of the journey, from "real" values of x in e^x to "imaginary" ones (e.g., $j\theta$), is to find series for $\sin x$ and $\cos x$. You could do this quite easily but uncomprehendingly—by "rule of thumb"—by dipping into a mathematical textbook, pulling out the tool labelled "Maclaurin's Theorem," and following the instructions. Anyone who is familiar with this tool already is too mathematically learned to be reading this, so I assume you have never heard of it and will therefore be surprised to know you have begun to use it already—and comprehendingly, too, I hope. It is in fact, a continuation of the rather interesting method we used for e^x ; namely, assuming that a converging power series exists, and successively getting rid of the first term by differentiating.

So we need to know what $\frac{d}{dx} \sin x$ and $\frac{d}{dx} \cos x$ are. If you don't know already, you can soon get a very good idea by drawing accurate \sin and \cos curves (one curve will do, if you move the starting line

from zero amplitude for \sin to peak amplitude for \cos) and then drawing curves of their slopes. These slopes are measured in so much per radian, of which there are 2π in each 360° . The \sin wave begins at zero but with positive peak slope, which measurement shows to be 1. At its peak its slope is zero. And so on, giving a curve which turns out to be the same as the \cos wave. Similarly the slope curve of a \cos wave turns out to be the same as an inverted \sin wave. The results, are, then,

$$\frac{d}{dx} \sin x = \cos x$$

$$\frac{d}{dx} \cos x = -\sin x$$

Now tackle our assumed series:

$$\sin x = a + bx + cx^2 + dx^3 + ex^4 + \dots$$

The value of a can be found at once by making $x = 0$. The series reduces to $0 = a$. Next, differentiate:

$$\cos x = b + 2cx + 3dx^2 + 4ex^3 + \dots$$

Again put $x = 0$, making $\cos x = 1$, so $b = 1$.

Differentiate again:

$$-\sin x = 2c + 6dx + 12ex^2 + \dots$$

This gives $c = 0$. Once more:

$$-\cos x = 6d + 24ex + \dots$$

This gives $-1 = 6d$, so $d = -\frac{1}{6}$ or $-\frac{1}{3!}$. And so

we can go on indefinitely, finding the values of the constants in the general series and establishing that

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$$

$$\text{and } \cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$$

Park those for a few minutes while we go back to our exponential series, boldly making $x = j\theta$ and seeing where it leads:

$$e^{j\theta} = 1 + j\theta + \frac{(j\theta)^2}{2!} + \frac{(j\theta)^3}{3!} + \frac{(j\theta)^4}{4!} + \frac{(j\theta)^5}{5!} + \frac{(j\theta)^6}{6!} + \frac{(j\theta)^7}{7!} + \dots$$

(Knowing what is to come, I have written down more terms than the bare minimum needed merely to make clear what the series is.) Now, since $j = \sqrt{-1}$, $j^2 = -1$, $j^3 = -j$, $j^4 = 1$, $j^5 = j$, and so on. Filling in these values, and sorting the sheep from the goats, we get

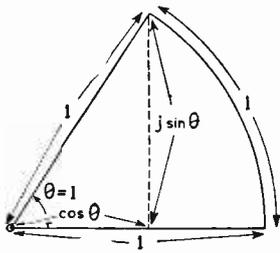
$$e^{j\theta} = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \frac{\theta^6}{6!} + \dots + j \left(\theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - \frac{\theta^7}{7!} + \dots \right)$$

Taking a good look at the two series in store to make sure, we can do no other than write

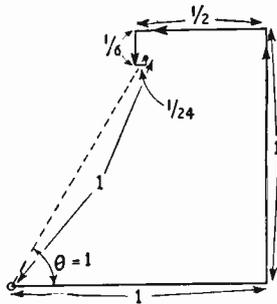
$$e^{j\theta} = \cos \theta + j \sin \theta$$

The first time this celebrated identity (Euler's) was put before us, without warning or explanation, it looked like the most outrageous of the six impossible things the Red Queen had schooled herself to believe by breakfast time. A useful abbreviation,

(Continued on page 189)



Left: Fig. 7. This shows how a unit vector, inclined at an angle θ , is equivalent to $\cos \theta + j \sin \theta$. But why should it also be equivalent to $e^{j\theta}$? In this example, for simplicity $\theta = 1$ radian.



Right: Fig. 8. Here $e^{j\theta}$ (for $\theta = 1$) is plotted term by term in its series and is found to give the same result as $\cos \theta + j \sin \theta$ (Fig. 7).

perhaps, but quite arbitrary, and indeed unintelligible if considered literally. It was like a rabbit produced from a hat we knew to be empty. But now that we have been standing by the conjuror's side, as it were, examining all the steps leading to the sensational denouement, does it begin to make sense? And if not, can we point to where we lost touch?

Well, I think with a little graph sketching we can make sense of it all the way through.

With Fig. 1 in front of us the meaning of e is pretty clear, and it can even be visualized as an infinite covering series, in which the first term (1) consists of the original "capital," the next (1) is the 100% "simple interest" increase in unit time, and the fractional terms give increasingly close approximations to the summit of curve (c), which represents continuous addition of "interest."

The meaning of e^x when x is a "real" number (even if it is negative or fractional) imposes no great strain on our credulity, for we are familiar with the fact that every time we raise the power of any number by 1 it means multiplying by that number. If anyone, lacking knowledge of the binomial theorem or faith in it, is dubious about the e^x series, he can check it for some easy value of x , say 2 or 3.

It is when x is made "imaginary" that we have to watch the conjuror very closely. For simplicity let us take as our example $\theta = 1$. The mathematical unit of angle is the radian, because that is the angle swept through when the moving end of a vector of unit length travels through unit distance (Fig. 7). Because the whole circumference of a circle is 2π times as long as its radius, 360° equals 2π radians, and 1 radian is about 57.3° . Fig. 7 also shows where the sine and cosine of θ come in, and how the inclined unit vector is equivalent to $\cos \theta + j \sin \theta$, j being (for the reason already noted) the standard instructions to reckon upwards instead of along to the right. Now let us follow the instructions given by the series for $\cos x$, x being = 1: $\cos 1 = 1 - \frac{1}{2} + \frac{1}{24} - \frac{1}{720}$, etc.

That is to say, from the zero point in Fig. 7 move one unit of distance to the right along the

horizontal axis, then back $\frac{1}{2}$, then forward $\frac{1}{24}$, and so on. Very soon we find ourselves settling down at the point we had already found by dropping the dotted vertical from the tip of the vector.

To do the same for $j \sin \theta$ we must obviously prefix every term in the series by j , which means that all our distances are measured up and down instead of along. When we have finished doing so, the net result is the dotted line.

And so, by making use of the series forms of $\cos x$ and $j \sin x$, instead of looking up the values in tables in the usual way, our two-part journey takes us from zero to the upper tip of the inclined vector and thereby is vectorially equivalent to that vector itself.

Obviously this result would equally be achieved if we moved as instructed by $\cos \theta$ and $j \sin \theta$ terms alternately; i.e., 1 to the right, 1 up, $\frac{1}{2}$ to the left, $\frac{1}{24}$ down, $\frac{1}{24}$ to the right, $\frac{1}{720}$ up, $\frac{1}{720}$ to the left, and so on, as in Fig. 8. At the end—theoretically never reached, but with an ordinary sized pencil point reached in about six steps—we find ourselves 1 unit of distance from the start, inclined at an angle of 1 radian, as before. In carrying out this manoeuvre we were in fact (whether we realized it or not) using as our instructions the series for $e^{j\theta}$, x being in this case $j\theta$ and the usual meanings given to j^2 , etc., consistent with successive anticlockwise right-angle turns.

Now at last we can see how a power (every "imaginary" power, in fact) of 2.71828... can equal 1. Because the expansion of e^x into a series, when x is "imaginary," involved periodical appearances of j , and these must be interpreted as instructions to move vertically, the length 2.71828... is traversed in a sort of squarish snail-shell manner, and by a remarkable coincidence always lands us 1 unit of distance from the starting point, whatever the value of θ . By another remarkable coincidence our net angular movement is always equal to θ . It would be a good idea to try a few other values for θ . For instance, $\theta = 2$, as in Fig. 9. Note that this time the total

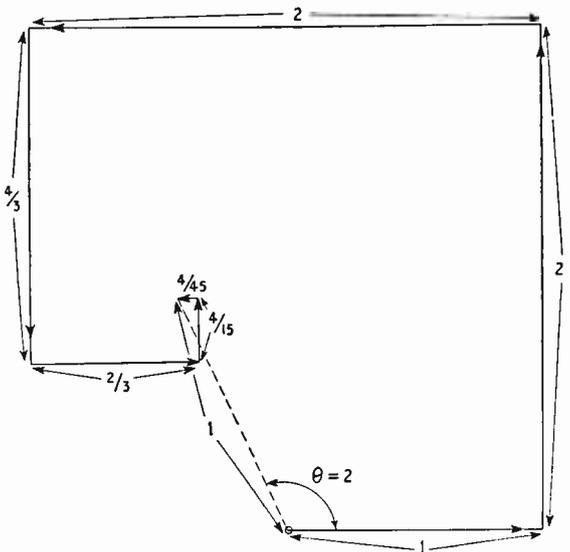


Fig. 9. This is the same as Fig. 8 except that $\theta = 2$.

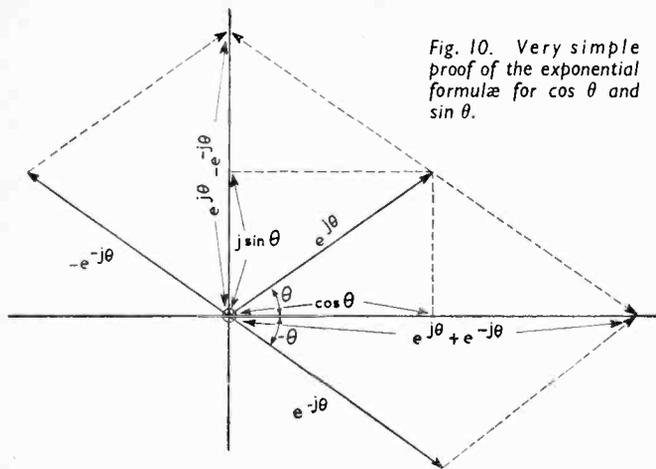


Fig. 10. Very simple proof of the exponential formulae for $\cos \theta$ and $\sin \theta$.

distance to be covered is considerably greater; actually, of course, e^2 , which is about 7.39.

By now we ought to be able to visualize not only $e^{j\theta}$ or e^{jx} as a piece of still life but, having taken several successive values of x , see how a steadily increasing x represents a steadily rotating vector. That is why books on a.c. are full of $e^{j\omega t}$. A frequency f means f cycles (or complete revolutions) per second, or $2\pi f$ ($=\omega$) radians per second; so ωt is the angle turned through in time t , and since time progresses steadily so does the angle. Therefore $e^{j\omega t}$ signifies a unit vector rotating steadily at f r.p.s. And $V e^{j\omega t}$ means an alternating voltage v of the same frequency, and peak value V . An impedance (operator) Z of magnitude Z and phase angle ϕ can similarly be expressed as $Z e^{j\phi}$. Since the current $i = v/Z$, it is $V e^{j\omega t} / Z e^{j\phi}$, and by the usual rule for indices this is $V e^{j(\omega t - \phi)} / Z$. (To save the printer it is sometimes written $V \exp [j(\omega t - \phi)] / Z$.) This indicates that the phase angle of the current is less than that of the voltage; in other words, the current lags behind the voltage. Whenever vector quantities have to be multiplied and divided then, this e^{jx} form is very convenient.

It is also very convenient for working out all those standard trigonometrical formulae we usually have to look up in a book. We have already seen (in Figs. 8 and 9) that $\cos 1 + j \sin 1 = e^{j1}$, and $\cos 2 + j \sin 2 = e^{j2}$, and by the usual law for indices the latter is equal to $(e^{j1})^2$ and therefore to $(\cos 1 + j \sin 1)^2$. This is true in general, i.e.,

$$\cos nx + j \sin nx = e^{jnx} = (\cos x + j \sin x)^n$$

That, by the way, is known as de Moivre's theorem. Suppose we have forgotten the formulae for $\sin 2x$ and $\cos 2x$ in terms of $\sin x$ and $\cos x$. Using this theorem, we put

$$\cos 2x + j \sin 2x = (\cos x + j \sin x)^2$$

and multiply out the right hand side to give $\cos^2 x - \sin^2 x + j 2 \cos x \sin x$

As I said before, the real and imaginary parts never mix, so we can equate them separately and get

$$\cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1$$

$$\sin 2x = 2 \cos x \sin x$$

(I've done this in "x" so as not to puzzle the unsophisticated by introducing too many different symbols for angles, but for some reason unknown to me the books usually use A for any one angle and B for any other.) Perhaps you would like to practise the same technique to rediscover the formulae for

$\sin(A+B)$, etc. The value of the exponential form ($e^{j(A+B)}$) in enabling one to use the adding-indices-for-multiplication law is particularly marked here. By now, in fact, I hope I may be allowed to take the usefulness of e as established. And I hope that any readers who, like me, tended to regard algebra, trigonometry, vectors, logarithms, etc., as separate subjects, pervaded by mysteries such as e^{jx} apparently decreed arbitrarily by remote mathematical high-ups, will find this unattractive vista of things that just had to be learnt giving place to a beautiful interlocking design, formed naturally by just following a few simple laws wherever they may lead.

Here, to end, is one final and very simple example. We have already seen, by expanding the terms into series, that $\cos x + j \sin x = e^{jx}$. Multiplying x

by -1 , we get $\cos(-x) + j \sin(-x) = \cos x - j \sin x = e^{-jx}$.

Adding these two together and dividing by 2:

$$\cos x = \frac{e^{jx} + e^{-jx}}{2}$$

and by subtracting:

$$\sin x = \frac{e^{jx} - e^{-jx}}{2j}$$

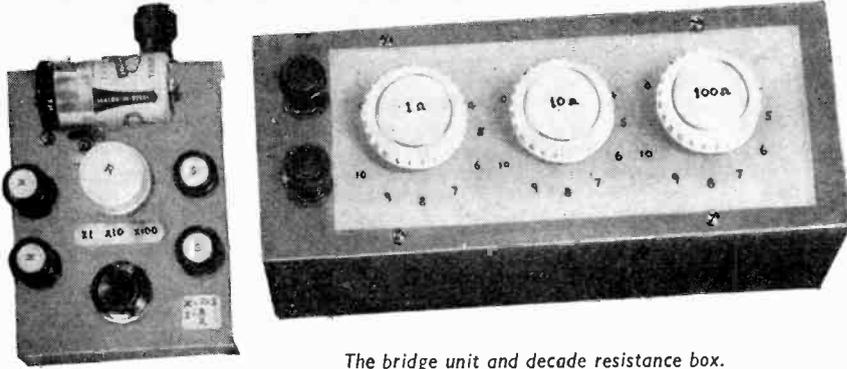
These open up new prospects which we have no time to explore just now. The relevant point is that here again we have rather surprising results, and although they are derived from the e^{jx} equation by very simple and entirely lawful means, we may be excused if we feel we have to accept them by faith rather than by sight. However, sight also can be granted very easily by means of our vector diagrams. If, as in the right-hand part of Fig. 10, we add a $e^{-j\theta}$ vector to the $e^{j\theta}$ vector of Fig. 7 ("completing the parallelogram") we clearly get $2 \cos \theta$. So the answer for $\cos \theta$ could hardly be more obvious! On the other hand, if we subtract $e^{-j\theta}$ (i.e., produce it in the opposite direction as $-e^{-j\theta}$) the answer is almost equally obvious. I can hardly believe that this demonstration is not in lots of books, but it is evidently not in nearly enough of them, because I have never seen it in any.

Television Society Awards

PREMIUMS for papers read at the Television Society's London meetings in 1958/59 have been awarded to the following: K. H. Smith, of A.E.I., receives the *Wireless World* premium for his paper "Design of Experimental Tuners for Bands IV and V Receivers"; E. Ribchester (G.E.C. Research Laboratories, Wembley), the E.M.I. premium for "Experimental Colour Receiver: Setting up and Adjustment"; D. Ingman (Young and Rubicam) the *Electronic Engineering* premium for "Advertising in Relation to Television"; B. Marsden (Associated Television) the Pye premium for "Master Control Room Techniques" and C. Grant-Dixon (British Amateur Television Club) the Mervyn premium for "The Present Position in Amateur Television." The Mullard premium goes to Dr. K. Schlesinger (General Electric Co., New York) for his paper "A New Electron Gun with Low Drive Signals" published in the Society's *Journal*. For his colour television receiver exhibited at the Society's 1959 Exhibition, John Ware receives the T.C.C. premium.

Simple Wheatstone Bridge

By H. B. DENT



The bridge unit and decade resistance box.

Making an Inexpensive Resistance Measuring Set with a Potentially High Order of Accuracy

FOR some time past the writer has felt the need for means of measuring resistance with greater precision than that provided by the popular type of ohmmeter, but since the need was not pressing it was decided to try to make a reasonably high grade piece of apparatus without the expenditure of too much money.

Reviewing the various means of measuring resistance it was felt that a Wheatstone bridge would probably be the best for this purpose as it seemed to be the easiest to construct with the very limited resources available at the time. Actually apart from a few precision resistors and a meter or two there was little else that seemed likely to be of any use in making and calibrating a bridge. There was a quantity of Eureka resistance wire in assorted gauges so this decided the use of wirewound resistors throughout.

The prospect of producing anything in the nature of precision measuring equipment seemed very remote at first, but as more thought was given to the matter it seemed likely that a reasonably satisfactory piece of equipment might conceivably emerge, with a little care and some patience, which would be capable of measuring resistance from a fraction of an ohm up to 10kΩ or possibly 100kΩ with an accuracy better than 1% over most of this range.

The Wheatstone bridge is possibly one of the oldest systems for measuring resistance and it forms the basis of many modern impedance-measuring bridges. The versatility of the Wheatstone bridge cannot be denied, yet it is a simple piece of apparatus and this was a deciding factor in the decision to make up a bridge of this kind. Basically it consists of four resistance arms arranged symmetrically as in Fig. 1, with a constant voltage applied across one diagonal and a sensitive meter, such as a milliammeter or preferably a microammeter, connected across the other diagonal. The bridge is said to be balanced when no current flows through the meter and this condition obtains when $R_1/R_2 = R_3/R_4$. Now if R_3 (usually denoted by x) is the unknown resistance to be measured, or adjusted, $x = (R_1/R_2) R_4$.

Since only the ratio of R_1 and R_2 need be known—their exact values are unimportant—it is only necessary to know the exact resistance of R_4 to

determine the value of the unknown resistance x . By using a calibrated resistance for R_4 , such as a decade resistance box, quite a wide range of resistance can be measured and adjusted with a fixed ratio R_1/R_2 . But if these two, generally called the ratio arms of the bridge, can be changed to two or three accurately known ratios, then the usefulness of the bridge is considerably extended, even with quite a modest range of resistance at R_4 . Decade ratios are the most convenient for R_1/R_2 as, with the bridge balanced, R_1 has only to be multiplied by the ratio in use to determine R_3 . By arranging R_1/R_2 to be $1/10$ or $1/100$, resistance can be measured at R_3 which is $1/10$ or $1/100$ of the resistance provided by R_4 . However it is not essential to introduce switching into the ratio arms because by merely changing over R_3 and R_4 the R_1/R_2 ratio, which hitherto provided a multiplying factor for the calibrated box, now provides a dividing factor of the same order.

A lot of the preliminary work entailed in making the bridge could have been

avoided by purchasing precision resistors for the ratio arms R_1 and R_2 , and a few assorted precision resistors, for the purpose of calibrating a resistance of one kind or another for use at R_4 . As it was particularly desirable to keep expenditure as low as possible it was decided to make do with the available parts, among which were precision resistors of 10Ω and 100Ω.

It was decided to make a decade resistance box for R_4 , but not to incorporate it in the bridge, as it would also be useful for other purposes; likewise the meter was not included. Terminals would be used for connecting in these external items. Stripped of these items very little remains of the bridge, only R_1 and R_2 , the ratio-arm switch, battery and its switch and six terminals are all that comprise the

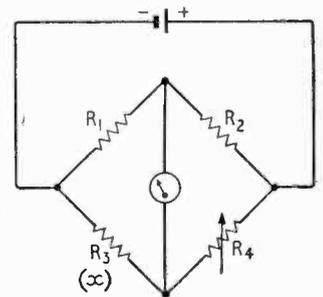


Fig. 1. Basic circuit of the Wheatstone bridge.

bridge unit, so even if it is used only very occasionally nothing of any value is permanently tied up (and so made unavailable for other purposes).

Three decades of resistance one each of 1- Ω , 10- Ω and 100- Ω steps were decided on for R_4 . With R_1/R_2 ratios of 1 to 1 and 10 to 1 only, resistance of from 0.1 Ω (theoretically) to 11.1k Ω can be measured on the bridge with the above three decades. Measurements to 0.1 Ω have been made, the widest tolerance being 2% in a 1.5- Ω resistor (home bridge value) compared with a laboratory standard, but with one of 19.9 Ω the accuracy was 0.2%, the same close agreement being achieved with a home-made (and adjusted) 100- Ω resistor. All these were, of course, wirewound.

Construction of the Bridge Unit.—The first step in the construction of the bridge unit was to make two very closely matched resistors for the ratio arms R_1 and R_2 . This was effected by using a

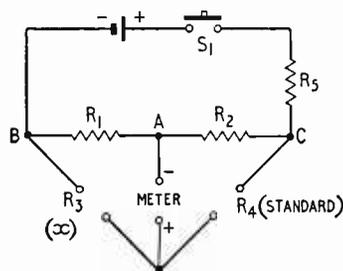


Fig. 2. Resistors R_1 and R_2 constitute a ratio arm, their exact values need not be known.

52-in length of No. 36 s.w.g. double-silk covered Eureka resistance wire with the exact centre connected to the point A in Fig. 2 and the two outer ends to B and C respectively. The two sections can be wound, for convenience in handling, on a rod or strip of insulating material such as shown in Fig. 3. The temporary bridge (Fig. 2) comprised a 1.5-volt dry cell, resistor R_5 of 33 Ω , a press-to-make single-pole switch S_1 and six terminals, two each for the meter, standard resistor R_4 and R_3 the resistor to be adjusted or measured. The resistor R_5 was included to limit the current through the bridge to a reasonable value, and, of course, R_1 and R_2 .

Ideally the balancing indicating meter should be a centre-zero type milliammeter or microammeter, but quite satisfactory results can be obtained with an ordinary 0-1mA meter with its pointer off-set slightly from the normal zero position. The usual "zero adjuster" should allow sufficient movement of the pointer. The writer used a meter of this kind for making the bridge described here.

The reason for using a 52-in length of No. 36 s.w.g. Eureka wire is that each half (26in) is approximately 10 Ω and a bridge of this kind is most sensitive to small differences in any of its four arms when all four resistances are of equal value, or very nearly so. It was thought undesirable to assume that the measured lengths of wire for R_1 and R_2 provided two resistors of exactly the same resistance, although the resistances would be close enough to satisfy many requirements in a bridge of this kind. The aim was to achieve the highest possible accuracy throughout. So two new resistors of known close match were made. For this purpose a 10- Ω standard was used in the R_4 -position and a 26-in length of No. 36 s.w.g. Eureka connected to the x terminals.

With the polarities of battery and meter shown in Fig. 2 the pointer of the meter will probably move up the scale when d.c. is fed to the bridge by closing

switch S_1 . This direction of movement would indicate that the resistance of x is higher in value than R_4 and it should be progressively shortened until a perfect balance is achieved. The conditions obtaining are now that $R_1/R_2 = x/R_4$. If R_1 exactly equals R_2 , x would equal R_4 , but the assumption that $R_1 = R_2$ is only based on measurement of the length of the wire in each, it has not been verified by any test so x might or might not exactly equal R_4 .

The measured length of wire at x can be removed and wound on a former like Fig. 3 but with only two wire pigtails, one at each end. Those used by the writer for the 10- Ω resistors, and for this one also, were strips (often called cards) of Paxolin $\frac{7}{8}$ in long, $\frac{1}{4}$ in wide and $\frac{3}{32}$ in thick. A winding length of $\frac{1}{2}$ in between end pigtails is ample. When winding on the wire care must be taken to ensure that the exact length of wire found to give the required resistance (the amount that was finally between the two terminals x on the bridge) is wound on the card. The excess, or part of it, can be used to twist round the end pigtails. Only one end of the resistance wire should be soldered to its pigtail at this stage, the other not being soldered until a further check has been made on the bridge and any final adjustment effected.

Another resistor exactly like the one just described is also required, these two are to replace the temporary R_1 and R_2 resistors in the bridge as they have now served their purpose. The two new resistors may not be exactly 10 Ω each, but if they have been carefully made they will be of equal resistance. Close matching of these two resistors is a vital factor in the bridge as the final overall accuracy depends entirely on the matching of these two resistors at this stage.

It will be useful to remember when adjusting resistors wound with No. 36 s.w.g. Eureka wire that a $\frac{1}{4}$ -in length measures approximately 0.1 Ω . Contact resistance at the x - and R_4 -terminals can affect the accuracy of adjustment of these resistors (and all subsequent ones) so terminals must be screwed down securely. Likewise, similar precautions to keep contact resistance down to the minimum must be

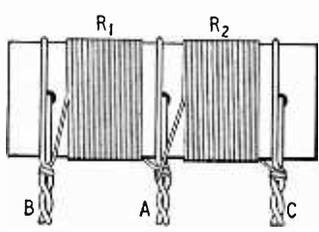


Fig. 3. Suggested method of constructing R_1 and R_2 .

taken throughout the bridge circuit; No. 18, s.w.g. tinned copper wire, or heavier gauge if available, should be used and all soldered joints must be good ones, no "dry" joints!

The two accurately matched resistors can now replace the temporary centre-tapped length of wire forming R_1 and R_2 and, with the bridge (still only in temporary form at this stage) now in a more satisfactory form for accurate measurement, attention can be turned to making up one of the resistance decades. A finalized form of the bridge cannot be made at this stage as R_1 and R_2 are still only "temporary" resistors. The final R_1 and R_2 have to be as close as possible to 10 Ω and it is also required to provide one of 100 Ω to make R_1 into a two-ratio arm as shown in Fig. 4.

If a 100- Ω standard is available it could be used

for the multiplier, or a 100-Ω resistor made up using the 100-Ω standard in R_4 position of the bridge. For the present purpose it will be assumed that a 100-Ω standard is not available and while one could have been used in making the author's version of the bridge the temptation to use it was resisted primarily

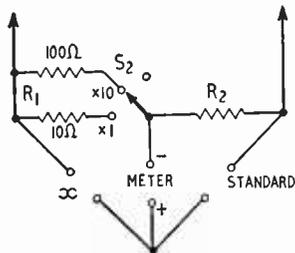


Fig. 4. By switching R_1 two or more ratios R_1/R_2 can be provided.

in order to explore the possibilities of constructing the equipment with only the one 10-Ω standard as the yardstick. In all 12 resistors of exactly 10Ω are required and each can be made in the same way as already described for the latest R_1 and R_2 resistors. With R_1 now equal to R_2 the new resistors will be exactly equal to R_4 , 10Ω with an accuracy which, if sufficient care is taken in adjustment, to about the same order as that of the standard. These are all wound on Paxolin cards as used for R_1 and R_2 . When completed they can be "doped" with any good impregnating varnish, or shellac varnish which was the writer's choice.

Shellac varnish may be a little old fashioned but it is reasonably easy to obtain, or rather to make, since it consists only of flake shellac dissolved in methylated spirit.

The ten 10-Ω resistors can now be assembled on a single-pole 11-way rotary switch as shown in Fig. 5 and in the illustration of the finished box. A 12-way switch was actually used as an 11-way was not readily obtainable. They were small switches measuring only 1½ in in diameter, but any kind will serve. With the small switches used by the writer the three decades are housed in a box 8 in. × 3½ in. × 3½ in made of ¾-in thick oak with a 1/16-in thick aluminium top plate on which the switches and terminals are mounted. Home-made scales, 0-10 for each decade, are marked on drawing paper and glued to the aluminium top plate of the box with "Durofix." If professionally made scales can be obtained with the switches they might be preferable, but the size of the box will then have to be adjusted to suit the scales. Likewise the small pointers on the knobs are home made, being cut from thin sheet brass and fixed to the underside of the knobs with 8BA screws, the knobs being drilled and tapped for the purpose. Knobs with pointers are however obtainable.

This 10-Ω decade with all 10 resistors in series was used as the standard for making the 100-Ω units for the 100-Ω decade. Eleven resistors are required, one for the multiplier in the bridge unit and 10 for the decade. Each 100-Ω resistor requires about 68 in. of No. 42 s.w.g. (d.s.c.)

Eureka resistance wire. Since the resistance of different batches of wire may vary slightly for a given length a start can be made with 70 in, later cut down to what is found to be the optimum for the wire used. The Paxolin cards on which these are wound measure 1 in long, 5/8 in wide and 3/32 in thick with wire pigtailed at each end leaving a winding length in the centre of 5/8 in. Procedure for making them is the same as for the 10-Ω resistors, but the fine gauge wire needs careful handling. For the record, No. 42 s.w.g. Eureka measures 0.672 in (nominal) per ohm, so for a 0.5% resistance tolerance the length of wire on each resistor must be within 0.34 in of the optimum length.

If the constructor has not had previous experience in making wire-wound resistors of this kind and to such close tolerances, a few early failures must be expected, but they should not be discouraging. It is essential for each unit to be as accurate as it is possible to make it.

The next job is to make the decade of 1-Ω units, but before embarking on this the bridge unit has to be put into correct form. Sufficient parts have now been acquired to justify making a final version of the unit. If the 10kΩ limit is acceptable the circuit arrangement of Fig. 4 will suffice, but if it is required to carry the measurements up to 100kΩ then a third multiplier must be added. Another switch could be embodied to switch R_2 from 10Ω to 1Ω but the writer preferred to switch R_1 only using a single-pole three-way switch for S_2 and fit a 1,000-Ω multiplier to give a 100 to 1 ratio. The 1,000-Ω multiplier will be dealt with later.

As the lowest resistance standard available was 10Ω, adjustment of the 1-Ω resistors on the bridge required a R_1/R_2 ratio of 1/10 and as explained earlier this can be achieved by changing over the positions of x and the standard R_1 . The final version of the bridge takes the form shown in Fig. 6, with the various parts assembled on a small aluminium

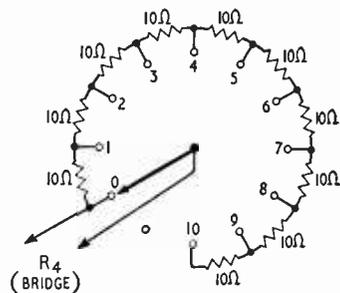
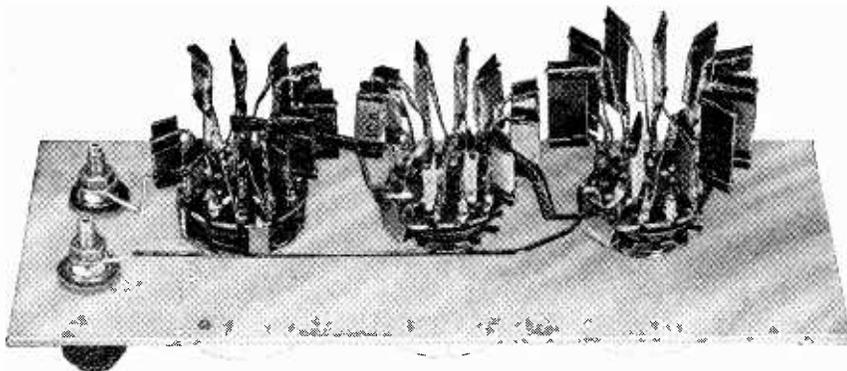
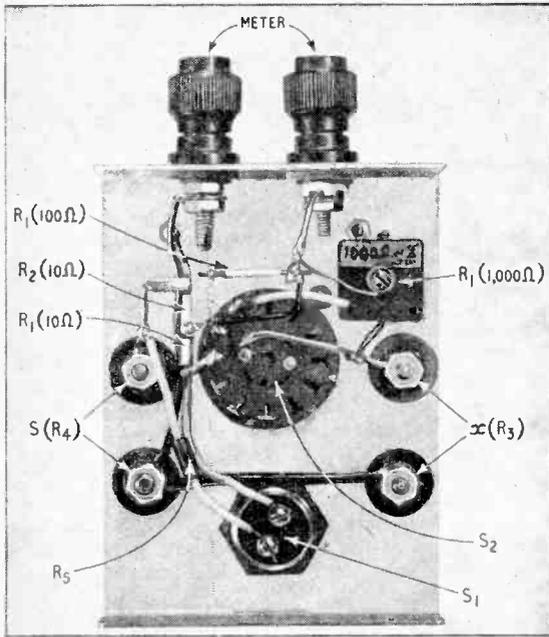


Fig. 5. Schematic arrangement of the completed 10-Ω decade.



The three resistance decades mounted on the underside of the aluminium top panel of its box.



Underside view of the bridge unit.

chassis, or on the top plate of a box of suitable size and depth. How the bridge unit is made is of little consequence provided the precautions mentioned earlier are taken in its construction.

Now with the 10-Ω standard connected to the x-terminals of the bridge, the ratio switch S_2 set to $\times 10$ (effectively $\times 10^0$), for the 1-Ω resistors a start can be made with 11in of No. 28 s.w.g. Eureka (d.s.c.) wire, connected to R_4 terminals. The procedure for adjusting them follows the same general lines as for the 10-Ω and 100-Ω resistors. The card

on which they are wound can be the same size and type as that for the 10-Ω resistors ($\frac{3}{8}$ in \times $\frac{1}{4}$ in \times $8\frac{1}{2}$ in) and with a $\frac{3}{8}$ -in winding space between the end wire pigtail connections. It is doubtful if an accuracy better than 2% to 3% can be achieved with the 1-Ω resistors using the method described here. Extra special care must be taken to keep terminal and switch contact resistance down to the absolute minimum otherwise quite large errors in adjustment of the resistance will be inevitable.

The 1,000-Ω resistor used by the writer for the $\times 100$ multiplier position of R_1 Fig. 6, was wound random-wise on a small bobbin using No. 42 s.w.g. (d.s.c.) Eureka resistance wire. The bobbin con-

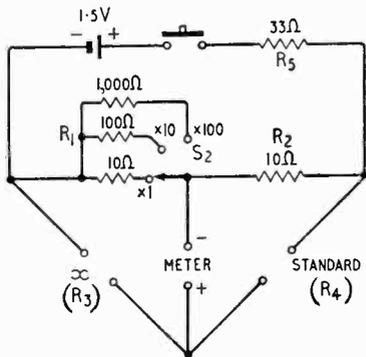


Fig. 6. Circuit of the complete bridge unit.

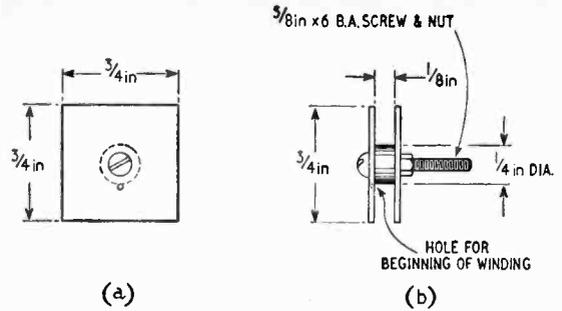


Fig. 7. Details of the bobbin for the 1,000-Ω ratio-arm resistor in Fig. 6.

sisted of two end cheeks $\frac{3}{8}$ in square and $\frac{1}{16}$ in thick separated by a centre boss $\frac{1}{8}$ in long cut from a piece of $\frac{1}{4}$ -in diameter Paxolin rod. A plastic knitting needle would serve just as well. All three are clamped together by a 6BA nut and screw, the latter $\frac{5}{8}$ in long; the projecting part of the screw being used to secure the bobbin to the bridge chassis. A small hole was drilled for the beginning of the winding as shown in Fig. 7(b). There are several ways of providing re-inforcement for the lead-out wires when very fine wire, such as No. 42 s.w.g., is wound on a bobbin. One is to fold the wire lengthwise two or three times, twist the strands together and wind one or two turns of the reinforced part round the centre of the bobbin; another is to solder the fine wire to a heavier gauge of wire (copper wire) and also wind one or two turns of it round the centre boss. The writer favours the second mentioned method, but it is inclined to make the winding a little uneven. Very thin insulating paper, or something equivalent, must be wrapped over the soldered joint and corrosive-type fluxes must be avoided at all costs.

For 1,000Ω about 19 yards of No. 42 s.w.g. (d.s.c.) Eureka resistance wire is required, but as it is awkward to measure without getting the wire into a hopeless tangle (Eureka is a "springy" type of wire) it is best to take a chance and wind on 550 turns; an ordinary hand drill can be used if a winding machine is not available.

The whole of the 100-Ω decade was used as the "standard" for adjusting the 1,000-Ω resistor, the decade box having previously been assembled with its three decade switches and resistors and wired up as shown in Fig. 8.

It is often difficult to know where to obtain small quantities of wire and other items for home construction of apparatus. Eureka resistance wire in small quantities is obtainable from Post Radio Supplies, 33 Bourne Gardens, London, E.4. One ounce of No. 42 s.w.g. (bare) Eureka wire has a resistance of 23,013Ω so even allowing generously for waste half an ounce of this fine gauge wire would suffice, assuming such a small quantity is procurable. The larger sizes of wire are not so expensive so that discriminating purchase is not so important.

Most of the firms advertising components in this journal will be able to supply the switches, but the Paxolin sheet may be more difficult to obtain. The writer found some in one of the shops dealing largely in disposal equipment and materials, but there is no reason why one of the several brands of plastic sheet

(Continued on page 195)

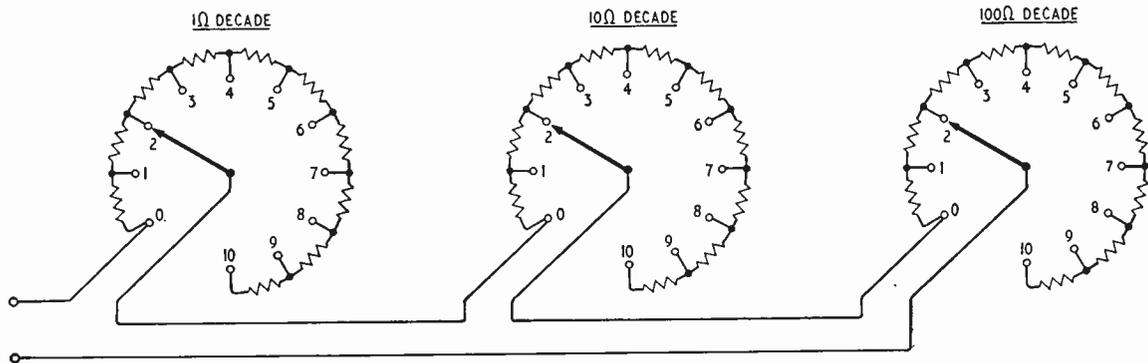


Fig. 8. Schematic arrangement of the completed three resistance decades.

sold for domestic uses should not be used. The only qualities required are toughness and good insulation to d.c. and if the decade box is ever to be used for a.f.

purposes, good insulation to frequencies up to say 20kc/s, but as the resistors are not non-inductively wound the accuracy at a.f. might be questionable.

Commercial Literature

High Stability Resistors of the carbon film type. Ratings of $\frac{1}{4}$ W, $\frac{1}{2}$ W, $\frac{3}{4}$ W and 1W with tolerances of $\pm 1\%$ and $\frac{1}{4}$ W rating with tolerance of $\pm 5\%$. Details and price list in leaflets from Standard Telephones and Cables, Edinburgh Way, Harlow, Essex. Also a brochure on **Silicon Rectifier Stacks** consisting of silicon junction rectifiers mounted in cooling fins.

Rare Earth Products, in the form of pure oxides and metals, are now available from Johnson Matthey in larger quantities and at lower prices (15 elements from lanthanum, atomic number 57, to lutetium, atomic number 71). Booklet describing their properties from the firm at 73-83 Hatton Garden, London, E.C.1.

Mobile H.F. Station for communications in the range 2-22Mc/s with an output of 350 watts p.e.p. Can be installed in a 1-ton truck and will give voice communication up to 70 miles (as well as telegraphy). Specification in a booklet from Marconi's Wireless Telegraph Company, Chelmsford, Essex.

R.F. Beam Tetrode, for power amplification up to 100Mc/s, high-speed pen recorders, and frame deflection for 110° c.r. tubes are three of the subjects dealt with in the November, 1959, "Radio & Electronics Review," a quarterly survey of products from A.E.I. (Woolwich), 155 Charing Cross Road, London, W.C.2. Also a leaflet on new **Transistors**—high-speed switching, high-voltage power and audio power output types.

Reflex Speaker Columns, suitable for stereo because of their small floor area of $17\text{in} \times 10\text{in}$. Also other speaker enclosures and equipment cabinets in an illustrated leaflet from Record Housing, N. & S.B. Field and Company, Brook Road, London, N.22.

Radar Developments.—A well produced and copiously illustrated booklet "The First Ten Years of Decca Radar" describing some of the important contributions to modern radar technique made by this company during the period 1949-59. From Decca Radar, Albert Embankment, London, S.E.11.

Switches and Signal Lamps.—A 60-page catalogue lists the complete range of products and contains blueprint diagrams with dimensions, etc., while an abridged 16-page catalogue lists the whole range without blueprints. From Arcoelectric (Switches), Central Avenue, West Molesey, Surrey.

Components and Accessories, including aeriels, receivers and sound reproduction equipment; a 1960 comprehensive illustrated catalogue of 127 pages listing the complete range from Home Radio (Mitcham), 187 London Road, Mitcham, Surrey; price 2s 9d including postage.

Crystal Marker Oscillator, a small transistorized unit weighing only $5\frac{1}{2}$ oz, including battery, is now available for a wider range of frequencies, from 500kc/s to 20Mc/s. Frequency stability on load is better than 0.01%. Leaflet from Labgear, Willow Place, Cambridge.

Electronic Stroboscopes, vibration measuring instruments, sound level and noise meters and analysers, and dynamic balancing equipments. Brief technical details in tabulated form on illustrated "summary leaflets" from Dawe Instruments, 99 Uxbridge Road, Ealing, London, W.5.

CLUB NEWS

Birmingham.—A 160-m mobile rally at Lickey Beacon, Rednal, is being organized by the South Birmingham Radio Society on April 3rd at 10.30. At the monthly club meeting on the 21st at the Friends Meeting House, 220 Moseley Road, T. R. Smith (G3BMN) and R. D. Franklin (G3ITH) will give a lecture on two-metre operation.

The month's meetings of the Midland Amateur Radio Society include a talk by Brigadier F. Jones on the G.P.O. subscriber trunk dialling system (7th); a talk entitled "Radio pictures of the sky" by K. Stevens, who has constructed his own radio telescope (19th); and a mobile rally (24th). The rally is being organized jointly with the Stoke Radio Society and will be held at the Trentham Gardens, Stoke-on-Trent.

Bradford.—D. G. Enoch (G3KLZ) will give a lecture on the development of television at the meeting of the Bradford Amateur Radio Society on April 26th. Meetings are held at 7.45 at Cambridge House, 66 Little Horton Lane.

Doncaster.—The South Yorkshire Amateur Radio Society meets on the 2nd Tuesday and 4th Thursday of each month at 8.0 at the Stag Inn, Dockin Hill Road. On April 12th there will be a general discussion on aerial systems and on the 28th W. Farrar (G3ESP), secretary of the Society, will discuss the radio amateur examination.

Leeds.—The theme of the meeting of the Leeds Amateur Radio Society on April 6th will be the radio control of models. The meeting will be held at 7.45 at the Swarthmore Education Centre, 4 Woodhouse Square.

Reading.—A lecture demonstration will be given to members of the Calcot Radio Society by a representative of Truvox on April 21st at 7.45 at St. Birinus Church Hall, Calcot.

India.—The secretary of the recently formed Electronics Club, Trivandrum, S. India, has asked for back numbers of radio journals. His address is:—C. Pereira, The Electronics Club, Trivandrum, S. India.

Thermoplastic Recording

NEW SYSTEM WITH HIGH INFORMATION DENSITY AND HIGH PROCESSING SPEED

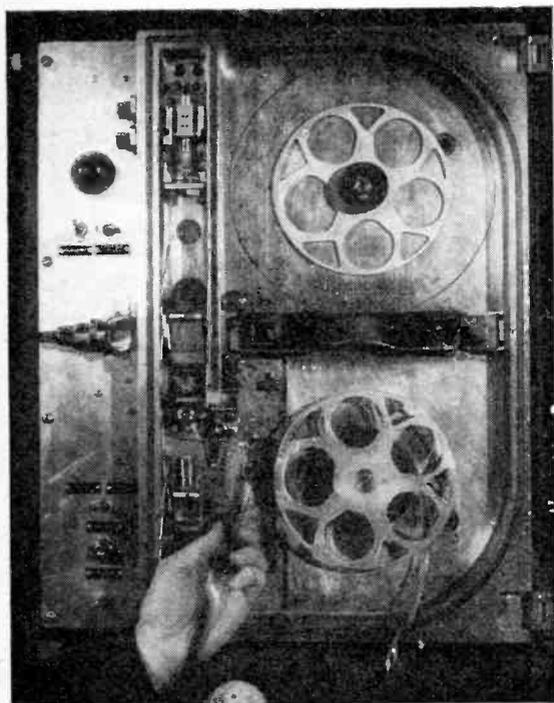
SIGNALS are recorded in the form of deformations of the surface of a special transparent tape in a new system developed by Dr. W. E. Glenn of the General Electric Company of America and described by him in the *Journal of Applied Physics* for December, 1959 (p. 1870).

In this system the tape is made up of three layers: a high melting point base similar to that used for

be used to erase, and local erasure in an area as small as a few mils square can then be made possible by confining the r.f. fields.

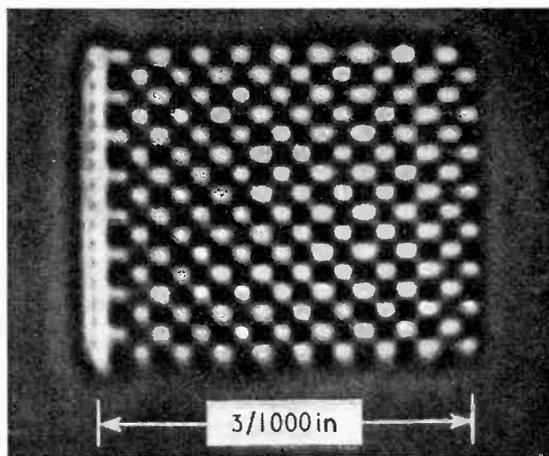
The recording tape is wound on and off spools as in an ordinary tape recorder. After the charges are laid down in a television-like raster by the electron gun, the tape passes over an r.f. heater. This induces currents in the conducting coating which heat the top surface layer of the tape for about the 10msec necessary to give the thermoplastic plenty of time to deform. After the tape has passed beyond the r.f. heater, the top layer of the tape then cools and the deformations are frozen in. The whole apparatus is continuously evacuated down to a pressure of about 0.1 microns.

One advantage of this recording system is that colour and black and white video signals can be recorded in such a way as to permit immediate visual reproduction by optical means. To permit such reproduction in colour, each signal is recorded in the form of four parallel deformations making up a small diffraction grating, and an optical system described by Dr. W. E. Glenn on p. 841 of the November, 1958, issue of the *Journal of the American Optical Society* is used. In this system, the light from a number of equally-spaced line sources is focused by a lens through the recording tape on to a number of equally-spaced opaque bars parallel to the line sources: any light which should happen to pass between the opaque bars is in turn focused by a second lens on to a viewing screen. Any grating deformations recorded on the tape will then diffract the light between the opaque bars through the second lens and on to the screen to form an image whose position corresponds to the position of the grating deformation and whose brightness cor-

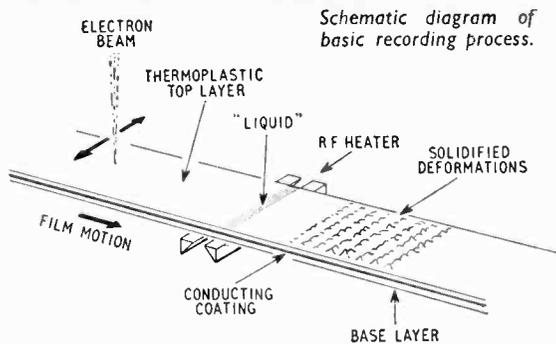


Thermoplastic recorder (G. E. of America).

ordinary cinematograph film, an electrically conducting coating on top of the base, and a thin film of thermoplastic material on top of the conducting coating. The signal to be recorded is used to modulate the intensity of a fine electron beam in a vacuum so as to lay down a pattern of charges of variable density on the surface of the thermoplastic. The thermoplastic is then heated until it softens. The attraction between the surface charges and the conducting film then deforms the surface of the thermoplastic until equilibrium is reached between the surface-tension restoring forces produced by the deformations and the electrostatic deforming forces. Recorded deformations can be erased by heating the thermoplastic well above its melting point which also makes it conducting. This disperses the charges on the thermoplastic surface and surface-tension forces then resmooth this surface. R.f. heating can



Example of high information density thermoplastic recording. If the light and dark squares are taken to represent 0 and 1 on the binary number system, the recorded information density is 4×10^7 bits per square inch.



responds to the amplitude of the deformations in the grating. The spaces between the opaque bars are made so small that they let through only one diffracted colour, the wavelength of this colour being determined by the spacing between adjacent deformations in the grating. By superimposing several grating deformations, a coloured image can thus be built up. To build up such images it is convenient to use one fixed and one variable colour rather than a three-colour system. Each grating is then recorded by means of a beam

which is split in one plane into a number of equally-spaced side-by-side beamlets. The splitting is carried out by means of an extra grid between the normal accelerating anode and the tape, this grid being made slightly positive with respect to the anode. The exact potential difference between the splitter grid and the anode then determines the spacing between adjacent parts of the split beam, and thus also the spacing between adjacent deformations in the recorded grating, and thus in turn the reproduced colour. Black and white images can be obtained by broadening the line sources and enlarging the spaces between the opaque bars until the full range of visible light wavelengths is let through: the recording being then made in single lines. Electrical reproduction of recorded signals by means of normal flying-spot scanning techniques is also possible.

Another advantage of this system is that recordings can be made with a very high information density, values as high as 4×10^7 bits per square inch having been achieved. Video recordings have been made on a 0.1-in wide track with the tape running at only 5in/sec; this may be compared with effective tape speeds of at least several hundred in/sec necessary with ordinary magnetic tape for video recording.

Frequency Allocation Problem

Computation Methods Used in Trying to Solve America's Growing Navaid Congestion

By MICHAEL LORANT

THE U.S. National Bureau of Standards, at the request of the Federal Aviation Agency of the United States, is studying automatic computation methods for determining the best possible operating frequencies for radio transmitters used as "road markers" on air lanes. A network of such transmitters marks routes between cities by sending out signals which assist pilots in flying a straight-line course. The rapid expansion of commercial and military air operations makes it necessary to add a substantial number of new transmitters to this network each year. The locations of these transmitters are determined by technical and economic considerations. However, the choice of carrier frequencies constitutes a surprisingly difficult problem. Efforts to solve this problem are being carried out by L. Joel, G. M. Galler, and A. J. Goldman of the Bureau's Applied Mathematics Division.

The difficulties of frequency selection stem from the fact that transmitters with identical or neighbouring carrier frequencies must be spaced widely enough to prevent signal interferences. Furthermore, this must be accomplished within the scope of 100 discrete frequencies assigned to the F.A.A. However, not only is the "interference radius" of a transmitter large (approximately three times the radius its signal actually serves) but the number of transmitters in existence is already considerable and is increasing rapidly. For these reasons, allocating

a frequency to a new transmitter without introducing any interference requires a laborious examination of many existing transmitters.

Such an allocation may, in fact, be impossible without changing the frequency of one or more existing transmitters. This, in turn, may create new interferences in the system and require alteration of the frequencies of still more transmitters. The insertion of a new transmitter into the network has sometimes required frequency changes at as many as 11 existing transmitters. Such changes are expensive and disturb the smooth operation of the system, since pilots must be informed of and become accustomed to the alterations. An additional requirement introduced into frequency allocation is therefore the limitation of the number of changes.

As the frequencies and transmitters (old and new) are finite in number, there is only a finite number of ways in which frequencies can be allocated throughout the network. This means that in principle the problem could be solved by examining all such network-wide allocations, rejecting those which lead to interference, and then selecting from the remainder one which allots the original frequencies to the largest number of existing transmitters. This procedure is impractical because the number of cases to be examined, though finite, is so enormous (exceeding 10^{2000}) that the investigation could not

be carried out in a reasonable time even on the fastest electronic computer. What is needed is a systematic, rather than an exhaustive, procedure.

The Bureau's efforts toward such a procedure can be roughly divided into two categories, which may be called "ad hoc methods" and "model construction." The preliminary direction of the *ad hoc* activities was suggested by the fact that many new transmitters require changing, at most, one old transmitter. As a temporary aid to the Federal Aviation Agency and an introduction to the general problem, a routine has been devised to make such "easy" frequency allocations when possible.

The major activity in the "model construction" technique has been the examination of a procedure which reduces the frequency allocation problem to the maximization of a sum. Computational methods and computer programming codes, although not immediately applicable in this instance, are available for this general type of problem, and efforts are being made to adapt them for frequency selection.

Ad Hoc Methods.—The computer programme developed on an individual or *ad hoc* basis first evaluates for each frequency, f , the number n_f , of old transmitters which would be interfered with should f be assigned to the new transmitter. It then notes the identity, T_f , of the first such old transmitter (if $n_f > 0$). If $n_f = 0$ for some frequency, then the new transmitter can simply be given that frequency, f . If $n_f > 1$ for every frequency, then the new transmitter cannot be introduced without changes of at least two old transmitters. If $n_f = 1$ for some frequency, then the new transmitter and T_f are artificially "interchanged"; that is, T_f is treated as a new transmitter, the (original) new transmitter is treated as an old transmitter with frequency f , and the programme is applied to this artificial situation to see whether T_f can be assigned a frequency without any change elsewhere in the system. If this proves possible the routine is completed; if not, it is impossible to assign f to the new transmitter without the changes elsewhere, and so the programme moves on to the next frequency for which $n_f = 1$.

The computer routine can be extended to examine cases in which more than one old transmitter must undergo a frequency change. However, this provides at best an inefficient approach to the problem, since it is merely an automatic trial-and-error process with no facilities for taking advantage of the special properties of the system that a deeper analysis might uncover.

Model Construction.—In the procedure now being considered as a real solution to the overall problem, a variable X_{fT} is associated with each frequency, f , and transmitter, T . X_{fT} is interpreted as having the value 1 if the frequency is assigned to T and the value 0 if it is not. The requirement of no interference is readily expressed in this notation. If, for example, transmitters 1 and 2 are so close together that they cannot have the same frequency, then the conditions " $X_{f1} + X_{f2} \leq 1$ for all f " must be imposed. The equation " $\sum_T X_{fT} = 1$ for all f " expresses the fact that each transmitter is allocated exactly one frequency. If constants X_{fT}^0 are introduced which take the value 1 or 0 depending upon whether the old transmitter T does or does not have the frequency f , then the expression $\sum_T X_{fT}^0 X_{fT}$ (where the sum is over old transmitters only) rep-

resents the number of old transmitters left unchanged by the variable allocations denoted by the X_{fT} 's. The variables should therefore be chosen to maximize this sum, subject to the constraints described above.

The maximization of a linear function subject to linear equation and inequality constraints is the typical problem of a fairly new branch of applied mathematics known as "linear programming." Several computational methods and computer codes are already available for the solution of such "linear programmes." However, these standard codes are not usable for the frequency selection problem because their limitations are greatly exceeded by the numbers of variables (about 250,000) and constraint conditions (about 1,200,000) involved. Nevertheless, there is reason to believe that this difficulty can eventually be overcome by exploiting the special nature of the constraints to modify the standard linear programming codes.

The result of the research should be a considerable improvement in the rapid and accurate allocation of carrier frequencies to new Federal Aviation Agency transmitters.

Telephone Hearing Aid

WEARERS of hearing aids experiencing difficulty in using the ordinary P.O. telephone should be interested in a small attachment for the earpiece of the P.O. handset which gives considerable amplification of the received speech.

It is known as the Clarafon and as the illustration shows is the same diameter and shape as the earpiece and is just under $\frac{1}{4}$ in deep.

It operates by magnetic induction, the thick moulded spike on the Clarafon houses a pickup coil and all sound currents flowing through the normal earphone bobbins induce corresponding voltages in the pickup coil by the resultant change in magnetic flux that normally operates the diaphragm. The voltages induced in the Clarafon pickup coil are amplified by three transistors, the amplified output being fed to an ordinary magnet telephone receiver occupying approximately the same position as the original earpiece.

The Clarafon is powered by two self-contained Mallory RM625 batteries, their estimated life being over 1,600 three-minute call periods. It incorporates a volume control and on-off switch, these two controls being the white projections visible on the side of the adaptor. After switching on the unit should be rotated round the earpiece in order to position its pickup coil in the strongest magnetic field. As the unit need not be removed except for replacing batteries re-positioning the pickup arm is only needed very occasionally.

The Clarafon is made by Multitone Electric Co. Ltd., 12-20 Underwood Street, N.1, and the price is £14 14s.



Multitone Clarafon
P.O. telephone
hearing aid.

A Brief and Not Too Informative Discourse on the Subject of

TECHNICAL WRITING

By JACK DARR*

NOT too long ago, P. P. Eckersley gave us some very sage advice about technical writing. Later, the Editor condescended to hold forth on the subject, together with some pertinent (and impertinent) comments by Mr. Waldron in the correspondence columns. Now that these capable and competent gentlemen have chopped down the tree, may I gather up a few chips for firewood? Just in case they missed anything let's briefly discuss some of the salient facts about the gentle art of technical writing, methods which they might have overlooked.

Really, there are a frightful lot of things that a good technical article must be: factual, informative, clear, educational (and brief: Editor). It should contain the maximum of information (in the minimum of words: Ed.) and must be authenticated most unimpeachably by numerous experiments. It must also be illustrated by numerous pictures. (Good sharp photos, please, and do send the negatives! Ed.) [I say, do you seem to hear a voice in the background? I seem to be getting a bit of interference from somewhere. Tropospheric skip, probably.]

Know Your Reader

The main object of all technical papers is the imparting of information. To do this, the basic facts must be couched in such language as to be readily comprehensible by the group to whom the article is directed! Here, the writer has his choice: he can write to the upper echelons: P. P. Eckersley, "Cathode Ray," Thomas Roddam *et al*; he can write to the larger mass of readers, gentlemen with engineering training and education, who can readily comprehend mathematical expositions, complicated diagrams, etc., or to a group of students, beginners (and me) to whom the subject is not thoroughly familiar as yet. By the proper use of long words, heavy mathematics, and complicated diagrams, it is quite possible to write a paper which cannot be understood by anyone except those to whom the subject is already quite familiar. To the bewildered reader who really needs the knowledge, it is completely incomprehensible! So, here we have our first problem: Communication! Your article must be "slanted," as the newspaper men say, toward the group you want it to reach. You must know to whom the message is to be addressed, so that it will reach its destination in understandable form.

I've several pet aphorisms that might be tossed in at this point. These have been gathered over a period of many years from various editors. "Express; don't impress!"; this is what Mr. Eckersley meant when he spoke of "prancing." And a notably exact description that was, too. Another; "Wad some power the giftie g'ie us, to express ourselves so others could 'see' us" misquoted, but apt, I think. So, use language appropriate to the group to whom you're talking.

The technical writer does have one big thing in

* Ouachita Radio-TV Service, Mena, Arkansas, U.S.A.

his favour: "Vantage Number one, said the Bi-Coloured Python Rock Snake": he is writing to a group who *want* the knowledge, (or they wouldn't be reading the bloomin' book in the first place!) and, therefore, are willing to take some pains to get the information out of it. So, make his task easier by getting the information over to him in as simple a manner as possible. Talk directly to him, and try to talk in his own tongue.

Don't be too verbose (Thanks! Ed.) but don't be too brief, either. In this connection, there is a story current among two-way radiomen here, concerning a pair of Latin-American gentlemen testing a radio system.

"Allo, Pedro, thees ees Pancho. Geeve me a short count, please. Over." "Allo, Pancho thees ees Pedro. Oné. Out!" So don't give your readers a "Mexican short-count" by trying to be too crisp or "snappy" in the style.

Speaking of style in technical writing (and this wasn't really intended to be in here, but inserted at the last moment, in direct contravention of all the principles I advocate, later on!) You'll find that there are really as many kinds of style as there are writers. Personally, I use two: what I've always called "Conversational," in which the writer is talking directly to the reader: this is derived from much experience in telling some of my many teenage technicians how to do various things. I have found it quite effective in various lower-echelon textbooks, etc., for beginners. Contrasting to this is another, what one might call, "Modified Pedantic": this is "straight college textbook" with a few irreverent touches now and then. Still further up the ladder would be "Straight Pedantic," which is good readable college textbook, followed at the top by "Incomprehensible Pedantic": the style consisting of about seven words in English followed by three pages of Greek symbols!

I have an unshakable belief that there is a place for humour even in a dry technical article.

A wee touch of humour often lightens a heavy discussion, and in my opinion, makes the article much more "rememberable." (If I can't find a word that'll do what I want, I'll *make* one!) I know that I shall never forget Thomas Roddam's classic phrase about the "engineers paddling happily in their troughs"! ("Return Loss": *Wireless World*, November '57) See? I even remembered the author's name! Somehow, a humorous association seems to make the subject matter stick more firmly in the memory.

So, the essentials of a good technical article are: Clarity, Continuity (and Brevity: Ed.).

Neglecting the interruption, we shall continue. Clarity, we have just discussed. Now, let's work over the remaining feature: Continuity. We may assume that the potential scribe already has in his possession sufficient facts to enable him to give a valid exposition of the subject. A technical article consists mainly of a series of facts: laws, processes, applications, conclusions drawn from experiments, etc. In order to make the material readily com-

prehensible, these must be set down in a logical order: Facts A, B, C, etc., follow each other like sheep over a hurdle. It should, in my opinion, have an order something like this: introduction, statement of purpose, material used, processes, and conclusions drawn from same. The whole article, in fact, should resemble a series circuit. At this point, the aspirin consumption among writers rises rapidly. Despite all precautions, Fact H will crop up in the final draft, nestling coyly between Facts B and C!

Creator and Critic

There are several methods used by technical writers to cope with this. Personally, I use the "Hobson-Jobson" method. This consists of sitting down to the typewriter with several fresh packs of cigarettes, a pot of strong coffee and a grimly determined look, and writing down as rapidly as possible without regard to grammar or spelling every possible pertinent fact that I can dredge out of my unwilling brain. Hew to the line and let the split infinitives fall where they may!

From the resulting hodge-podge, the various statements, assertions and incontrovertible facts are sorted out, and rearranged in some sort of order. This, too, is but a preliminary: the result is then rewritten, and rechecked for continuity of thought. At this point it is a good idea to tuck the dog under one arm, whistle for your gun, stuff the manuscript into your hip pocket, and head for the woods. Find a suitable stump, and sit thereupon for a period sufficient to permit consecutive thought. Read the ms. (mess? Ed.) (Quiet! D.) and try to criticize it. Incidentally, it is always impossible to be completely objective about one's own work, so don't feel too badly if it still looks good to you.

An alternative to this is the "abandonment method." After finishing the first or second rough, place the whole thing firmly upon a convenient shelf, and forget all about it for a period of about a week. (A disadvantage of this method is that during the waiting period, one usually finds that someone else has had the same idea, written and sold an article to the magazine on the same subject! This happened to *me* on this one!) However, if the mental telegraph isn't working and the idea is still valid, get it out and see if it still looks as good to you as it did upon completion. If so, make a fair copy of it, on pristine white paper, liberally margined, and double-spaced, to provide space for sarcastic editorial comments (*Well!* Ed.), stuff it in a suitable envelope, and bung it into the nearest post box. There will now ensue a waiting period of indeterminate length, while Editor and Staff chew over the unfortunate ms, to see if it is suitable for inclusion in their august journal.

We might close with a few observations of the genus *Scribus Technicalis*, gleaned from looking over my own shoulder, and from watching a few of my confrères at work. There are two distinct species of T-writers, which may be identified by their methods of preparing the subject material. They can be divided into Mumlbers and Jotters, with the inevitable sub-phyla having mixed characteristics of each class.

The Mumber goes about for a period of roughly two weeks prior to the launching of an article, with a preoccupied look on his face, muttering under his

breath, to himself. He is reminding himself of certain points which he must remember to include in the finished paper. This often causes him to be looked upon askance by normal members of his community, until his habits are understood.

The Jotter, on the other hand, mistrusts his own memory (and with very good reason, too). He writes everything down on odd bits of paper, and squirrels them away on his person. When actual production begins, these are unearthed, deciphered, and included in the finished product. There are two distinct drawbacks to this method, and, remember, I speak from actual experience. The first hazard is the laundry. When the Wife decides that our absent-minded friend's linen has gone quite long enough (and, truthfully, he is prone to getting a bit grubby about the collar and cuffs!), she is quite apt to sequester it without his knowledge, and pop it into the washer. So, sad to say, full many an important contribution to the world's technical literature has vanished down the drains in a soggy wad of wood pulp.

The last, and most heart-rending of all, is the inability of the author to translate his own notes! (And once again I speak from bitter experience!) A whole mass of vital statistics has vanished into the Limbo of such cryptic notations as "Fzll turnspike mst be vshtred" and "Mss cap's shd be tnd wth fzzlbat xpal!"

Words are tricky things; they have a dreadful habit of meaning one thing and saying another. In addition to the methods discussed above, there is always the possibility of the "Inadvertent Howler." This is a sort of technical Irish Bull, and crops up in the most amazing places. Here are a few examples of meaning one thing and saying another.

A certain U.S. company with a well-deserved reputation for excellence and clarity in its technical writing came up with this not long ago: "This progress would not be possible without the intense interest in learning new things that you electronics technicians have!" (Why should they want to know what new things we technicians have?)

Our very favourite item, and one which I shall always remember for its sheer purity of thought and simplicity, was unearthed long ago in an instruction book for a mechanical phonograph, or juke box. At the bottom of a long list of troubles and their causes and repairs, this came up. The item was the slipping of a small gear, or something, and the suggested cure was, brief and very much to the point, "Find cause and repair!"

Technical Authorship

FOR what is believed to be the first time in this country a responsible and qualified body, *viz*, the City & Guilds of London Institute, is holding examinations in technical authorship. They are being held in May and are the culmination of a long period of planning between the Institute and the Technical Publications Association. The two papers to be set aim at testing candidates' knowledge of the principles and practice of technical authorship and their skill in technical writing and editing.

The principal objects of the T.P.A., which now has a membership of just under 300, are: "To promote the advancement and improvement of technical publications techniques . . . and to promote and maintain a recognized status for its members." Its offices are at 46, Brook Street, London, W.1.

News from the Industry

English Electric Group, which includes the Marconi group, English Electric Valve Co., Napier and Son and a number of overseas subsidiaries, announces a group profit in 1959 of £3,433,759, which was over £400,000 above the previous year's figure. The diversity of interests of the twenty-five or so companies in the group is shown in a 28-page illustrated brochure "English Electric Activities 1959-1960."

Marconi Group, which includes Marconi's W/T, Marconi Marine and Marconi Instruments and a number of overseas companies, made a net profit of £411,470 in 1959 compared with £431,783 the previous year. The net profit of the Marine company was £264,624, compared with £222,039 in 1958. The Instrument company, which had a record turnover last year, is building an additional factory of 30,000 sq ft at the St. Albans works.

Metal Industries Group, which includes Igranic, Avo and Taylor Instruments as well as a number of companies in the engineering and metal industries, has acquired Lancashire Dynamo Holdings, Ltd. It will be recalled that E.M.I. withdrew their offer for the stock of Lancashire Dynamo.

Relay Exchanges Ltd.—A 50% increase in the group's trading profit as compared with the previous year is shown in the preliminary figures for 1959. The group net profit was £1,068,701 compared with £391,276.

Regentone Group.—Reference is made in the annual report of the chairman of Lloyd's Packing Warehouses (Holdings) Ltd. to the activities of its subsidiary, the Regentone group. Both the turnover and the profit of the group, which manufactures R.G.D., Regentone and Argosy receivers, were "the highest in the history of the company."

Radio Rentals Ltd., who, through their 220 branches in the U.K., rent sound and television sets, record a net group profit, after taxation, of £1,098,616—an increase of £293,958 on 1957/58. Mains Radio Gramophones Ltd., of Bradford, a subsidiary, manufactures all sets handled by the group.

Simmonds Aerocessories Ltd., of Treforest, South Wales, a member of the Firth Cleveland Group, have formed a company in Western Germany in association with Mecano-Bundy, G.m.b.H., of Heidelberg, for the manufacture and sale of Spire Speed Nuts and other fastenings. The new company will be known as Mecano-Simmonds G.m.b.H., with headquarters in Heidelberg.

Anglo-American Agreement.—Marconi's W/T Co. and Hermes Electronics Co. (formerly Hycon Eastern Inc.), of America, have concluded an agreement providing for general technical collaboration between their two companies in the field of point-to-point communications. Each company will act as agents and licensees for certain equipment manufactured by the other.

Tektronix.—It may not be generally known that for the past fifteen months Tektronix Inc., of Portland, U.S.A., have been assembling oscilloscopes in Guernsey, C.I. A resultant saving in freight has enabled their agents in this country—Livingston Laboratories—to make about a 3% reduction in price.

A.E.I.—A new product department devoted to semiconductor has been set up within the A.E.I. radio and electronic components division. The semiconductor department's sales office is at 155 Charing Cross Road, London, W.C.2. The sales manager is F Szekely

Heathkits.—Direct TV Replacements, Ltd., of 138, Lewisham Way, London, S.E.14, are now marketing a range of test equipment which is basically constructed from Heathkits. The instruments are being marketed under the name Beulah Electronics.

Belling & Lee have reorganized their sales department into two divisions—industrial and domestic. Both divisions come under the jurisdiction of the sales director, E. A. Taylor, and each has two assistant sales managers. These are: Industrial Division: R. M. Prett (internal) and R. W. Elliott (field); Domestic Division: L. R. Dunlop (internal) and H. J. Walters (field).

Transistor Television Set.—This prototype portable television set with an 8-in tube and using twenty-three transistors and fourteen diodes is soon to be marketed in Japan by Sony Corporation. Monthly production initially will be about 1,000 sets which it is planned to increase to 10,000 in about a year. The set, weighing 11-lb and measuring $6\frac{1}{2} \times 8 \times 8\frac{3}{4}$ inches, will sell at about \$200.

DEAC (Great Britain), Ltd., was formed last year to produce in this country the Perma-seal hermetically sealed re-chargeable nickel-cadmium cells manufactured in Germany by DEAC. The first types to go into production at the factory established at Altona Way, Buckingham Avenue, Trading Estate, Slough, Bucks., is the range of "button" type cells. They will be marketed by G. A. Stanley Palmer, Ltd., Maxwell House, Arundel Street, Strand, London, W.C.2, who will continue to handle those German-made cells which are not yet manufactured in this country.

Muirhead's have produced a tape recorder for the storage at relay stations of facsimile signals for re-transmission when immediate relaying is impracticable. By recording a 1,000 c/s standard frequency (from a Muirhead tuning fork) on the lower tape track at the same time as recording the facsimile signal on the upper track, the speed of the tape on replay can be synchronized with the original recording speed.

Aveley Electric.—With the formation of the new Avel-Toroid division of Aveley Electric, Ltd., of South Ockendon, Essex, A. C. Green becomes works manager, J. R. Erskine chief engineer, and S. J. Arliss production engineer. R. S. Mattin has assumed responsibility for all toroidal winding machine sales and service, and handles general sales enquiries for sub-contract toroidal winding. A. J. Cornwell, who has been with the company since 1955, has taken charge of the Technical Services Department, which is responsible for service and overhaul of all Rohde & Schwarz and other similar equipment distributed by Aveley Electric.



Canberra.—Tannoy have supplied the sound installation for the 45,000-ton P. & O. liner *Canberra*, the largest turbo-electric passenger ship to be built in Britain. Each of the 1,000 or more cabins has provision for receiving either a broadcast programme or a programme originating in the ship's control room. Marconi's are providing the ship's radio-communication equipment and are also installing multi-standard television equipment which will permit the relaying to cabins and public rooms of programmes from countries employing either 405, 525 or 625 lines. There will also be a closed-circuit TV system aboard.

Shure Brothers, the American manufacturers of microphones, pickups, etc., have appointed J. W. Maunder, of 95 Hayes Lane, Beckenham, Kent, as their representative in this country.

Tellux Ltd., and **Perihel Ltd.** (members of the K.G. Holdings group of companies) are moving from 146 New Cavendish Street, London, W.1, to the factory premises at 44 Brunel Road, London, W.3, occupied by their associated company, W.S. Electronics, Ltd. (Tel.: Shepherds Bush 0333).

R.E.E. Telecommunications Ltd., of Crewkerne, Somerset, have appointed J. H. V. Stephens, previously with Standard Telecommunications Laboratories, as technical manager. G. E. Webster, formerly with Panda Radio, is export manager.

A new service depot at London Airport has been opened by Marconi's W/T Co. to replace the temporary one previously in use. The engineer-in-charge is J. W. Grandey, and the address: Marconi's Service Depot, Sections A & B, Building 201, No. 1 Maintenance Area, London Airport, Middx (Tel.: Skyport 1039).

Solus-Schall Ltd., have transferred their sales, administration and accounts departments to County Building, Honeypot Lane, Stanmore, Middx (Tel.: Wordsworth 4300). The service department is continuing for the time being at 15/18 Clipstone Street, London, W.1 (Tel.: Museum 5080).

McKellan Automation Ltd., of 122 Seymour Grove, Old Trafford, Manchester, 16, agents for a number of instrument manufacturers, have formed an associate company, Automac Ltd., which is undertaking instrument repairs, installation and maintenance work previously carried out by the parent company. The address of Automac is Throstle Grove Works, Great Egerton Street, Stockport, Cheshire (Tel.: Stockport 6767). G. M. P. McKellan is managing director.

The Pye Group has acquired 50,000 sq ft of buildings in the Sheerness Dockyard which will be used for additional production space.

EXPORT NEWS

Computers, data processing equipment, scientific and industrial instruments, automation systems and closed-circuit television manufactured by E.M.I. Electronics, is to be marketed in the U.S.A. by Fairbanks Whitney Corp. of New York. The company will also manufacture some E.M.I. equipment under licence.

Field trials of a new Decca Navigator receiver for use in South Africa, where atmospheric conditions are exceptionally bad, were undertaken last November by the South African Council of Scientific and Industrial Research. Decca Navigator have now appointed as their representative in the Union Brigadier H. G. Willmott, C.B.E., who until his retirement a few years ago was Air Chief of Staff in the South African Air Force.

True-motion radar (Type TM909) is being supplied by Decca for four new cargo vessels under construction in France for the Compagnie des Messageries Maritime. Decca are also supplying river radars (Type 215) for eleven inland waterway tankers owned by Esso Tankschiff Reederei, G.m.b.H., of Hamburg.

Italy's new intercontinental airport at Fiumicino is to be equipped with a Marconi 500-kW 50-cm radar (Type S.264A/H), together with two display systems (comprising eleven display units), microwave radar link and ancillary equipment.

Television O.B. Unit.—E.M.I. Electronics have received an order from Elektroimpex, Budapest, on be-

half of the Hungarian broadcasting authority, for a television outside broadcast unit. It will be equipped with four Image Orthicon cameras. Two O.B. units, each with three cameras, have recently been supplied to the Australian Broadcasting Commission.

Radio-telephone transmitter-receivers.—Some of the 500 R/T transmitter-receivers ordered from Pye Telecommunications for installation in Mexico are for the extension of the existing Public Correspondence system and others for private radio-telephone services. Pye have already supplied over 3,000 mobile units to Mexico.

Surveillance radar for the new international airport being built at Belgrade, has been ordered from Cossor. Duplicate 10-cm transmitters with four display consoles are being supplied.

Airborne v.h.f. communications equipment to the value of 1M Swiss francs has been ordered from W.S. Electronics, Ltd., by the Swiss authorities.

A six-month tour of factories, research establishments, government organizations and technical colleges on the Continent is being undertaken by a new mobile showroom and demonstration unit of Marconi Instruments.

Marine apparatus, including the "Escort" true-motion and "R.M.S." radars, is fitted in A.E.I.'s new mobile radar unit, which is on a five-month demonstration tour of Western Europe.

APRIL MEETINGS

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

LONDON

4th. I.E.E.—"V.H.F. sound broadcasting: subjective appraisal of distortion due to multi-path propagation in f.m. reception" by R. V. Harvey at 5.30 at Savoy Place, W.C.2.

5th. I.E.E.—"Thermistors — their theory, manufacture and application" by Dr. R. W. A. Scarr and R. A. Setterington at 5.30 at Savoy Place, W.C.2.

7th. Brit.I.R.E.—"The work of the B.S.I. in relation to the radio and electronics industry" by H. A. R. Binney at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

7th. Society of Instrument Technology.—"The electronic computer as a unit in an automatic electronic data processing system for missile trials" by W. C. J. White and D. L. Overheu at 7.0 at Manson House, 26 Portland Place, W.1.

8th. I.E.E.—Symposium on data handling and display systems for air traffic control at 5.30 at Savoy Place, W.C.2.

8th. Television Society.—"Video tape in action" by R. H. Hammans

(Granada TV) at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

8th. Junior Institution of Engineers.—"The atomic clock" by Dr. L. Essen (N.P.L.) at 7.0 at Pepys House, 14 Rochester Row, S.W.1.

12th. I.E.E.—Medical Electronics Group discussion on "Aids for the blind" opened by Lord Fraser of Lonsdale (St. Dunstan's) and Dr. R. L. Beurle (English Electric Valve Co.) at 6.0 at Savoy Place, W.C.2.

13th. Brit.I.R.E.—"Guided weapon control" by F. R. J. Spearman at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

21st. Brit.I.R.E. Medical Electronics Group.—"Nerve impulses from stretch receptors in muscles" by Dr. J. G. Nicholls at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

22nd. I.E.E.—Discussion on "Broadening university courses" opened by Professor H. E. M. Barlow at 6.0 at Savoy Place, W.C.2.

22nd. B.S.R.A.—“Sound radiation from loudspeaker cabinets” by J. Moir at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

23rd. B.S.R.A.—Audio Convention at 10.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

25th. I.E.E. Graduate and Student Section.—“A survey of microwave techniques for the transmission of speech and vision” by K. C. Kao at 6.30 at Savoy Place, W.C.2.

26th. I.E.E.—“An experimental transistor-controlled component selection and testing machine” by T. C. Cardwell, J. R. W. Smith and G. H. King at 5.30 at Savoy Place, W.C.2.

27th. I.E.E.—“Henri de France colour television system” by R. Chaste and P. Cassagne at 5.30 at Savoy Place, W.C.2.

27th. Brit.I.R.E.—“Electronics in oceanography” by M. J. Tucker at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

28th. British Computer Society.—“Automation and uncertainty” by Stafford Beer (United Steel Co.) at 2.30 at the Northampton College of Advanced Technology, St. John Street, E.C.1.

28th. I.E.E.—“Radar observations of birds and ‘angels’” by Dr. E. Eastwood at 5.30 at Savoy Place, W.C.2.

28th. Brit.I.R.E.—Discussion on the Education Committee’s report entitled “The education and training of the professional radio and electronics engineer” at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

ABERDEEN

8th. I.E.E.—“Engineering education in the technical universities in Western Germany” by D. E. Welbourn, Professor D. B. Spalding and G. L. Ashdown at 7.30 at Robert Gordon’s Technical College.

BIRMINGHAM

13th. A.S.E.E.—“Electronics in industry” by R. J. F. Howard at 7.30 at the Birmingham Exchange and Engineering Centre, Stephenson Place.

BOLTON

4th. A.S.E.E.—“Servo speed control of d.c. motors” by J. Bailey (A.E.I., Manchester) at 7.45 at the Railway Hotel, Trinity Street.

CARDIFF

28th. British Computer Society.—Symposium on auto codes at 6.30 at the Small Shanlon Lecture Theatre, University College.

CHELTENHAM

29th. Brit.I.R.E.—“The application of semiconductor devices in power supplies” by D. D. Jones at 7.0 at the North Gloucestershire Technical College.

COVENTRY

6th. I.E.E.—“High-capacity s.h.f. radio transmission systems” by H. D. Hyamson at 6.30 at the Technical College.

DUNDEE

7th. I.E.E.—“Engineering education in the technical universities in Western Germany” by D. B. Welbourn, Professor D. B. Spalding and G. L. Ash-

down at 7.0 in the Electrical Engineering Department, Queen’s College.

EDINBURGH

5th. I.E.E.—Faraday lecture on “Electrical Machines” by Professor M. G. Say at 7.0 at the Heriot-Watt College.

13th. I.E.E.—“High-current-density thermionic emitters: a survey” by A. H. W. Beck at 7.0 at the Carlton Hotel, North Bridge.

FARNBOROUGH

20th. I.E.E.—“Machine translation of languages” by Dr. A. D. Booth at 6.15 at Farnborough Technical College, Boundary Road.

GLASGOW

12th. I.E.E.—“High-current-density thermionic emitters: a survey” by A. H. W. Beck at 6.0 at the Royal College of Science and Technology.

KIDSGROVE

11th. I.E.E.—“Silicone transistors—their manufacture and fields of application” by Dr. J. T. Kendall at 7.0 at the English Electric Co.

LIVERPOOL

7th. Institute of Physics.—“New techniques in electron and X-ray microscopy” by C. W. Oatley at 7.0 at the University.

MANCHESTER

14th. Brit.I.R.E.—“The measurement of human performance” by H. Woolf at 6.30 at the Reynolds Hall, College of Technology, Sackville Street.

MIDDLESBROUGH

21st. Institute of Physics.—“The Jodrell Bank telescope” by H. A. Prime (Brush Electrical Engineering Co.) at 6.30 at the Cleveland Scientific and Technical Institute.

NEWCASTLE-ON-TYNE

13th. Brit.I.R.E.—“The development of electronics in the North East” by J. Bilbrough (chairman, N. E. Section) at 6.30 at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road.

PLYMOUTH

7th. I.E.E.—“A new cathode-ray tube for monochrome and colour television” by Dr. D. Gabor, P. R. Stuart and P. G. Kalman at 3.0 at Plymouth “B” Generating Station, Prince Rock.

PORTSMOUTH

6th. I.E.E.—“Modern ferromagnetic materials” by Professor F. Brailsford at 6.30 at the College of Technology.

STONE

22nd. I.E.E.—“The application of transistors to line communication equipment” by H. T. Prior, D. J. R. Chapman and A. A. M. Whitehead at 7.0 at the Duncan Hall. (Joint meeting with Institution of Post Office Electrical Engineers.)

SWANSEA

14th. I.E.E.—“Electronic applications in a modern steelworks” by J. K. Edwards at 6.0 at the Conference Room, S.W.E.B. Showrooms, The Kingsway.

WEYMOUTH

7th. I.E.E.—“Sound reproduction” by D. E. L. Shorter at 6.30 at South Dorset Technical College.

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RANDOM RADIATIONS

By "DIALLIST"

Le Serviceman

VERY few suggestions of an alternative to "serviceman" (see February issue) have reached me from readers. One, writing from Johannesburg, tells me that the local term is "radiotrician," though "teletrician" hasn't yet appeared, as there is no TV service in South Africa. He wonders if wireless-trouble-shooters are known as radiotricians anywhere else. I can't answer that one, though I've never come across the word before. None of the men whom I consulted had the faintest objection to being styled a serviceman; which was just what I'd expected. There's certainly nothing derogatory about the word, which exactly describes what they do. Most sound radio and television dealers advertise "sales and service." The people who do the selling are rightly known as salesmen; servicemen then seems just to fit those who provide the service. By the way, I've recently come across *le serviceman* in a French magazine, so the term seems to have found acceptance on the other side of the Channel. I'm all for plain rather than fancy terms: you can call a good rider a horseman; but to speak of him as an equestrian rather suggests the circus.

Transistor Life

THE article "How Long Will a Transistor Live" by R. Brewer, of the G.E.C. Research Labs., at Wembley, in the March issue of *Wireless World*, fascinated me and no doubt many readers too. All sorts of answers have been offered, but this is the only one I've seen which is based on a controlled test extending, so far as it has gone (for I imagine it will be continued) to 20,000 hours. One American physicist has spoken of transistors which will run for a century, but I don't think we've got quite that far yet, undoubtedly we shall do so as improved methods of manufacture and of "doping" in particular are developed; but that's likely to take a little time. Brewer's curve for the change of median value of β during a test of 20,000 hours is particularly interesting. It shows that following the nose-dive at the start the per-

centage of the initial median β value steadies up after the first thousand hours and then falls gradually until the 8,000 hours point is reached. And then comes a surprise; the value rises during the next 3,000 hours. Then comes another small dip, followed by a rise, another dip, a further rise at 16,000 hours and then almost steady readings until the 20,000-hour mark is reached. It's all so very unlike the life-curve of a valve, for there's none of that maintained or, more likely, accelerating deterioration.

Electronics and Honey

THE most surprising applications are being found for electronics. Who'd have thought, for instance, that it could do anything to help the beekeeper? Nevertheless, it can and a gadget called the Apidictor is now doing valuable work in many parts of the world. E. F. Woods, of the B.B.C. Engineering Division, is a knowledgeable and enthusiastic beekeeper and it was his work, in collaboration with E. F. Birch, a Post Office engineer, which led to the production by Wayne Kerr Laboratories of the instrument. One of the problems of beekeeping is swarming, which may take place at any time during the summer. Before there's to be an exodus the inhabitants hum with a peculiar

sound for at least fifteen days. This Apidictor responds to the frequency of this sound and so gives the beekeeper advance warning of a swarm and makes unnecessary the opening of the hive and the search for queen cells which would otherwise have to be done every 9 or 10 days from about mid-April to mid-July.

Ring Angels

YOU may remember that some months ago I mentioned one type of radar "angel" which was undoubtedly caused by birds. Something over a year ago a new kind, known as the ring angel, made its appearance. This starts as a spot of light on the screen, but it quickly spreads outwards in the form of concentric rings exactly like those seen when a stone is dropped into a calm pond. The expansion is rapid: the rings travel outwards at speeds between 25 and 50 miles an hour. Such angels occur only in the half hour immediately before or after sunrise. For many months now the phenomenon has been investigated by radio engineers at the Marconi Research Establishment at Great Baddow. About 70 places in south-east England have been identified as repeated but irregular centres of such displays. So far no quite satisfactory explanation has been found. Birds have again been suggested as the cause; but



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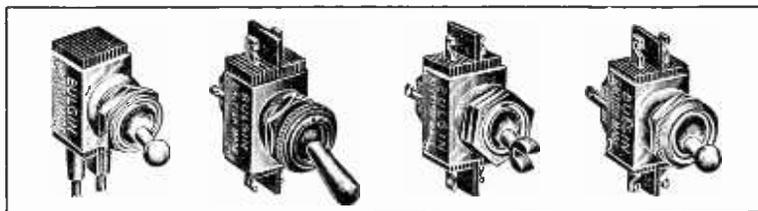
flocks leaving the roosting places don't spread outwards in circles. The most likely suggestion, which still remains to be proved, is that these angels are caused by rapidly expanding thermal fronts in the upper atmosphere.

V.H.F. DX at Aylesbury

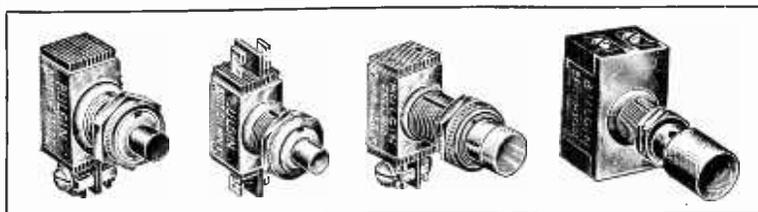
A LONDON reader writes that he is very envious of the regular reception in Aylesbury of French and West German v.h.f./f.m. stations reported in my notes in February. He asks how it's done: is some very special form of tuner used, or is the secret in the aerial array? Perhaps my Aylesbury correspondent will be kind enough to let him into the secret. It may well be that Aylesbury is a particularly favourable spot for v.h.f. DX reception, for I recall that when I lived in Hertfordshire at a place about a dozen miles from Aylesbury I often picked up distant f.m. transmissions. The aerial then in use was just the simplest of single half-wave dipoles, oriented on Wrotham. Admittedly my home was on the 500-ft contour line above sea-level and the aerial, mounted on a chimney stack, was a good 30-feet above the road; but the tuner wasn't designed specially for sensitivity.

Not Good Enough

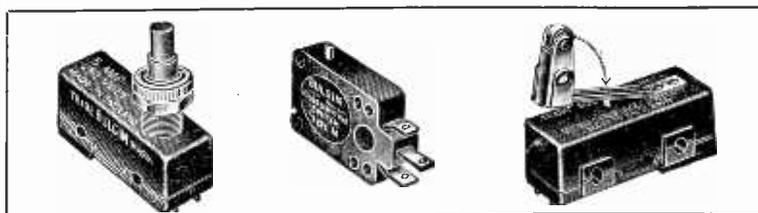
A WEEK or so before this was written a friend remarked, "I still can't get that wretched valve." As he hadn't mentioned that he was short of one, I asked him to tell me more—this is the sad story he unfolded. He has a 17-inch television set of well-known make, now a little over three years old, which had broken down five weeks before. The dealer found that a valve had gone phut; he hadn't that particular type in stock, but ordered one the same day. The set remained out of action, for he'd not been able to get delivery of the valve. I'm sure you'll agree that this sort of thing just isn't good enough. The makers of the set (a large and important firm) should surely have stipulated when the contract for its valves was placed that replacements should be readily available for a reasonable number of years. I imagine that they did so, for disappointments of this kind do not help future sales. Apart from that, did the dealer not consult a valve data book to make sure that there wasn't a substitute of another make? I don't yet know. But one thing I'm sure of is that this kind of thing happens rather too often.



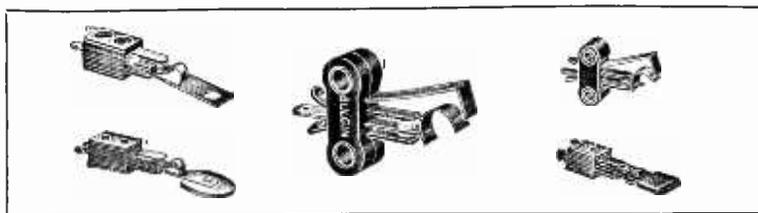
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UNBIASED

By FREE GRID

Laurels and Lolly

NEARLY every daily journal reported an alleged television novelty in the Furniture Exhibition held at Earls Court in February. In this show five different people, who were said to be experts in the business, were given the task of re-furnishing a couple of old-fashioned rooms within the limits of budgets ranging from £100 to £2,000. The expert who was responsible for the £1,000 effort was the one who had the brainwave which caused all the newspapers to burst into songs of praise.

His jack-pot-hitting idea was to place a TV set in the fireplace, which, in these days of central heating, fewer people are using. It is, of course, a thoroughly sound idea from all points of view as I myself thought when I first put it forward in these columns, complete with illustration, 14 years ago, in March, 1946. Technically it is the ideal position for a television set because the aerial lead can go straight up the flue to the dipole on the chimney stack.

Since we are all creatures of habit and tend to sit around the fireplace, even if there is no fire, it is obviously also the correct place for a TV set from the viewing aspect. I only wish I could share some of the laurels and the lolly which came the way of the Earls Court designer for this old idea of mine. But I have thought of a way of improving it which I will mention here in the hope of helping other designers.

It will be realized that people sitting at each side of the fireplace would get a rather distorted view of the television picture. My idea is to avoid this by designing a television set with three screens set at an angle of 120 degrees to each other. This

would mean that the front of the set would be shaped like half a hexagon. In these days of wide-angle tubes the relatively short necks could, by a bit of wangling, be prevented from fouling each other. Three tubes in the same cabinet could, of course, all share the same power pack and other ancillary equipment.

A further improvement would be to place a specially shaped electric fan-heater under the set in the place normally occupied by the ash tray. If it did nothing else it would prevent our getting cold feet in some of the horror plays that we sometimes see on the screen.

The Telegraphone

THOSE of you who, like myself, date back to the days of the first world war, may recollect "The Exploits of Elaine," a series of detective stories by Arthur B. Reeve, published in 1915. The book was sufficiently famous to be made into a serial film for the silent cinema of the early 'twenties.

In looking through this book again recently I found (p. 180) a very convincing account of the *modus operandi* of the magnetic recorder. Its invention is rightly ascribed to Poulsen who seems to have intended it for recording telephone conversations; hence the name "Telegraphone." The date of Poulsen's invention was, I find, 1898 although that is not mentioned in the book.

The antiquity of Poulsen's invention reminds me that only six years later in 1904, the first radar patent was taken out by Hulsmeyer. Owing to the fact that valves and transistors were, as Shakespeare puts it, still hidden in the womb of time, there was not much that either Poulsen or Hulsmeyer could do to bring their re-

spective inventions to full fruition. Even in 1915, although the valve was on the map, it would have been difficult to make a really worthwhile magnetic recorder and I am surprised that such a detailed description is given in this book of 45 years ago.

Down with Dials

A FEW weeks ago I was astonished to read in the pages of *Electrical Review* a suggestion that cyclometer-type meters, instead of the multi-dial type with which we are all so familiar, be fitted into our houses for recording electrical power consumption. The writer mentioned that he had advocated this previously, and that an effort is to be made in influential quarters to get the Eastern Electricity Board to make the change.

Now *Electrical Review* certainly would not allow its reputation to be endangered by putting forward irresponsible views or suggestions. The reason for my astonishment is that when I made this very same suggestion in these columns some years ago, I was sternly taken to task by knowledgeable correspondents—some of whom were members of the electrical industry—who pointed out the error of my ways.

My correspondents reminded me that all types of meter are power-consuming devices, and it is the consumer who pays for the power required to work the meter. For that reason the Board of Trade imposed a definite limit on the power which a meter could be permitted to consume. It was furthermore pointed out to me that the reason why the cyclometer-type meter was barred was that its power consumption, unlike that of the multi-dial type, exceeded the permissible limit. The Board of Trade's powers in this matter are today vested in the Ministry of Power but surely this old consumer-protecting restriction has not been thrown overboard?

In view of what is said in *Electrical Review*, it is, I think, reasonable to suppose that in recent times either the cyclometer-type meter has been redesigned so that its power consumption is within the permissible limit, or this limit has been raised in order to bring it within the fold. In this latter case, of course, it would mean that the supply authorities are now allowed to dip still deeper into our pockets. If neither of my suppositions is correct can anyone give me the correct information?

Sirkit and Condewit

WHY is it that some electricians and radio servicemen persist in pronouncing conduit as condewit? They have a perfectly good example of the correct pronunciation in the word circuit. They never call that a sirkit; or do they? I have even heard electrical engineers, and others who ought to know better, speak of condewit.



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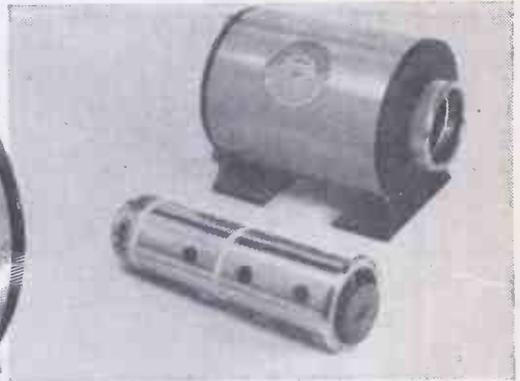
Quadrant Works, Wortley Road, Croydon, Surrey.

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Backward Wave Oscillators

Mullard now have available a range of O-type backward wave oscillators covering operation in the S, X and J bands.

The mechanical design allows substantial cuts in maintenance costs to be effected as the focusing system may be re-employed should the valves need to be changed. The valves are supplied pre-aligned in a protective capsule which automatically locates in the focusing system and any replacements may be made quickly and easily without need for focusing adjustments. Both electro-magnet and permanent magnet focusing systems are available.



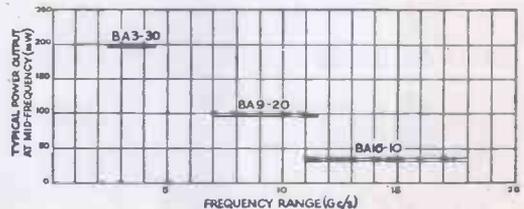
BA16-10 demounted from electromagnet focusing system

See Mullard valves and tubes on Stand M559 at the INSTRUMENTS, ELECTRONICS AND AUTOMATION EXHIBITION

Abridged data

Type No.	Frequency Range (Gc/s)	Power Output over Frequency Range (mW)	Delay Structure Voltage Range (V)	Sensitivity at Mid-frequency (Mc/s per V)	Cathode Current max (mA)
BA3-30	2.4 to 4.5	30 to 500	150 to 1600	3.0	50
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Where modulation of the valve output is required this can be readily achieved by modulating the appropriate electrode. The output connection is isolated from the delay structure so that the valve may be operated with its cathode earthed and consequently high modulation frequencies may be used. These specialised microwave valves make possible the design of wide frequency range microwave instruments, microwave search receivers and f.m. carrier systems. Write to the address below for full details of these and other Mullard microwave valves.



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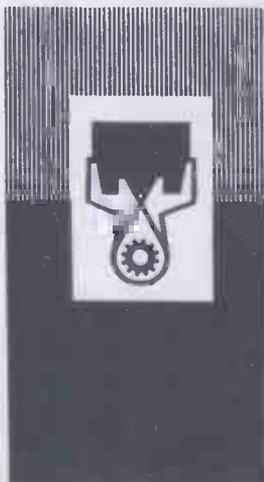
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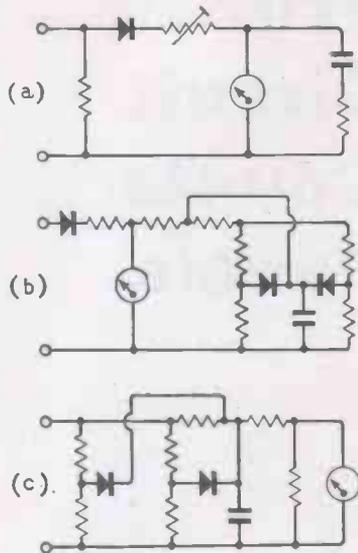
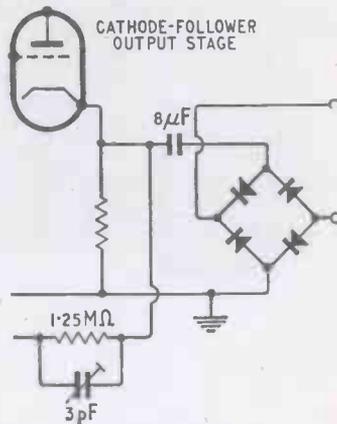
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Modern Valve Voltmeters



The March issue of **ELECTRONIC TECHNOLOGY** included a survey of current valve voltmeters suitable for measurements at audio and radio frequencies. The article gives details of modern circuit practice and trends and indicates how different designs have been evolved for different parts of the frequency spectrum. Many typical instruments are discussed and performance details given.

ELECTRONIC TECHNOLOGY covers all technical interests in electronics, using this word in its widest possible sense. All the familiar features of ELECTRONIC & RADIO ENGINEER are retained, including, of course, the well-known Abstracts and References section. Regular readership will keep you in constant touch with progress in the entire field.

ARTICLES IN THE APRIL ISSUE INCLUDE:

AMMONIA MASER OSCILLATOR
The article describes a 23,870-Mc/s constant-frequency oscillator using an ammonia maser. The principles of operation, the construction of component parts and the parameters affecting the frequency and stability are discussed together with potential applications of the maser.

RING-TYPE TRANSMISSION-LINE NETWORKS
Filters using closed rings of transmission line or waveguide are being increasingly used at v.h.f. and above, because they permit the construction of filters embodying only unbalanced elements. In this article, they are simply related to lumped-impedance networks and the use of this equivalence in building up networks is discussed.



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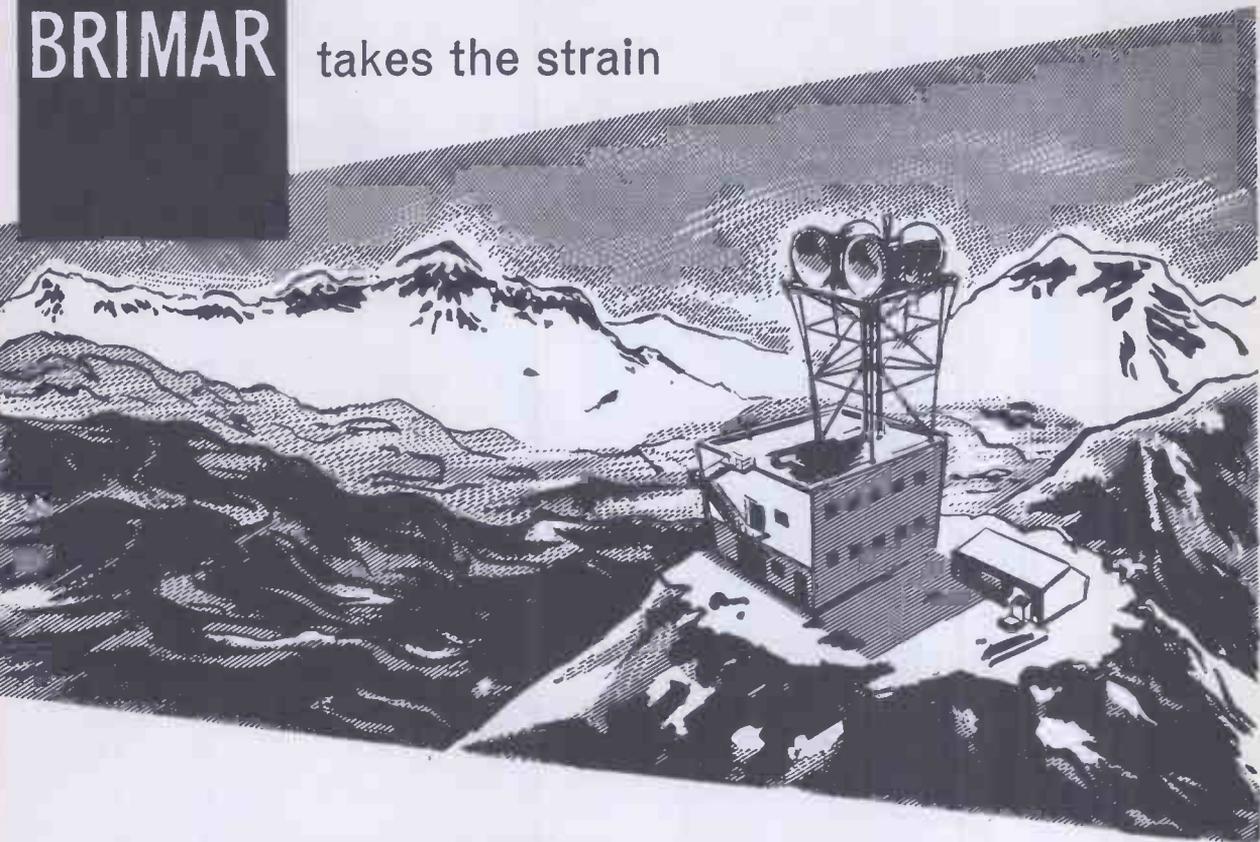
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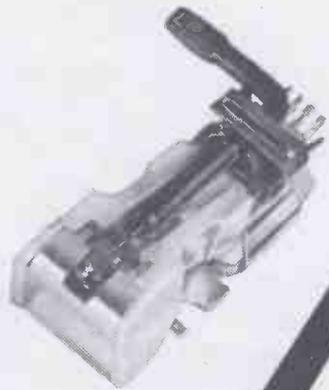


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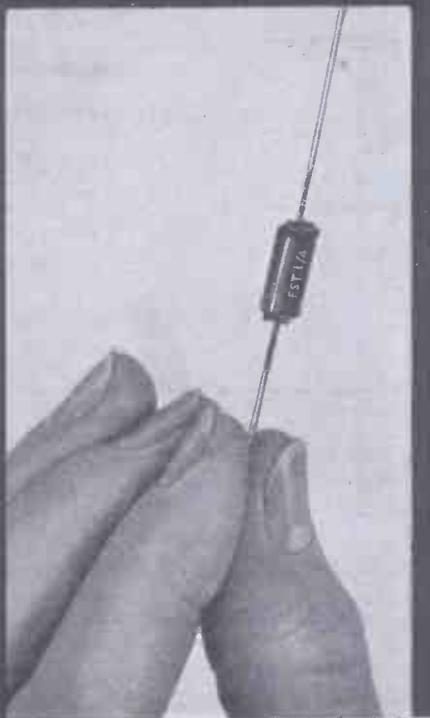
SILICON h.t. power rectifier type FST1/4 for television receivers

The FST1/4 Silicon Power Diode has been specially designed for domestic television receiver H.T. power supplies and is of particular interest to circuit designers planning receivers with 110° scanning, 625 line receivers and colour television receivers. Two diodes may be used in series to provide capacitor smoothed H.T., direct from 250 volts A.C. mains.

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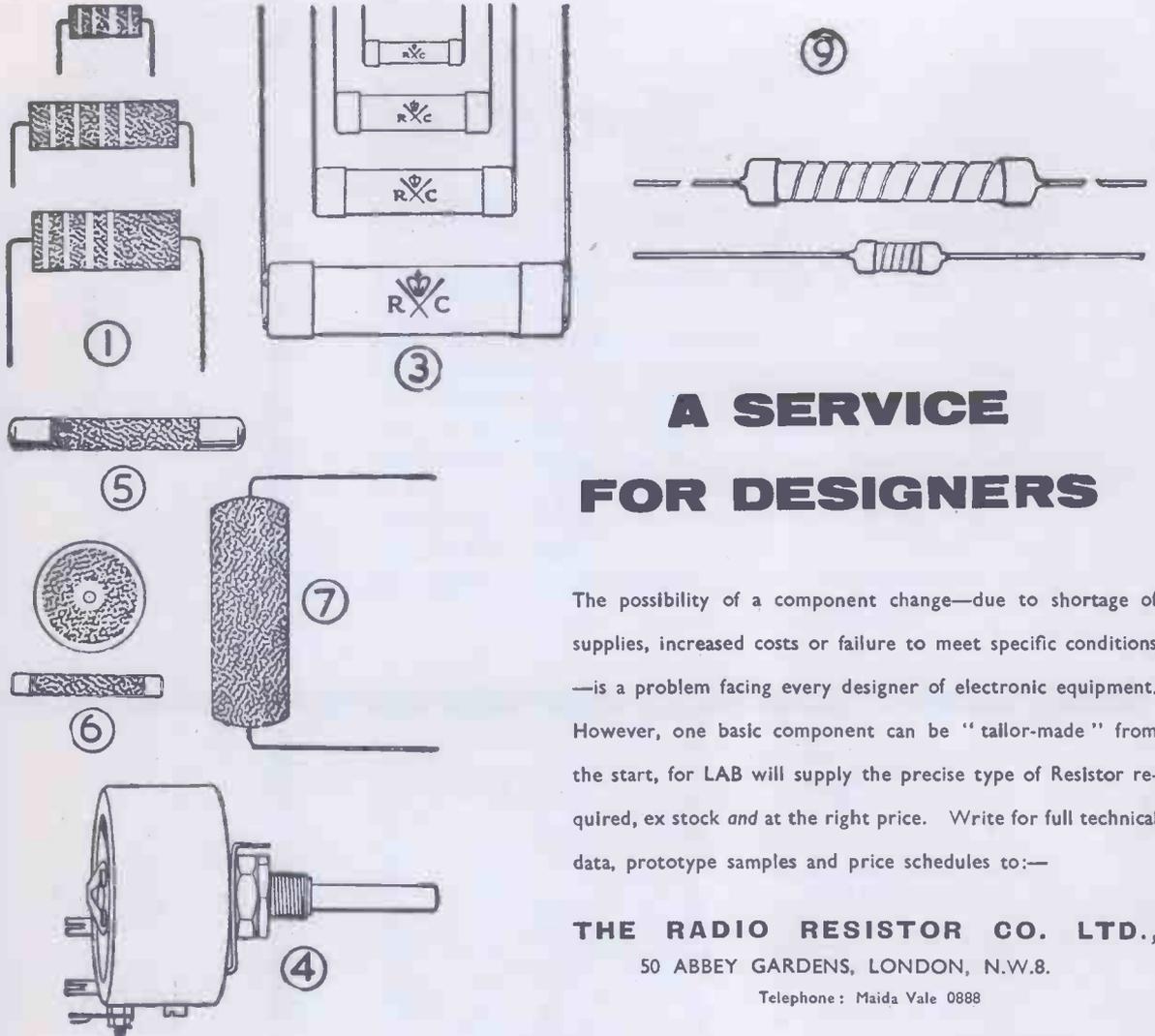


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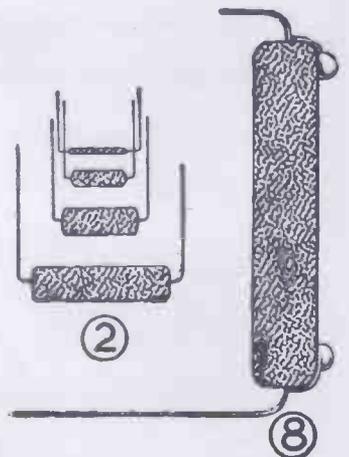
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WIREWOUND			
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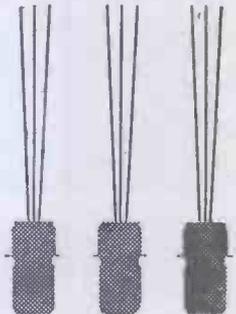
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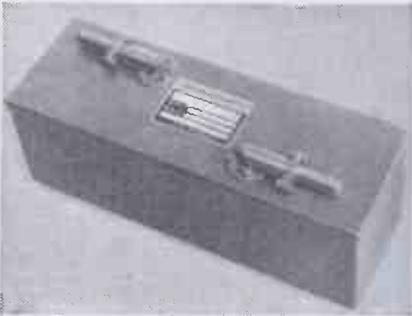
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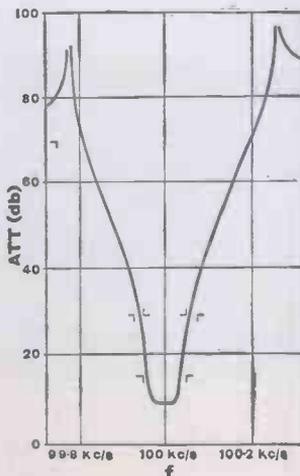
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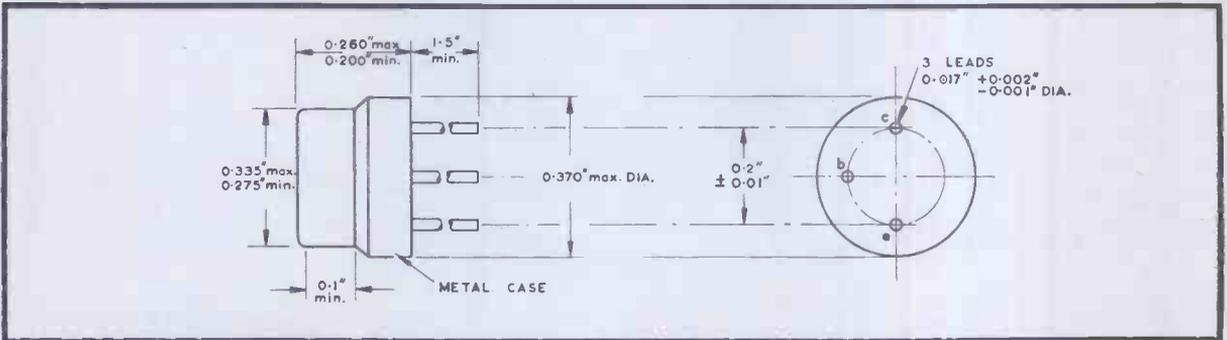
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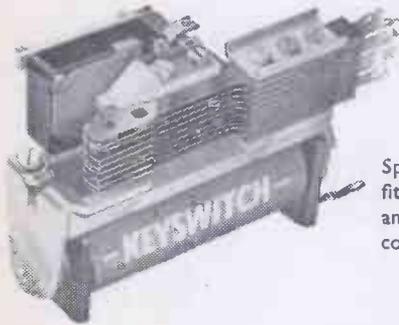
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	Average	45	45	45
	Maximum	5	5	5
Collector to base capacity (pF).....	Average	2	2	2
	Maximum	5	5	5
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	Average	30	50	75

*Typical production spreads

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MAZDA

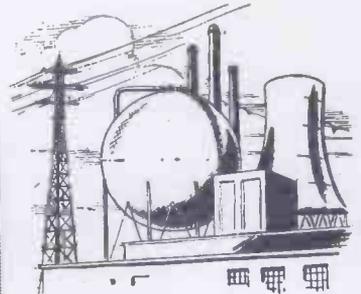
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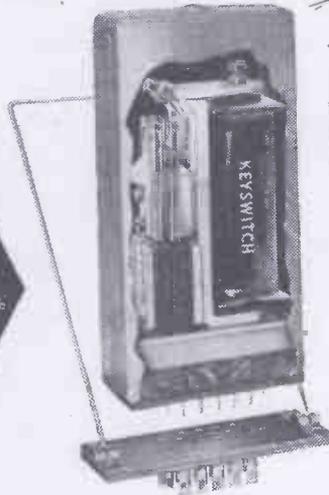
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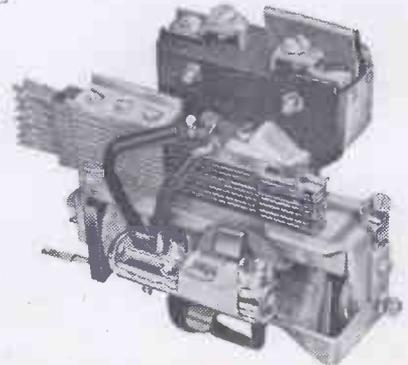
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adjustment of $\pm 7\%$

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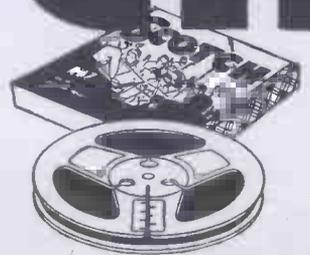
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W197 – a unique, vibration and acceleration resistant capacitor

Capacitance $\mu\text{F} \pm 25\%$	List Number	Joint Service Cat. No.	Style Part. Size Ref.
200 volts D.C. Working			
0.1	B5000KZ	5910-99-011-9827	CPM4-G
0.25	B5010KZ	5910-99-011-9830	CPM4-H
0.5	B5020KZ	5910-99-011-9833	CPM4-J
1	B5030KZ	5910-99-011-9836	CPM4-K
2	B5040KZ	5910-99-011-9839	CPM4-N
250 volts D.C. Working			
0.05	B5050KZ	5910-99-011-9825	CPM4-G
0.1	B5060KZ	5910-99-011-9828	CPM4-H
0.25	B5070KZ	5910-99-011-9831	CPM4-J
0.5	B5080KZ	5910-99-011-9834	CPM4-K
1	B5090KZ	5910-99-011-9837	CPM4-L
2	B5100KZ	5910-99-011-9840	CPM4-P
400 volts D.C. Working			
0.05	B5110KZ	5910-99-011-9826	CPM4-H
0.1	B5120KZ	5910-99-011-9829	CPM4-J
0.25	B5130KZ	5910-99-011-9832	CPM4-K
0.5	B5140KZ	5910-99-011-9835	CPM4-M
1	B5150KZ	5910-99-011-9838	CPM4-P



It's the W197 capacitor, by Hunts — the *only* High Capacitance Miniature Metallised Paper Capacitor with *Joint Services approval* to Humidity Class H1 and Temperature Category 55/100.

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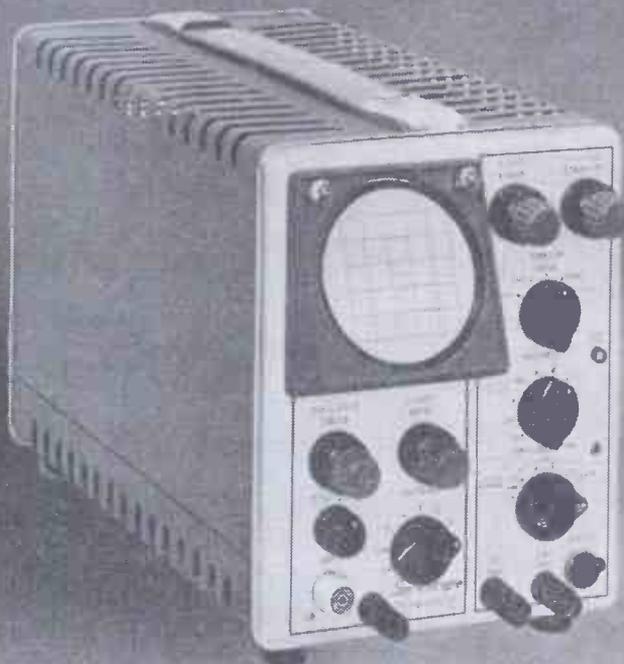
Full details freely available on request.

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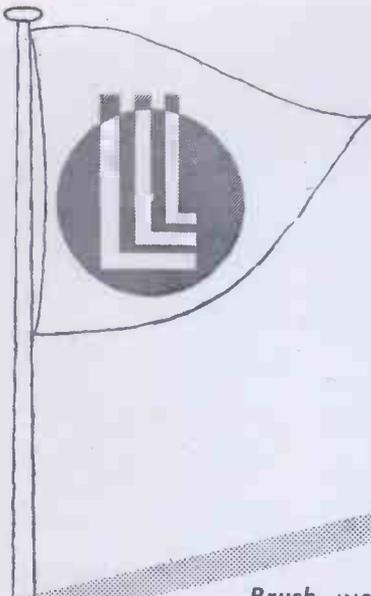
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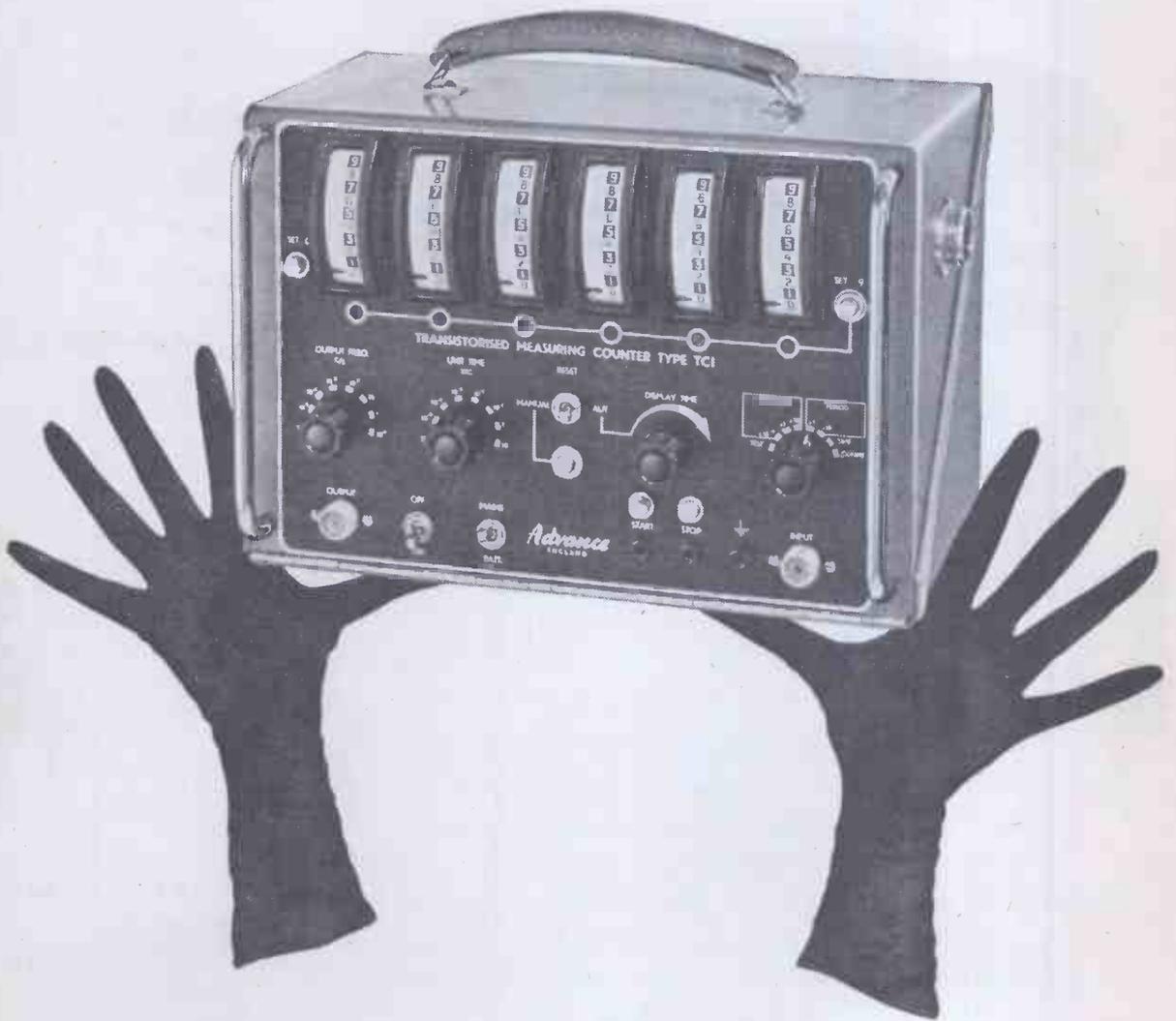
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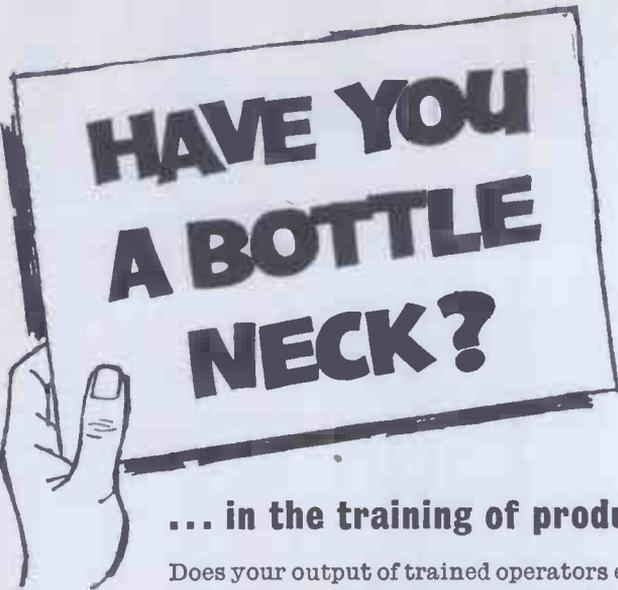
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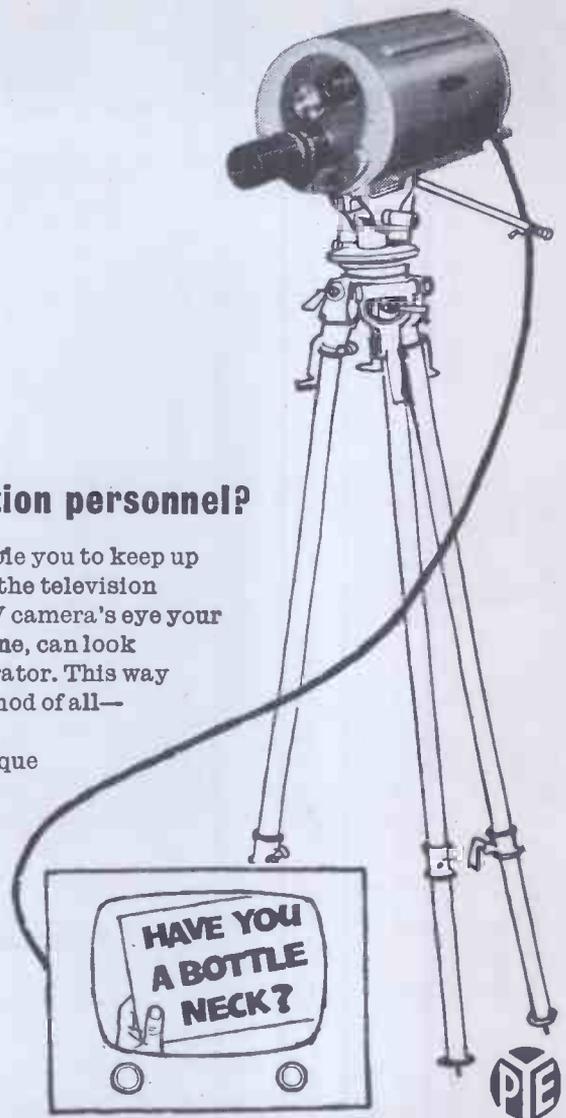


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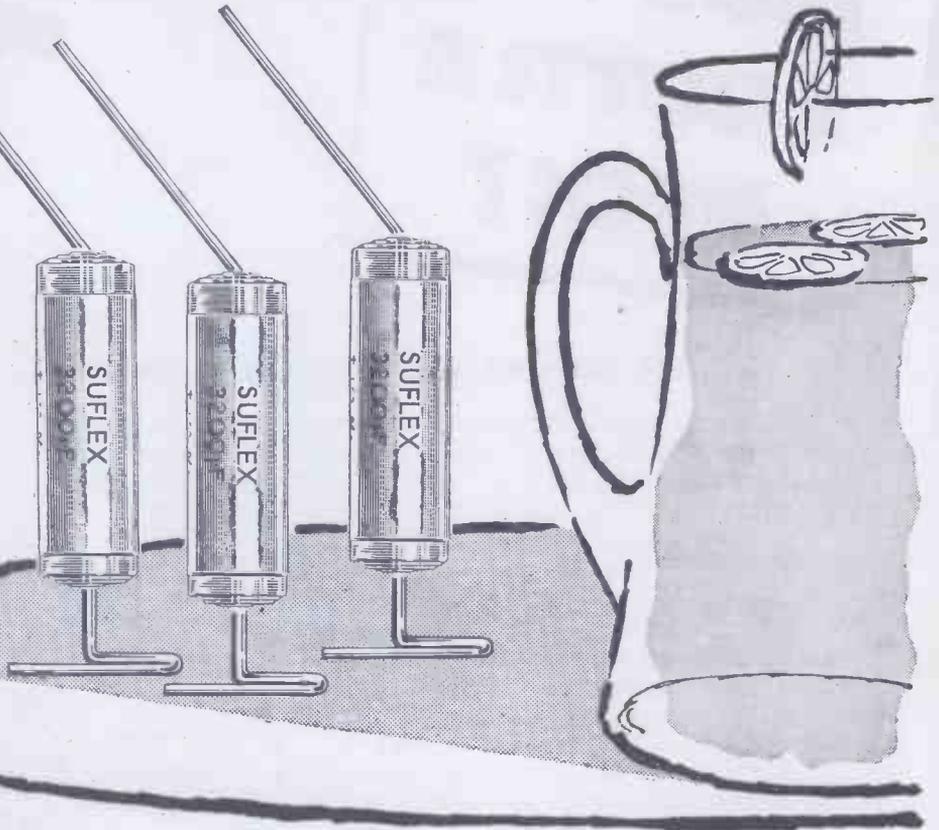
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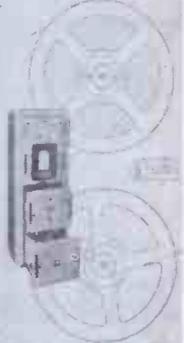
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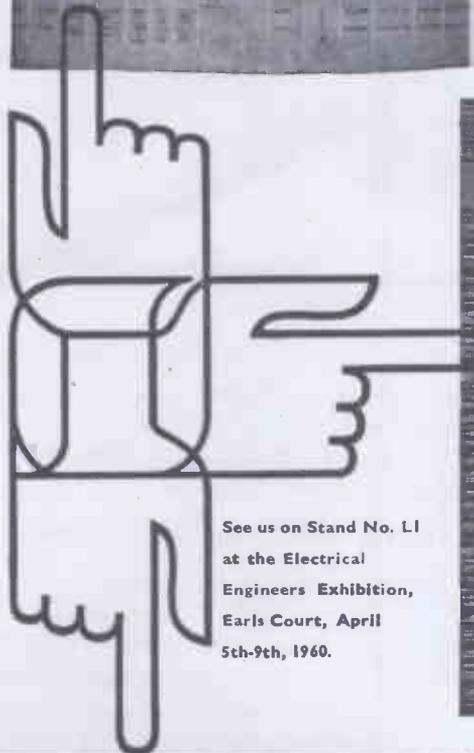
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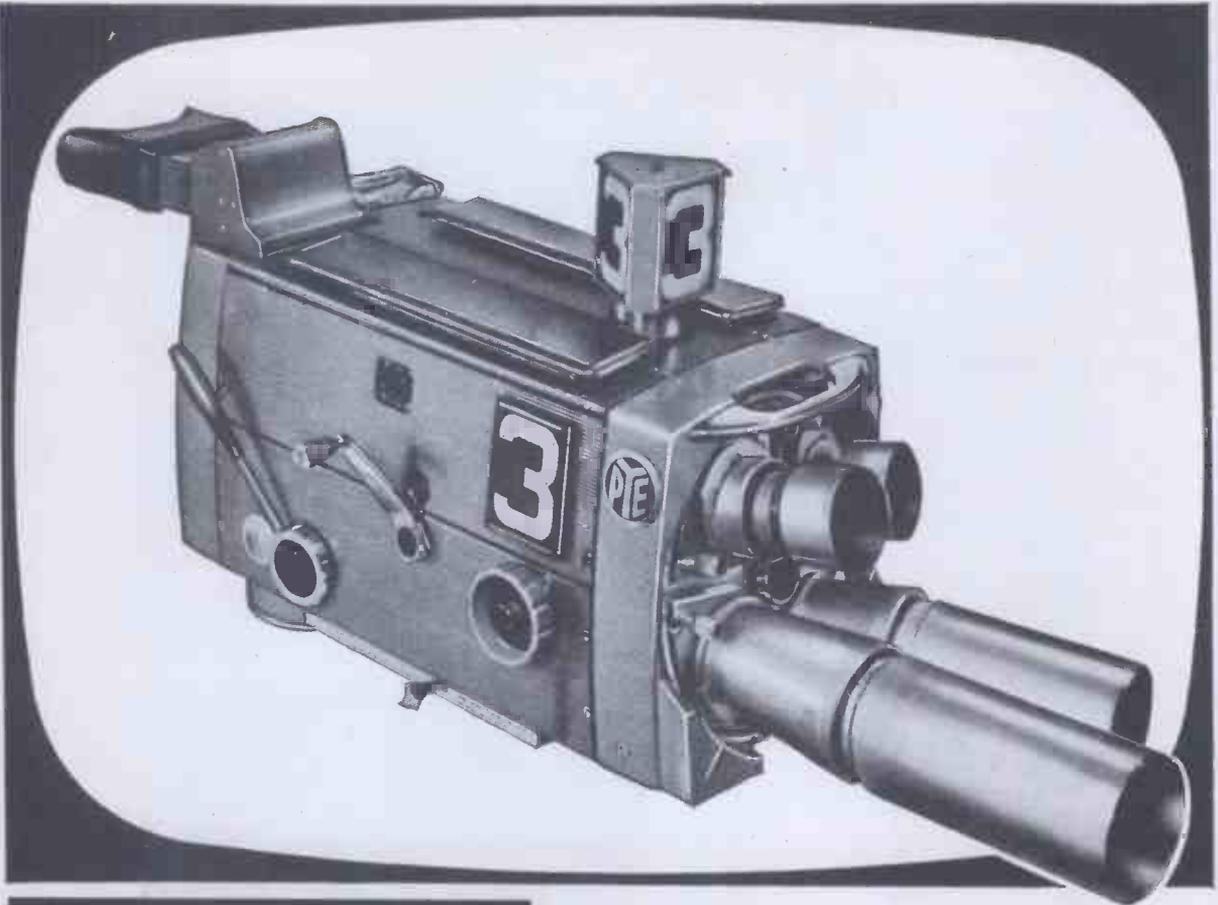


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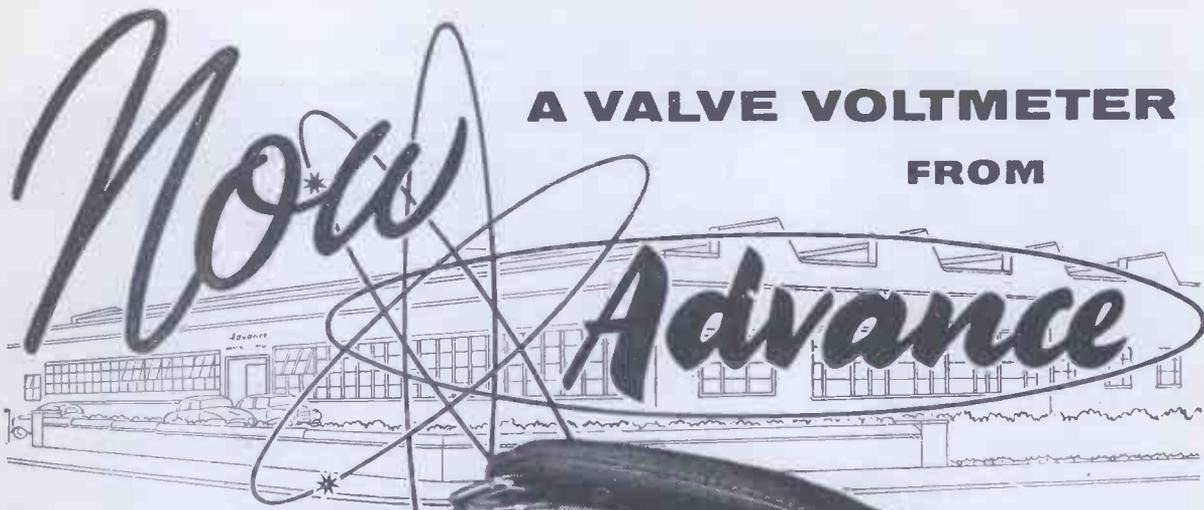
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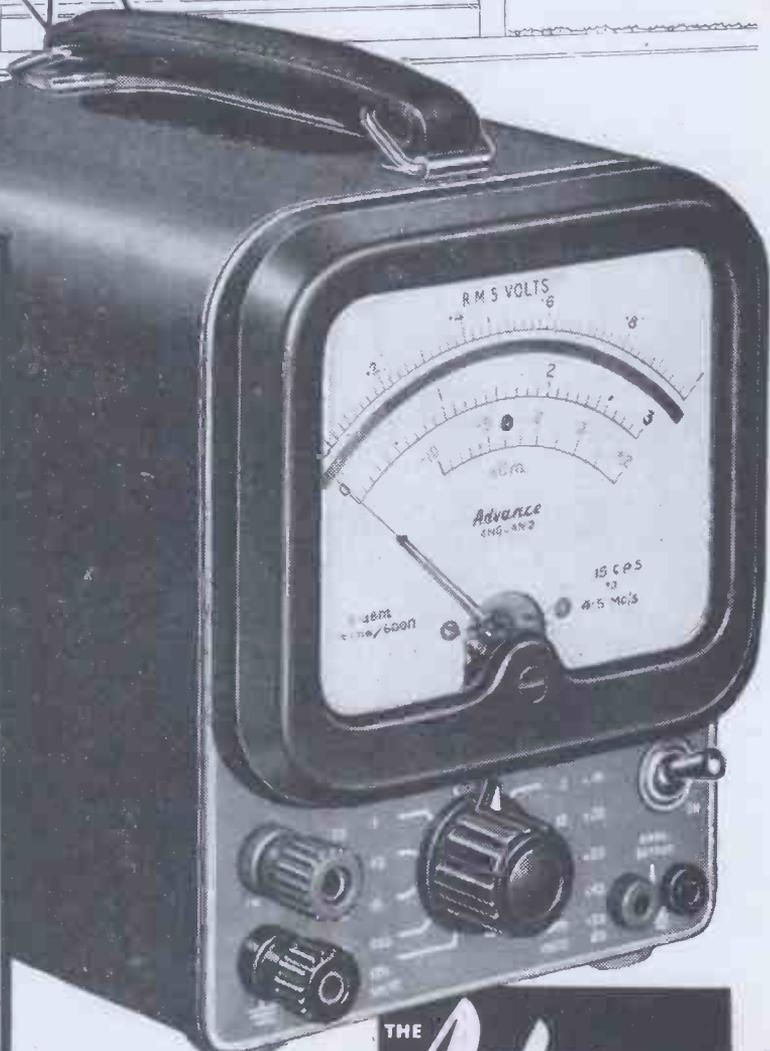
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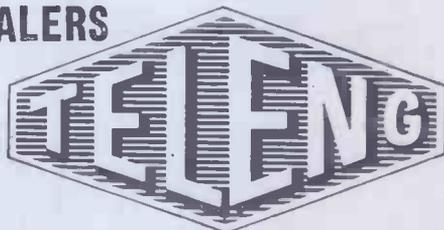
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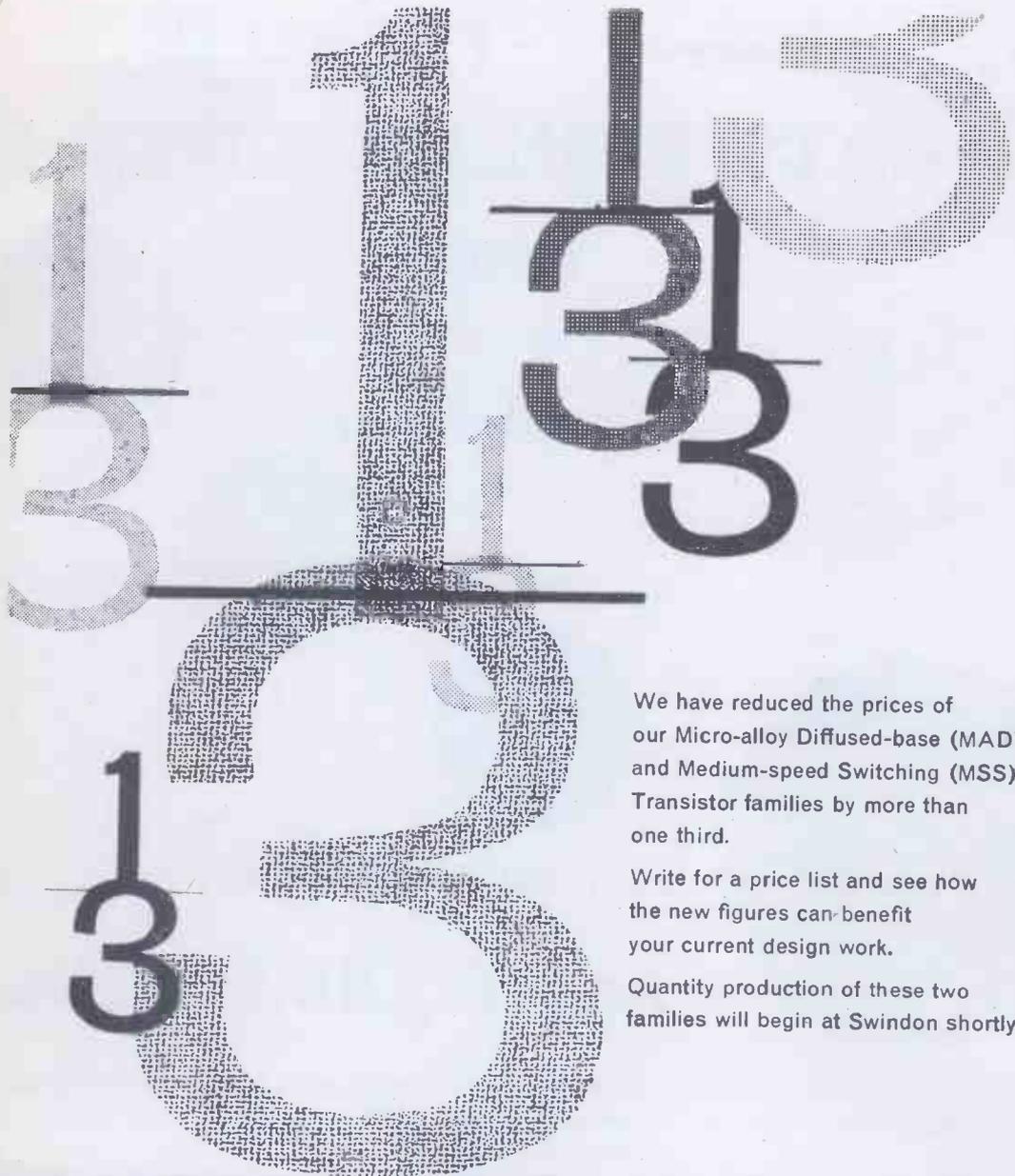
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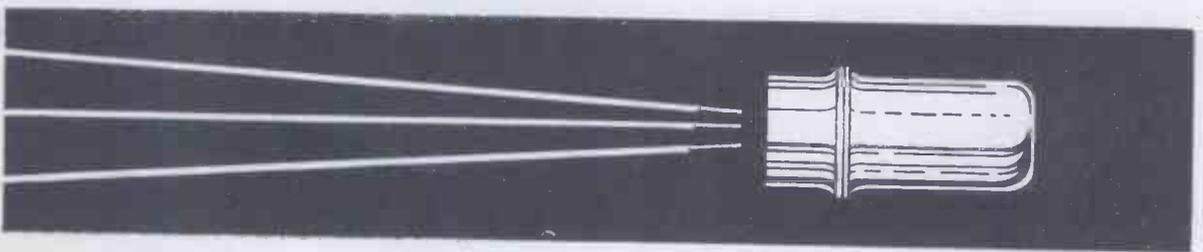




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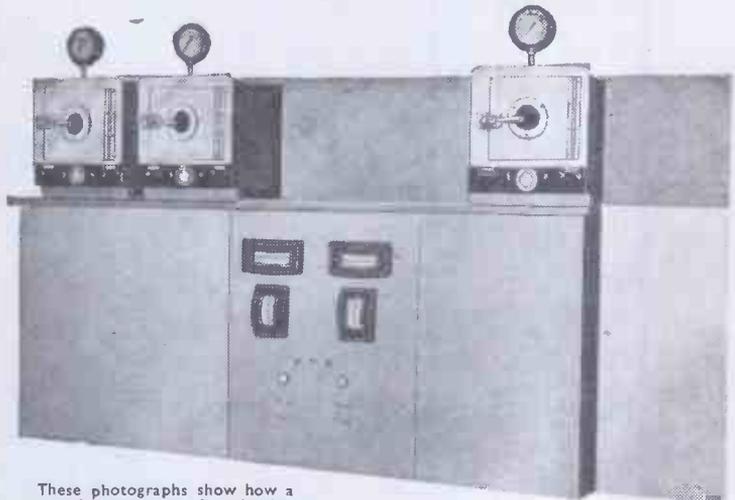


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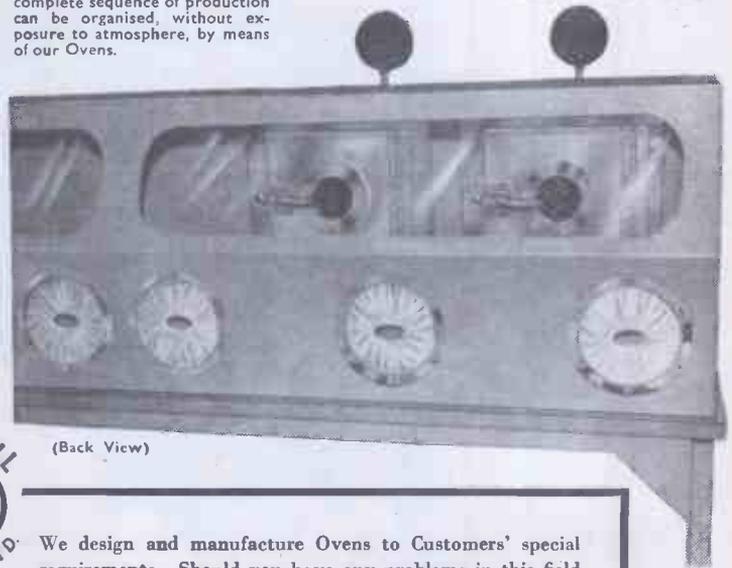
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(Back View)

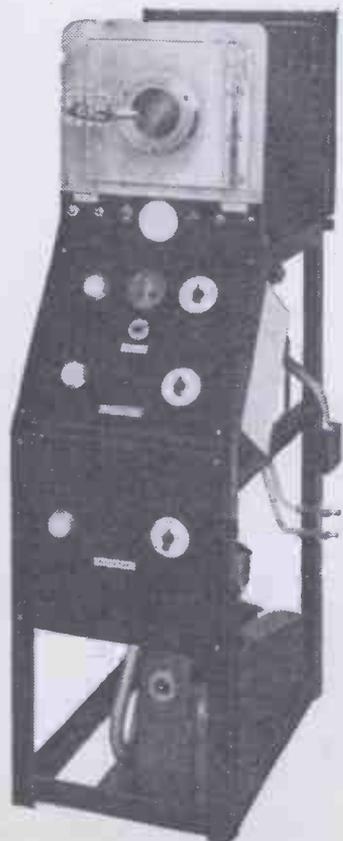


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NICKEL METALLISING**

Quality Approved (Joint Service R.C.S.C.)

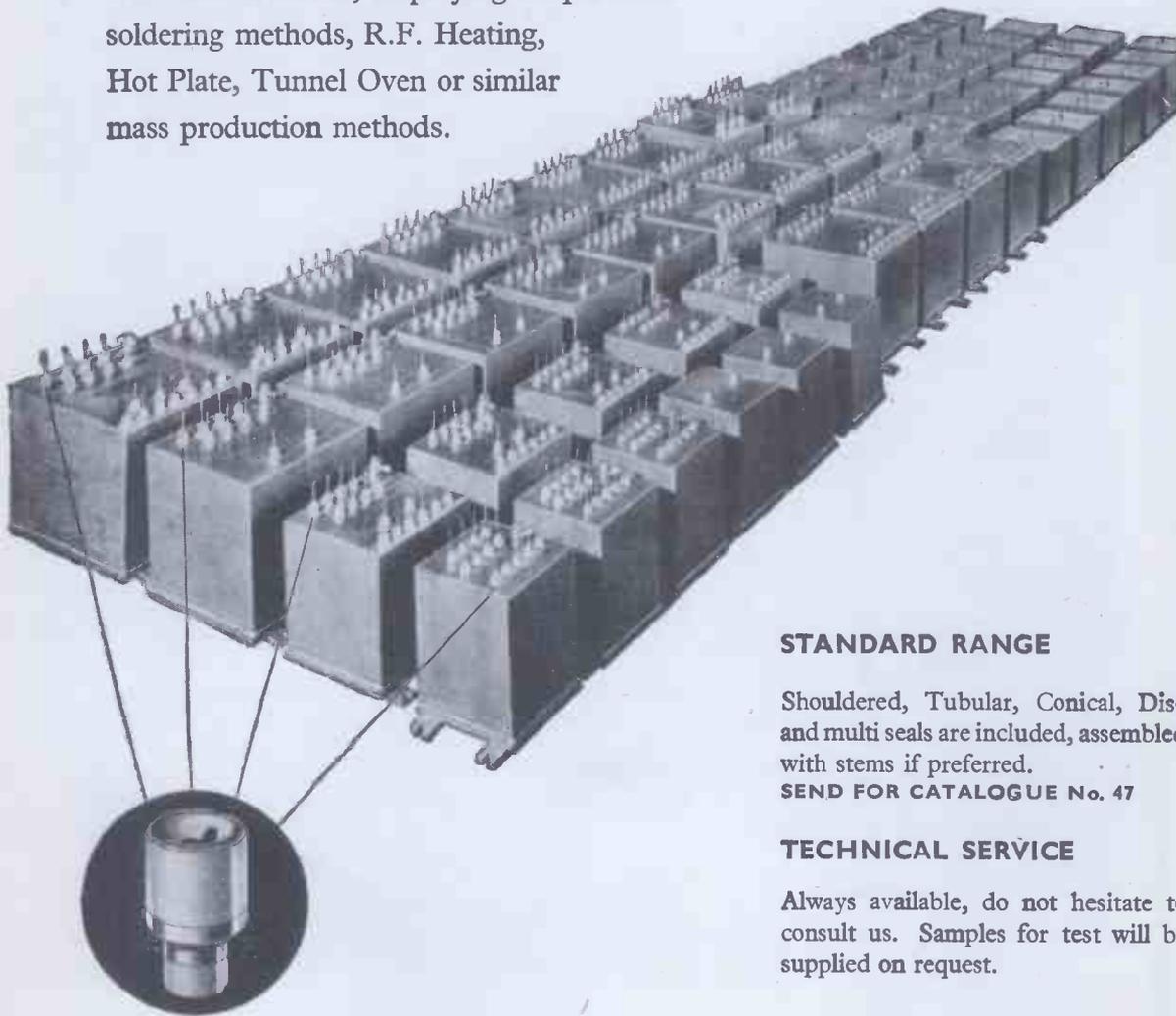
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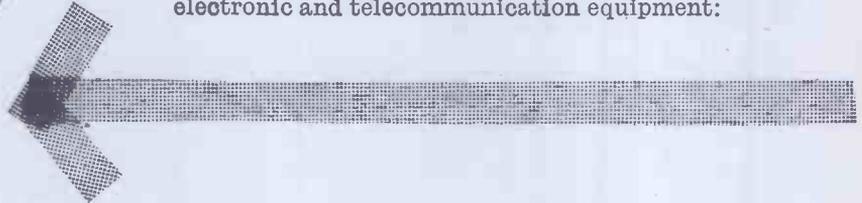
Telegrams: Steataln, Stourport

Joint responsibility...

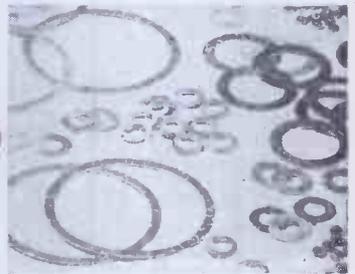
To rely on Enthoven for *all* your soldering requirements is a policy that will take a load off your shoulders...



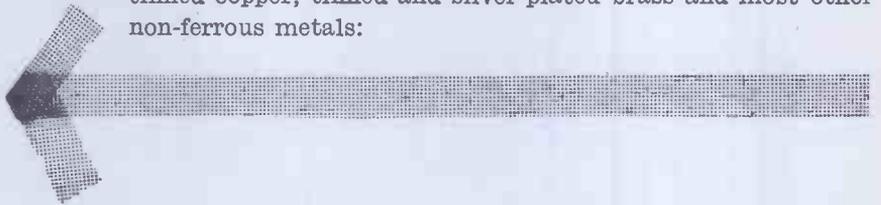
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The comprehensive Enthoven range of solder products comprises cored solder wire, solid solders, materials for soldering aluminium and for the processing of printed circuits, fluxes of all kinds, standard and special preforms and many other special-purpose products. For technical information on all these items please send today for your copy of "Enthoven Solder Products" — or for more detailed technical literature on any soldering material in which you are specifically interested.

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Avantic

AUDIO AMPLIFIER STANDARD

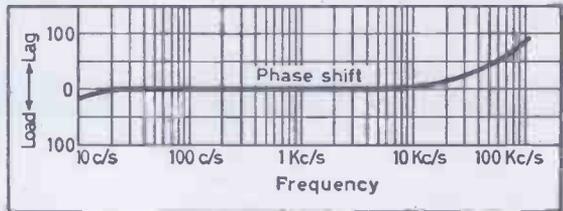
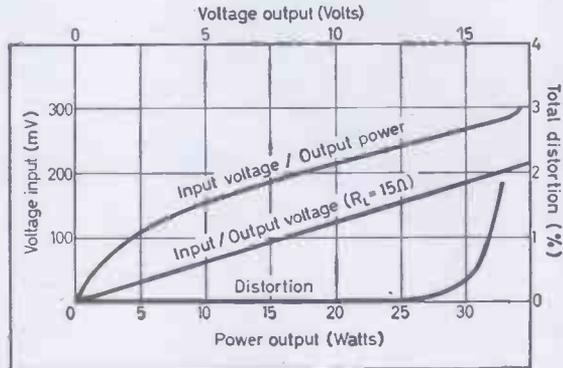
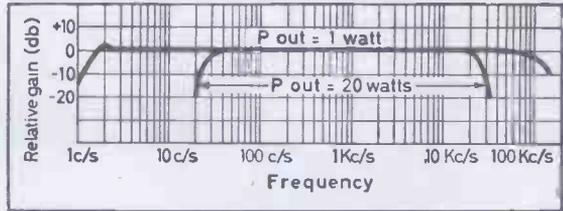
Suitable for use as:

- * Laboratory Standard
- * Test amplifier for microphones, pick-ups, loudspeakers, pre-amplifiers, tape decks etc.
- * Recording amplifier.
- * Broadcast Transmitter Modulator.

The Avantic DL7-35, originally designed as a high fidelity amplifier, has proved to be of such advanced design that it has remained unsurpassed. During the three years it has been manufactured the high performance laid down in the design has been consistently maintained. It can now be regarded as a Laboratory Standard of the utmost reliability.

AVANTIC DL7-35 POWER AMPLIFIER

- Harmonic Distortion: <math>< 0.05\%</math> at 20 watts sine wave output.
- Intermodulation Distortion:
 - 0.7% at 20 watts
 - 1.0% at 29 watts
 - $f_m = 40$ c/s. $f_c = 10$ kc/s. $f_m/f_c = 4$
- Hum and Noise:
 - 85dB relative to 20 watts output with $10k\Omega$ source resistance.
- Load Impedance:
 - 4Ω , 8Ω , 16Ω switch selected with automatic feedback compensation.
- Damping Factor:
 - 50
- Rise Time:
 - 5μ secs.
- Power Inputs:
 - 105, 117, 125, 210, 233, 251 V. a.c.
 - 40-60 c/s.

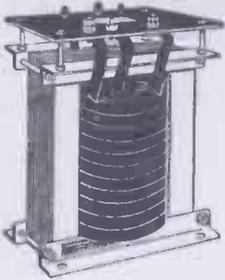


- Volume Control.
- Fused input.
- H.T. fuse.
- Distributed Load Push-Pull Output Stage.
- High stability resistors in input stage.
- Power outlets of 6.3V. at 2.5A. a.c.
- Price: 30 gns. 440V. at 30mA. d.c.

* Suitable pre-amplifiers available to increase sensitivity to 3mV.

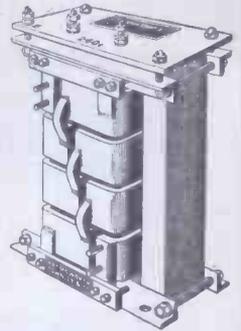
TRANSFORMERS

All for 240 V Input. Other Supply Voltages as Required
CONTINUOUS RATING. Short Rating Transformers also available

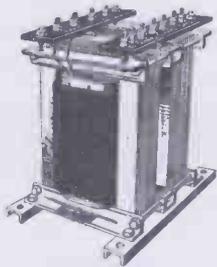


5 V	80 A	... £8
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110-120 V	4 A	... £9
12 V	40 A	... £8
18 V	30 A	... £9
17 V	40 A	... £9
24 V	30 A	... £10
30 V	25 A	... £10
55 V	15 A	... £10
5 V	140 A	... £11
110-120 V	10 A	... £15
40 V	25 A	... £15
5 V	300 A	... £20
6-12 V	50 A	... £10
12 V	60 A	... £10
12 V	100 A	... £16
50 V	60 A	... £25
10-15-25 V	100 A	... £26
10-20-30 V	100 A	... £33
100 V centre tapped	25 A	... £38
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5 V	5,000 A£110
2.5 V	5,000 A£64
2 V	10,000 A£98
3.5 V	20,000 A£127
2 V	30,000 A£130
10 V	2,000 A£103
10 V	1,000 A£59
10 V	900 A£55
10 V	500 A£38
10 V	300 A£28
20 V	800 A£80
5 V	1,000 A£39
22 V	1,000 A£90



TRANSDUCTORS



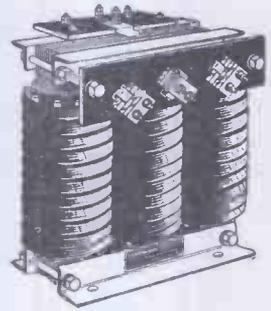
Saturable Reactors for controlling AC loads from .5kVA to 300kVA. Available for all standard AC supply voltages, single-phase and three-phase. Standard DC control volts; 12, 24, 36, 110 and 240 V.

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110 V	100 A 3-phase	£90
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VOLTMOBILES can be used by themselves or in the primary of another transformer to give very fine changes of output.		Single Phase Units	240 V	420 V
		15 A	£26	£36
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12 V	30 A£25	110 V	5 A£32
12 V	60 A£35	110 V	10 A£42
12 V	105 A£55	110 V	15 A£53
12 V	210 A£71	110 V	20 A£67
12 V	1,000 A£185	110 V	25 A£84
24 V	12 A£23	250 V	6 A£49
24 V	20 A£27	250 V	10 A£70
24 V	30 A£33	250 V	15 A£89
24 V	60 A£41	250 V	20 A£110
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24 V	200 A£86	Built-in Rheostats		
24 V	750 A£262	Built-in Inductive Regulators from		
36 V	10 A£26			



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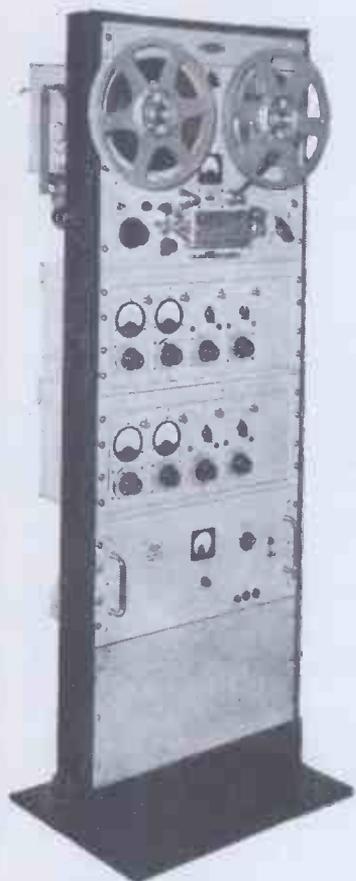
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"ANALYST" range of data recorders

These magnetic recorders embody an advanced form of unit design for both mechanism and electronic units which makes them extremely versatile in performance.



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Versatile in tape speed

Capstan units of both the synchronous and servo controlled type are available to cover a wide range of tape speeds. Multiple or adjustable speed systems may be fitted.

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Direct recording and replay channels for frequency bands ranging up to 100 kc/s. F.M. carrier systems for frequency bands up to 10 kc/s.

Versatile basic design

Standard mechanisms are available for tape widths of $\frac{1}{4}$ in., $\frac{1}{2}$ in. and 1 in.

Versatile in channel capacity

Integral head assembly as a plug-in unit. In-line heads giving one, two or four channels for $\frac{1}{2}$ in. of tape width.

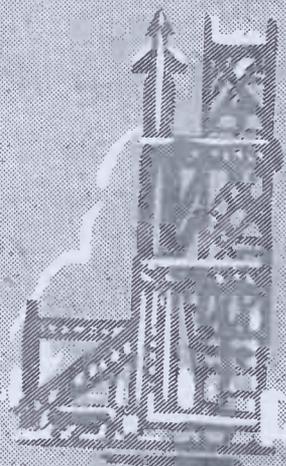
Such versatility is the result of a carefully planned design which has already proved successful as a precision recorder in many branches of audio engineering, scientific research, and industrial control. New uses are constantly being discovered for this versatile equipment and we shall be pleased to advise you on your application.

Stand No. R837 Instruments, Electronics & Automation Exhibition,
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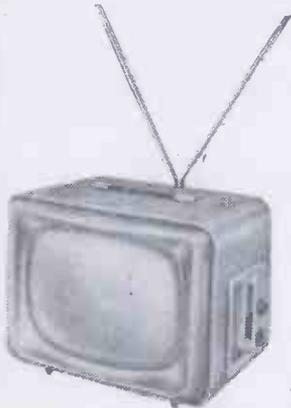
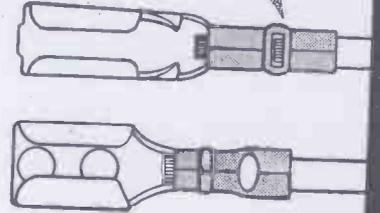
solderless wiring devices



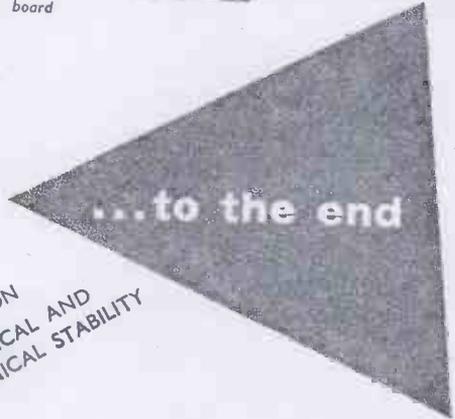
Taper Tab terminations used on co-axial cable



Edge-on connectors on printed circuit board



Sobell 17in. portable T.V. plus V.H.F. radio receiver, employing devices illustrated above



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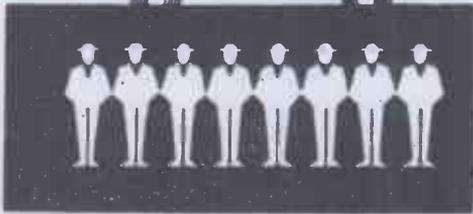
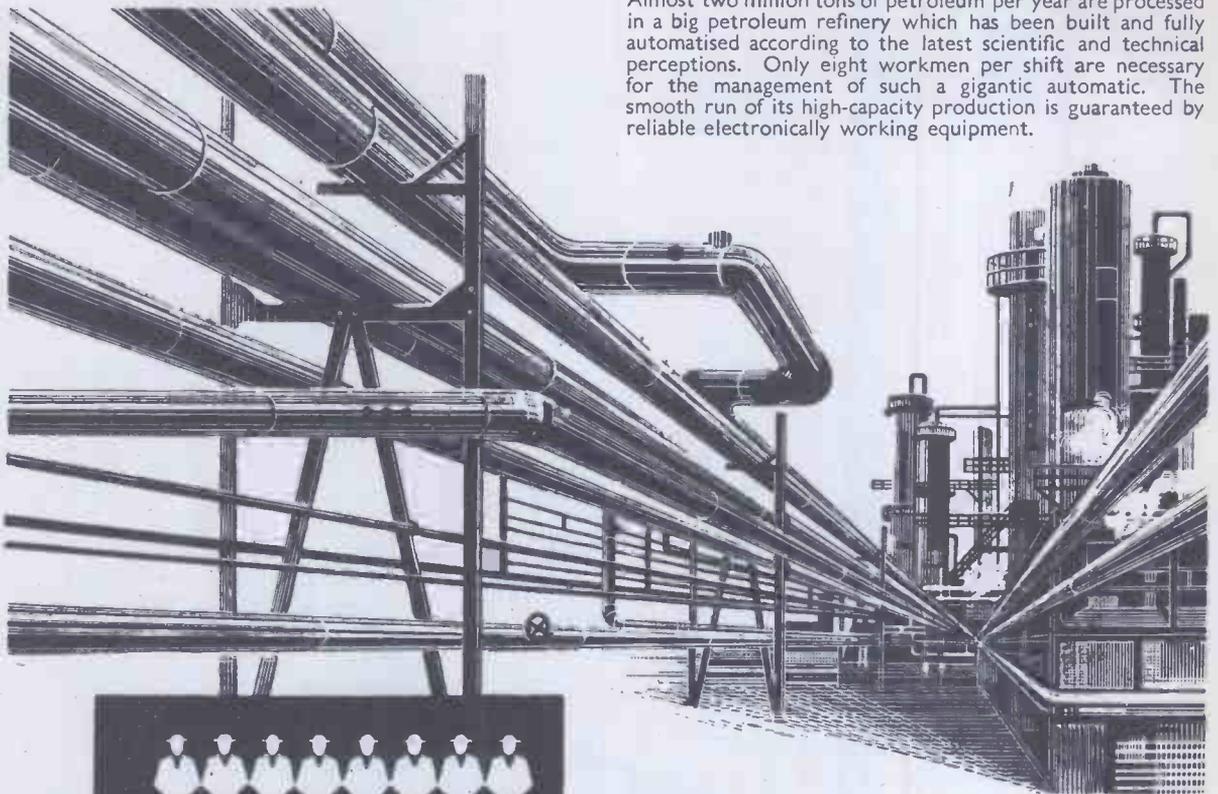
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Electronic implements are of vital importance for automation. They work with many hundreds of valves the quality of which influences the capacity considerably . . . Year by year more automatic works are built up all the world over. At the same time the demand for special valves increases. Trade with these important elements has already become an interesting business branch on the world market. The valve factories of the German Democratic Republic supply you with high-quality special valves: thyratrons, high-tension rectifying valves, tension-stabilizer valves.

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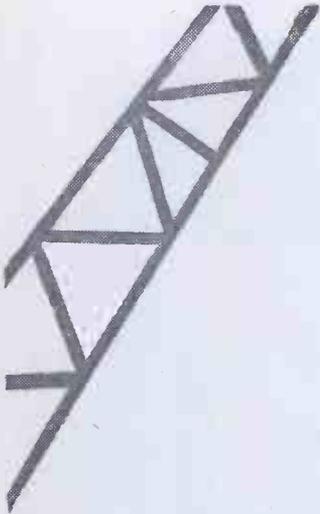
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HALTRON HOUSE, ANGLERS LANE, LONDON N.W.5.

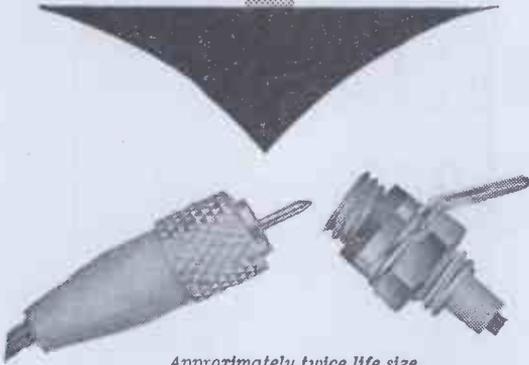


Tel.: Gulliver 8531 (10 lines) Telex 2-2573 Cables: "Halléctric London"

The very best connections

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SUB-MINIATURE COAXIAL CONNECTORS



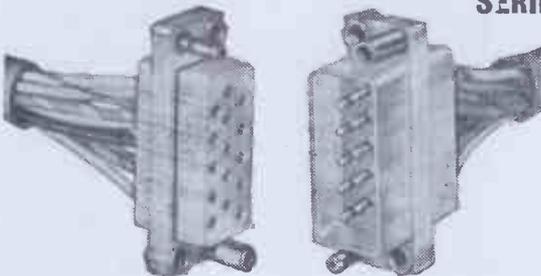
Approximately twice life size

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Designed for the matched impedance coupling of high frequency coaxial cables operating in the super high frequency bands, these connectors—

- * have a working voltage of 650 volts Peak at sea level, and matched impedance coupling of 50 ohm lines is accommodated.
- * have hard gold plated contacts on silver plate to give maximum performance with minimum voltage drop.

SERIES '110' (15- and 30-way) MINIATURE RECTANGULAR CONNECTORS



Developed specifically by Plessey to meet the demand for a safe, inexpensive connector for commercial applications, this new series embodies excellent electrical and mechanical characteristics, and the many unique features that make it really outstanding include:—

- * Plug pins and socket inserts are polythene shrouded to dispense with gaskets and ensure insert anchorage.
- * Mismatching is prevented by corner pins and corner sockets.
- * Extreme simplicity of wiring, demands less-skilled operation than the orthodox methods of soldering pins *in situ*.

For further information, please write for Publication numbers 128 and 114.

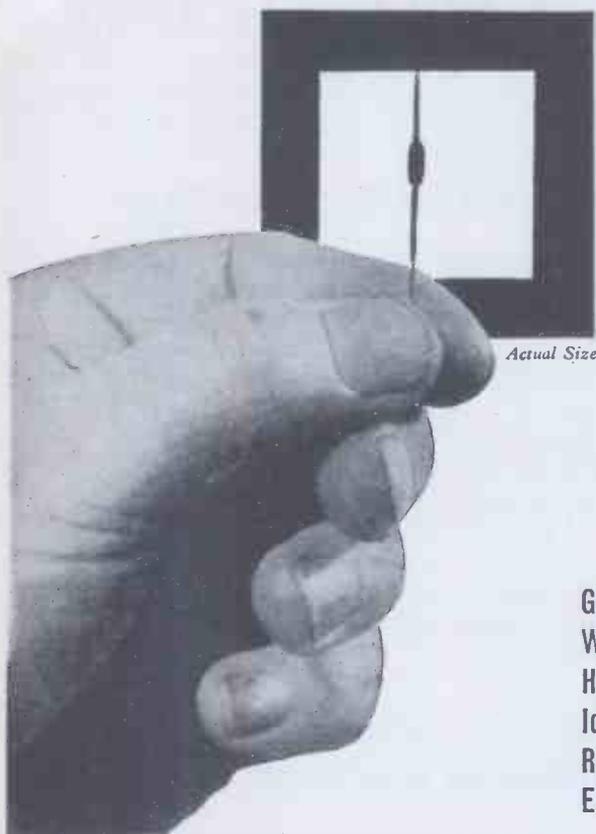
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SILICON DIODES MULLARD OA202

Generously rated
Wide temperature range
High back resistance
Ideal for automatic wiring
Rugged construction
ECONOMICALLY PRICED

Despite its extremely small size, the Mullard Silicon Junction Diode OA202 will handle peak currents of up to 250 mA at 25°C. Apart from other favourable electrical and mechanical characteristics, the OA202 is distinguished by its cost which is kept at the lowest possible level by very large scale production.

This all-glass diode is hermetically sealed and really is a rugged device. It is made in exactly the same way as the Government Type Approved CV7040, whose rigorous specification includes temperature cycling, climatic cycling, fatigue and shock tests, 1000 hour life tests and high temperature storage.

Brief electrical data is given below. For further information please contact Mullard House.

ABRIDGED DATA (AT 25°C UNLESS OTHERWISE STATED)

Max. peak inverse voltage..... 150 V
Max. peak forward current..... 250 mA
Max. d.c. forward current..... 160 mA

*Average forward current (sinusoidal input with resistive load)..... 80 mA
Typical forward voltage drop at 30 mA..... 0.9 V
Inverse current at -150 volts:
Maximum at 25°C..... 0.1 μA
Maximum at 125°C..... 10 μA
Ambient temperature range..... -55 to +125°C

*Max. averaging time 50 milliseconds.

(An alternative type, OA200, is available for lower voltage applications.)

See Mullard Semiconductor Devices
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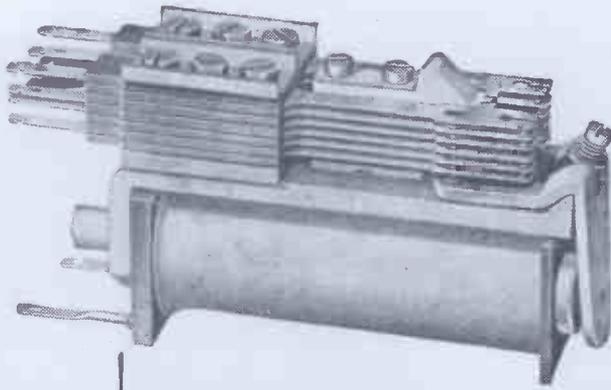
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STROWGER HOUSE, ARUNDEL STREET, LONDON W.C.2. Tel: TEMple Bar 9262. 'Grams: Strowger, Estrand, London

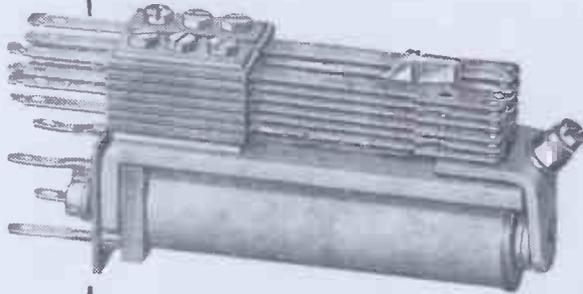
AT 8871



RELAYS

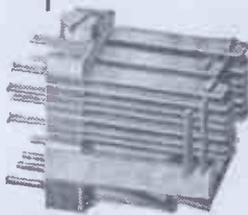


Type 3000, available with a wide range of contact combinations, coil resistances and slugs. Tropical finish type approved to RCS 161. Standard finish for telecommunications applications in temperate climates.



Type 600, available with a wide range of contact combinations and coil resistances. Tropical finish type approved to RCS 161. Standard finish for telecommunications applications in temperate climates.

Remanent (magnetic latching) versions of type 3000 and type 600 are also available.



Cubic Inch, combining high speed and sensitivity in a new miniature design with twin contacts of the well-proven form used on the type 3000 relay.

During the period of the IEA Exhibition informal interviews in the evening can be arranged in Kensington for engineers who are interested in appointments in this and allied fields.

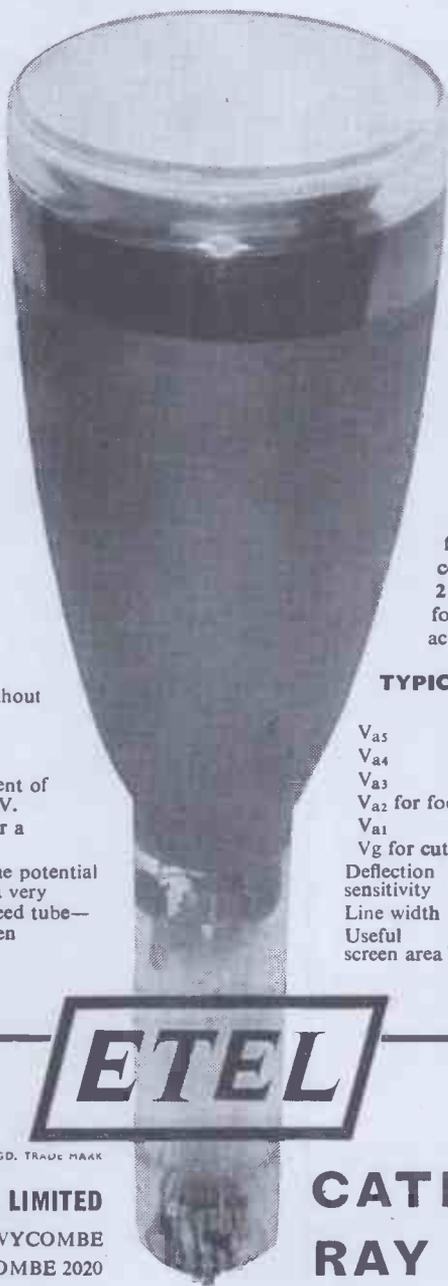
THE PHOENIX TELEPHONE AND ELECTRIC WORKS LIMITED,
THE HYDE, LONDON, N.W.9. Telephone COLINDALE 7243



EXTRA HIGH SENSITIVITY instrument tube 5CLP1

THE FIVE-INCH instrument tube 5CLP1 has a deflection sensitivity of 1.7V/cm with a useful Y scan of 6 cm. A special system of shielding the post-deflection field from the deflection plates in this tube allows p.d.a. ratios as high as 15 to 1 to be used without pattern distortion. The extraordinary deflection sensitivity achieved with such high p.d.a. ratios profoundly affects oscillograph design. Bandwidths can be increased, amplifiers simplified and power supply requirements reduced. Write to the address below for full details of 'Etel' Instrument Tube type 5CLP1.

- * P.d.a. ratios of 15 : 1 possible without pattern distortion.
- * Sensitivity 1.7V/cm with useful Y scan of 6 cm.
- * Sensitivity substantially independent of final p.d.a. voltages from 10 to 15 kV.
- * High resolution—only 200 mV for a deflection of one spot-width.
- * Versatility—by simply altering one potential the 5CLP1 may be converted from a very sensitive tube to a higher writing speed tube—pulses may be first examined and then a single shot photograph taken.



ABRIDGED DATA

This is tentative. Final data is being prepared.
5-inch flat faced precision oscillograph tube 5CLP1.

CAPACITANCES

X₁ to X₂ ... 2.5 pF
Y₁ to Y₂ ... 2.0 pF
One X plate to all other electrodes
less other X plate 4.0 pF
One Y plate to all other electrodes
less other Y plate 2.0 pF

COMPARE CONDITIONS SHOWN IN DATA

1 and 2
to see how deflection sensitivity is maintained over range of V_{a4} and V_{a5}.
1 and 2 with 3
for an illustration of a slightly lower sensitivity condition giving higher brightness.
2 and 4
for the reduction required in V_{a4} potential to achieve higher writing speeds.

TYPICAL OPERATING CONDITIONS

	1.	2.	3.	4.
V _{a5}	10kV	15kV	15kV	15kV
V _{a4}	10kV	15kV	15kV	3kV
V _{a3}	1kV	1kV	1.5kV	1kV
V _{a2} for focus	250V	250V	375V	250V
V _{a1}	1kV	1kV	1.5kV	1kV
V _g for cut-off	-60V	-60V	-90V	-60V
Deflection sensitivity {	y 1.7V/cm	1.7V/cm	2.5V/cm	2.5V/cm
x	7V/cm	7V/cm	11V/cm	11V/cm
Line width	1mm	1mm	<1mm	<1mm
Useful screen area {	y 6cm	6cm	6cm	4cm
x	10cm	10cm	10cm	6.6cm



REGD. TRADE MARK

ELECTRONIC TUBES LIMITED
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BUCKS · TEL: HIGH WYCOMBE 2020

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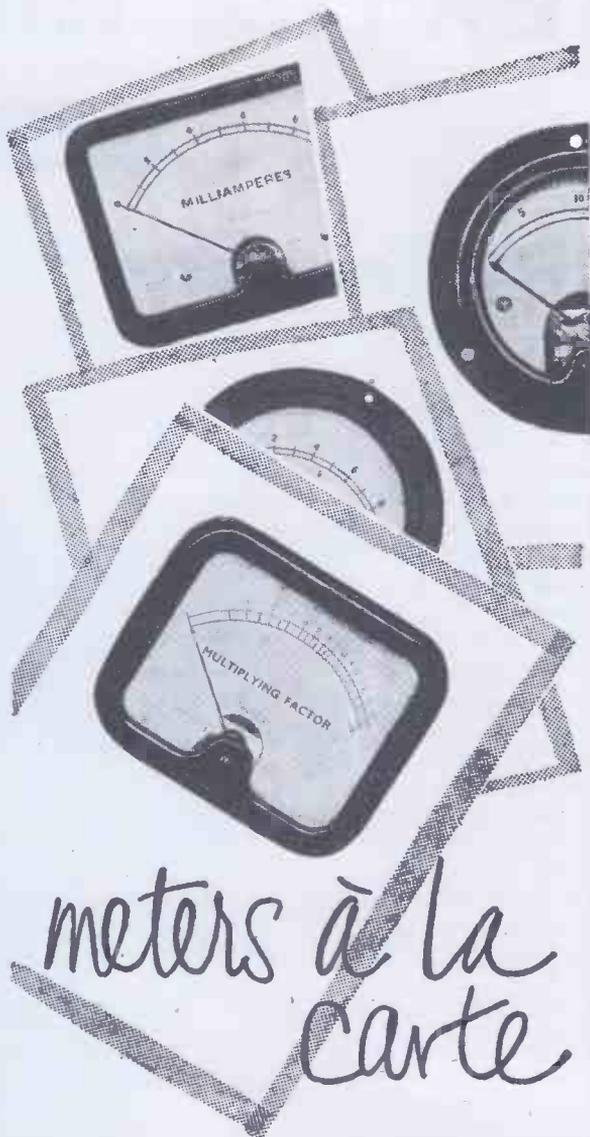
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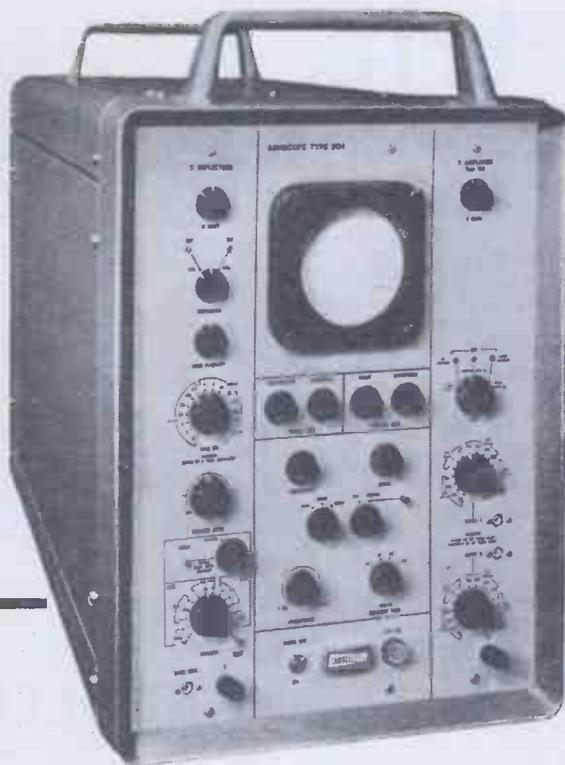
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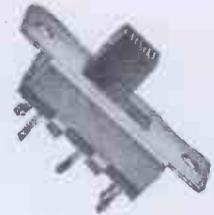
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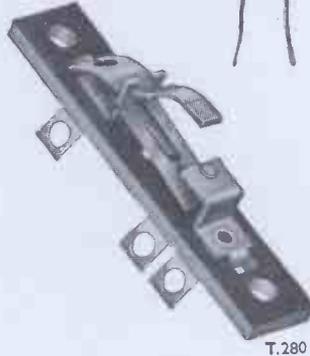
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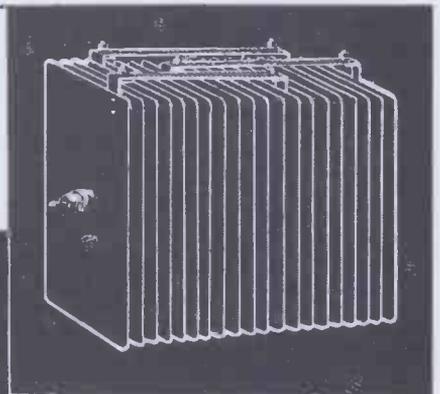
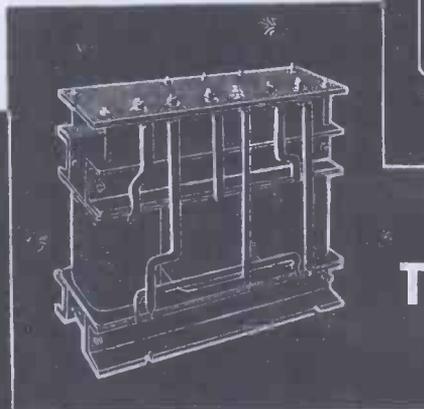
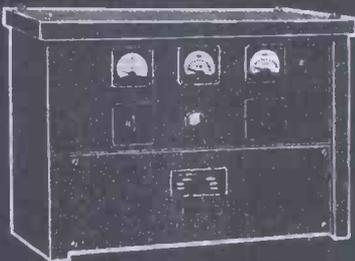
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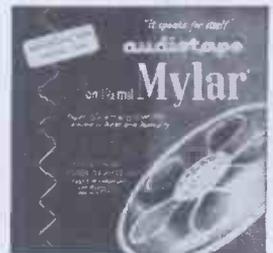
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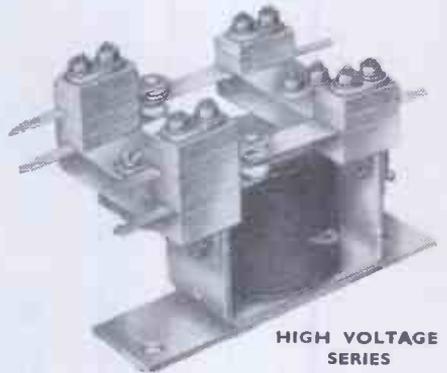
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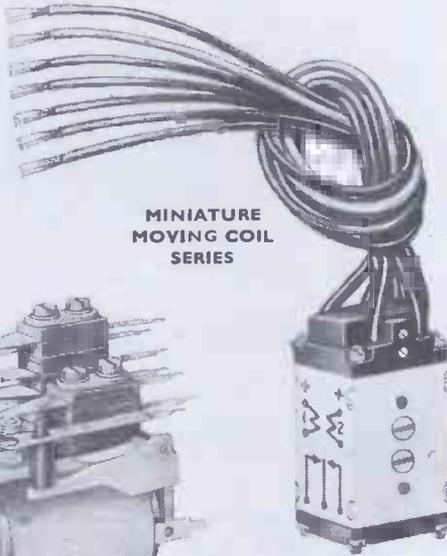
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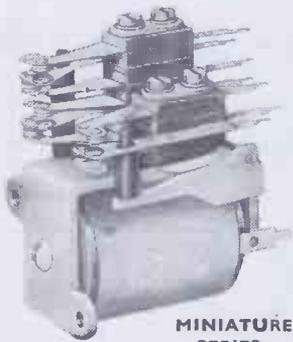
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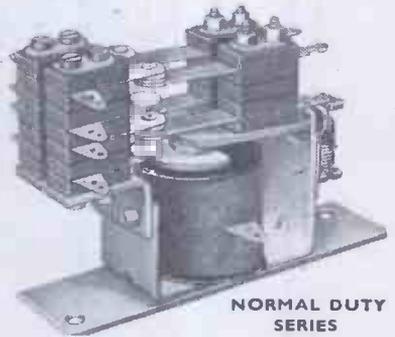
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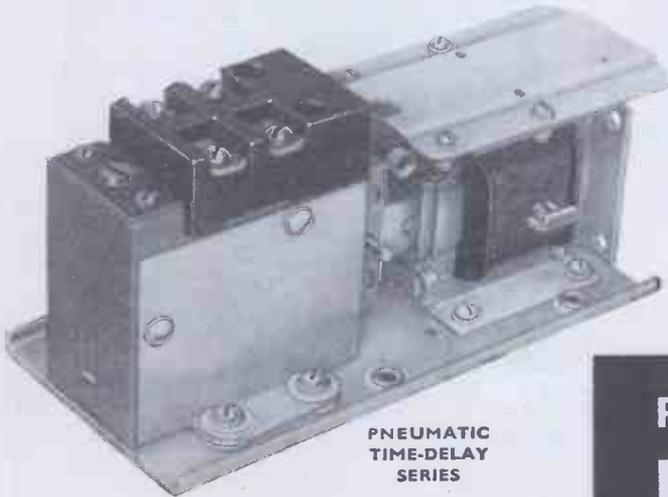
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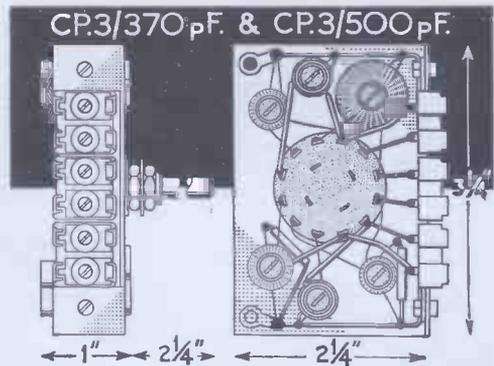
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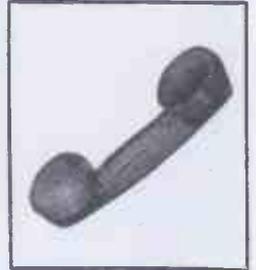
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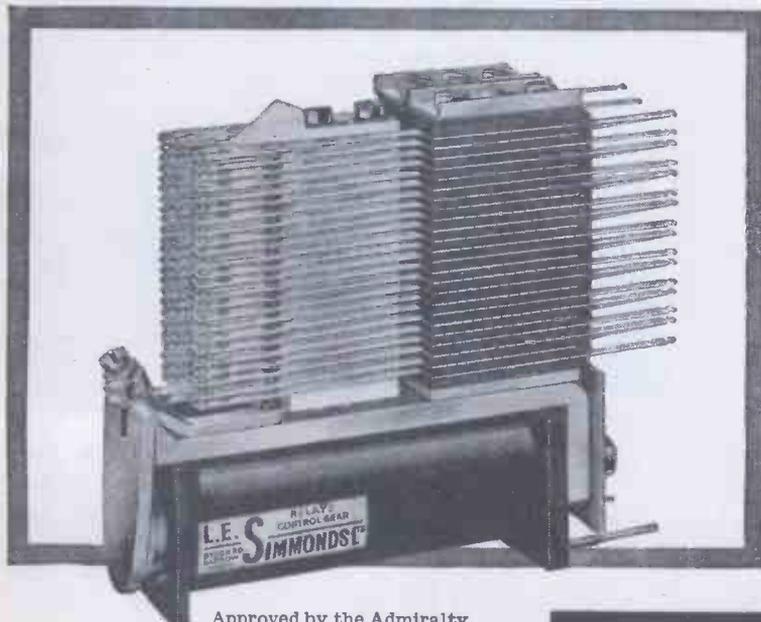
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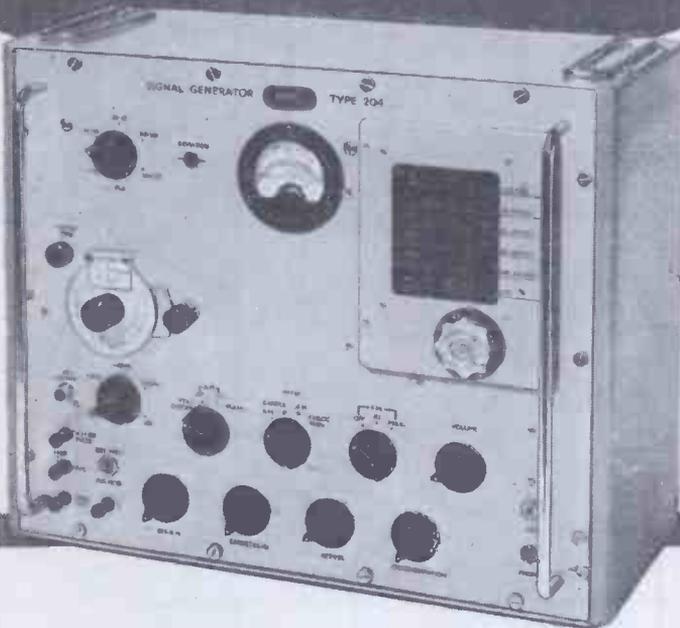
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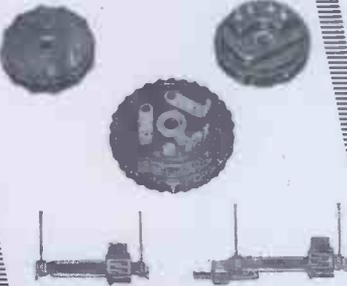
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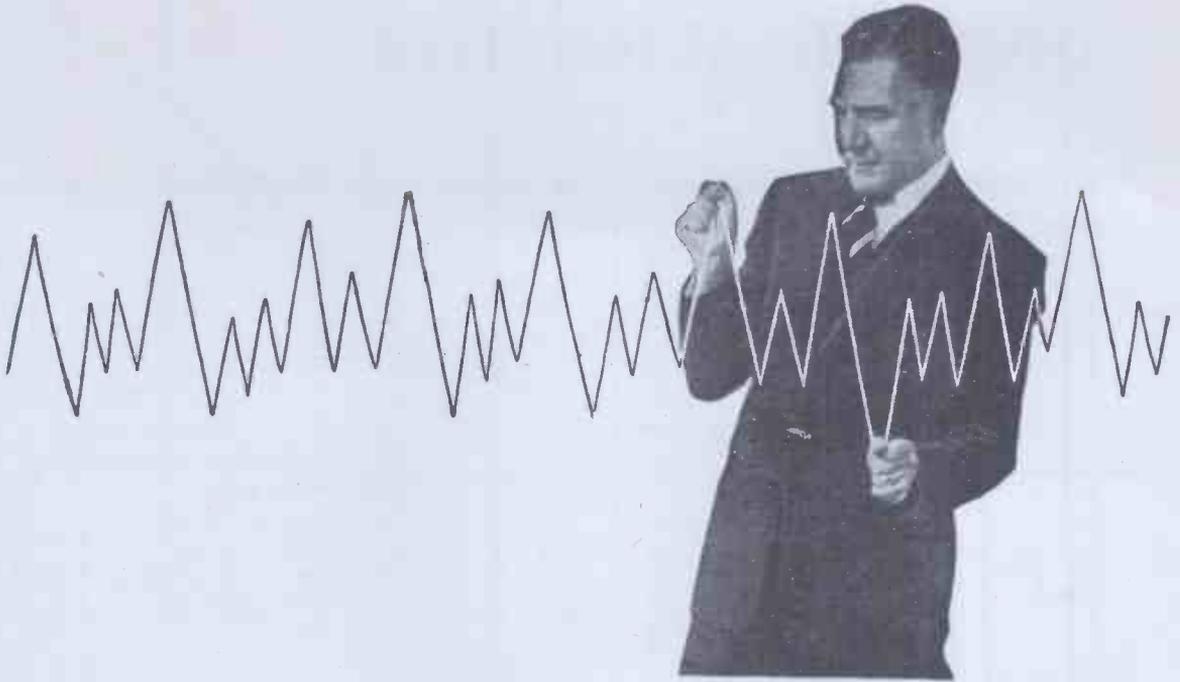
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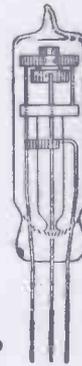
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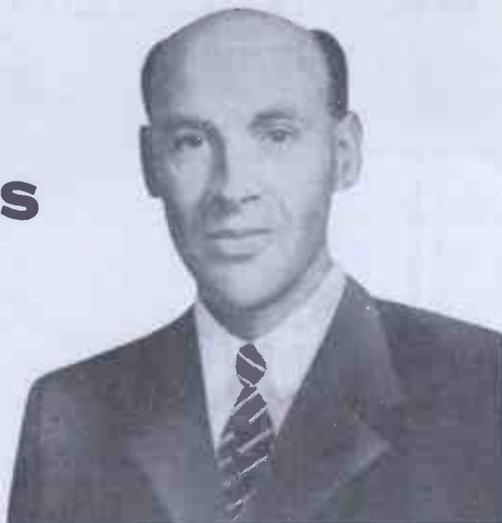
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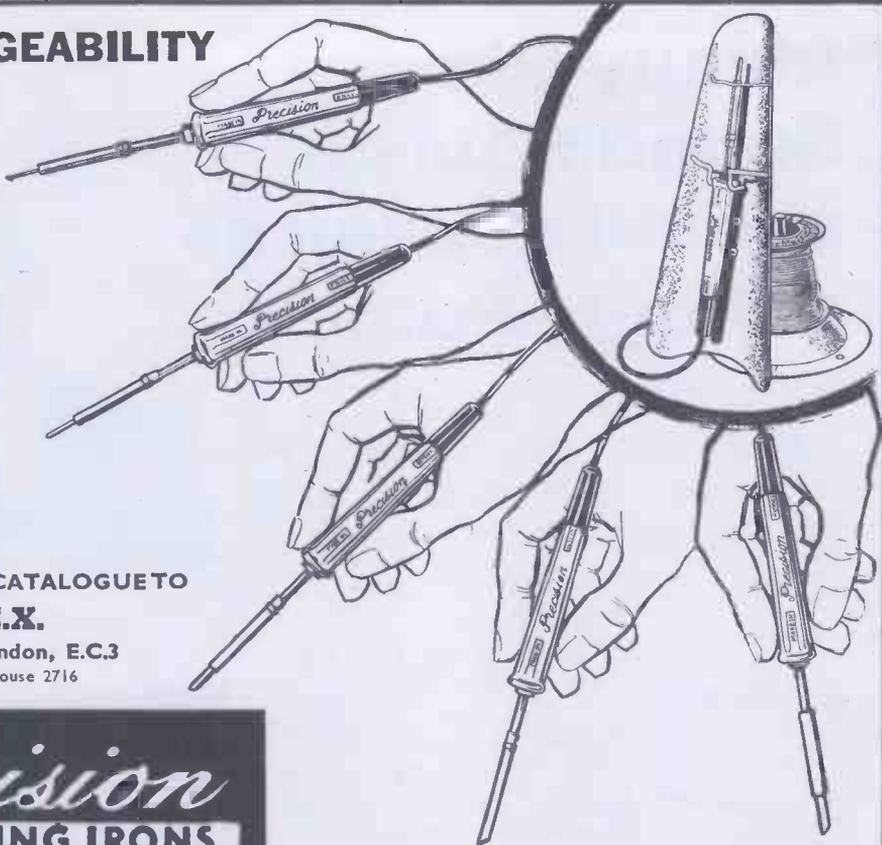
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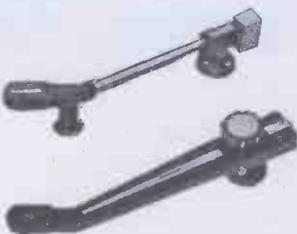
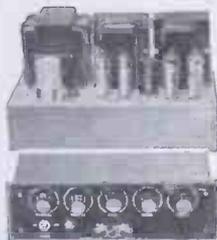


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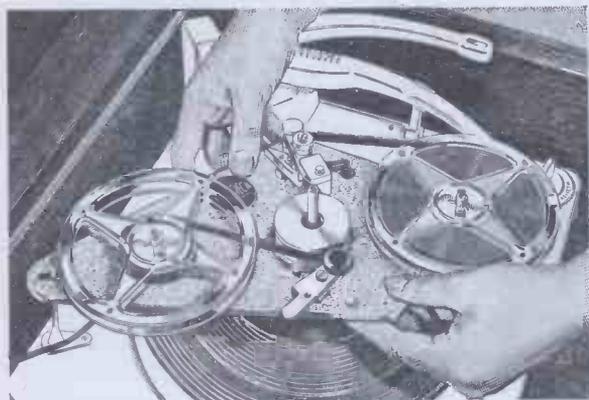
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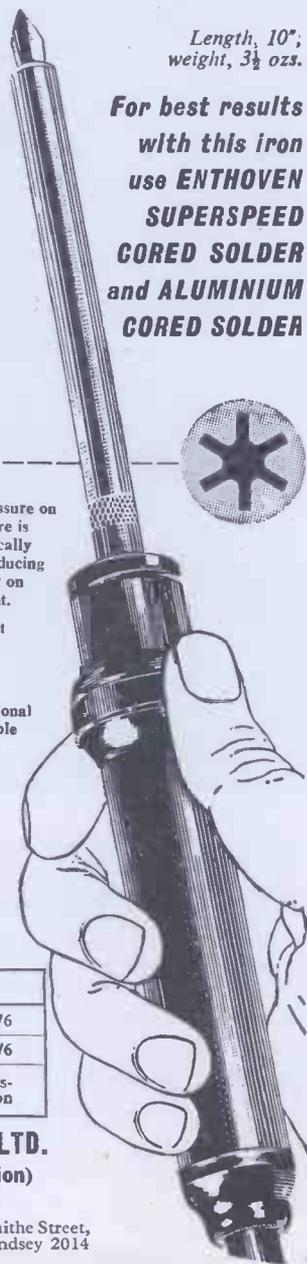
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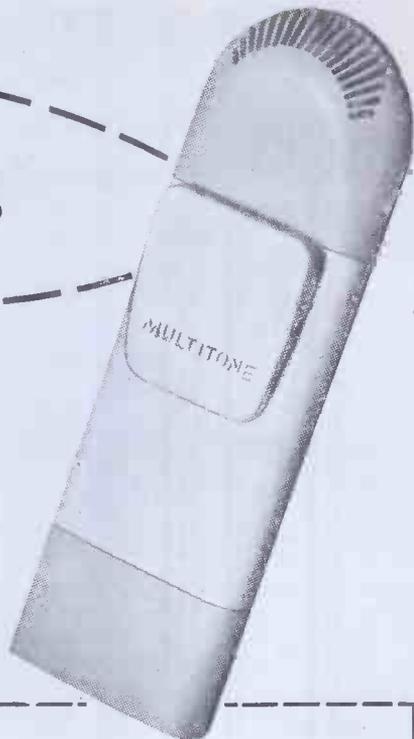
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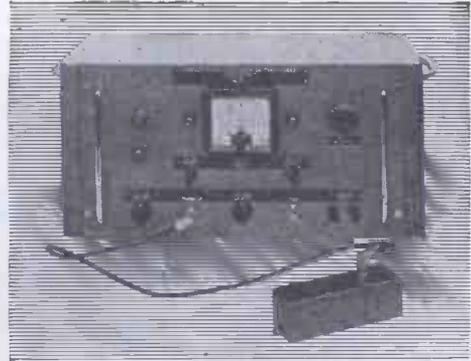
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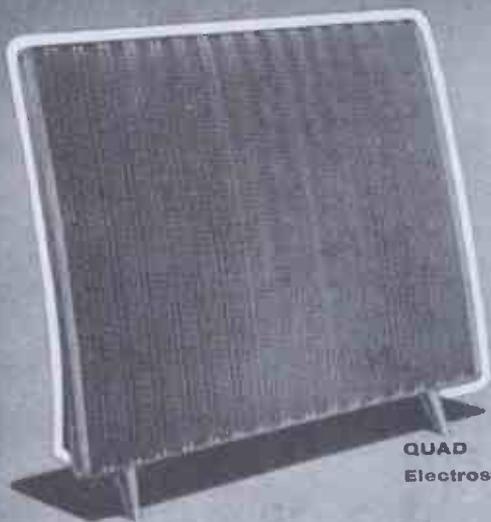
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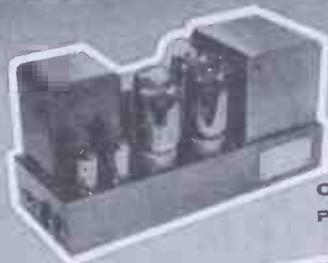
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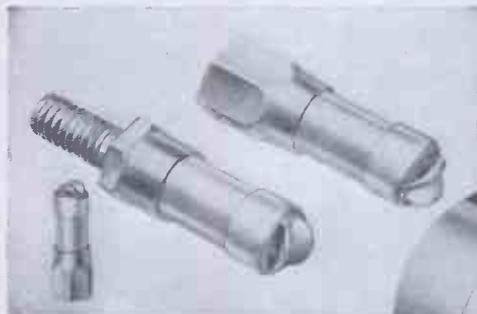
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Withstands 10g acceleration with a resultant maximum frequency modulation of 2 Mc/s.

● **Specified Noise Performance**

Typical a.m. signal to noise ratio greater than 160 dB per cycle of l.f. bandwidth for receiver intermediate frequency in excess of 25 Mc/s.

● **External Tuned Cavity**

This constructional feature isolates the turning cavity from the effects of variations of beam current and contributes largely to the high frequency stability.

● **Low Warm-up Frequency Drift**

3 Mc/s max. after first 5 minutes of operation.

● **Good Altitude Performance**

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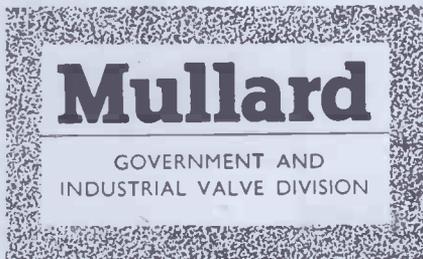
● **Waveguide Output**

Incorporates a matching screw to ensure close tolerance power output.

Mechanical tuning range 9.3 to 9.5 Gc/s.

Typical operation

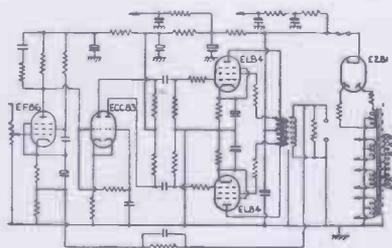
Frequency	9.37.....	Gc/s
Resonator voltage	300	V
Resonator current.....	35	mA
Reflector voltage.....	-90	V
Electronic tuning range between half power points	±20	Mc/s
Output power	40	mW



See Mullard valves and tubes
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Dimensions: 32in. high (including 6in. legs), maximum width 19in.; depth 12in.

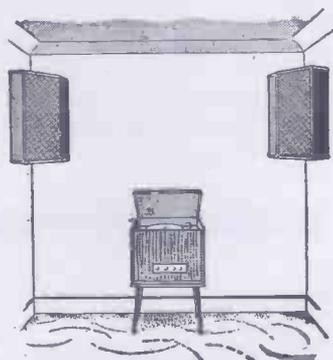
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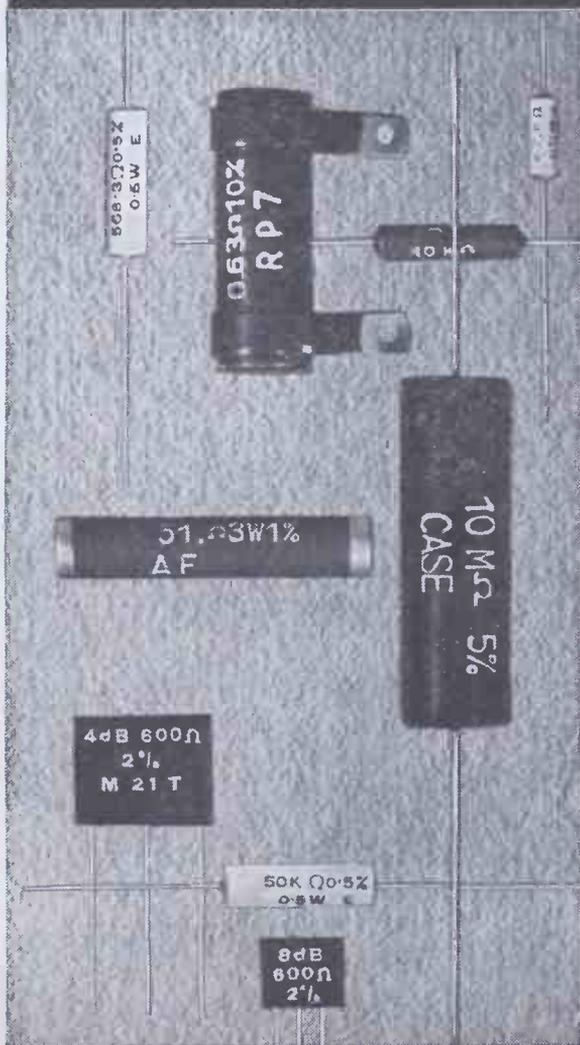
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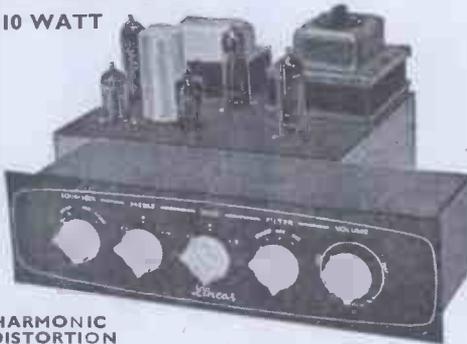
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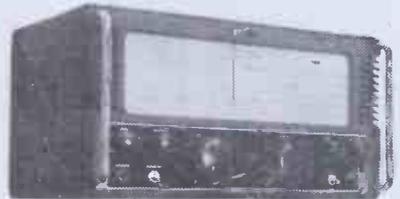
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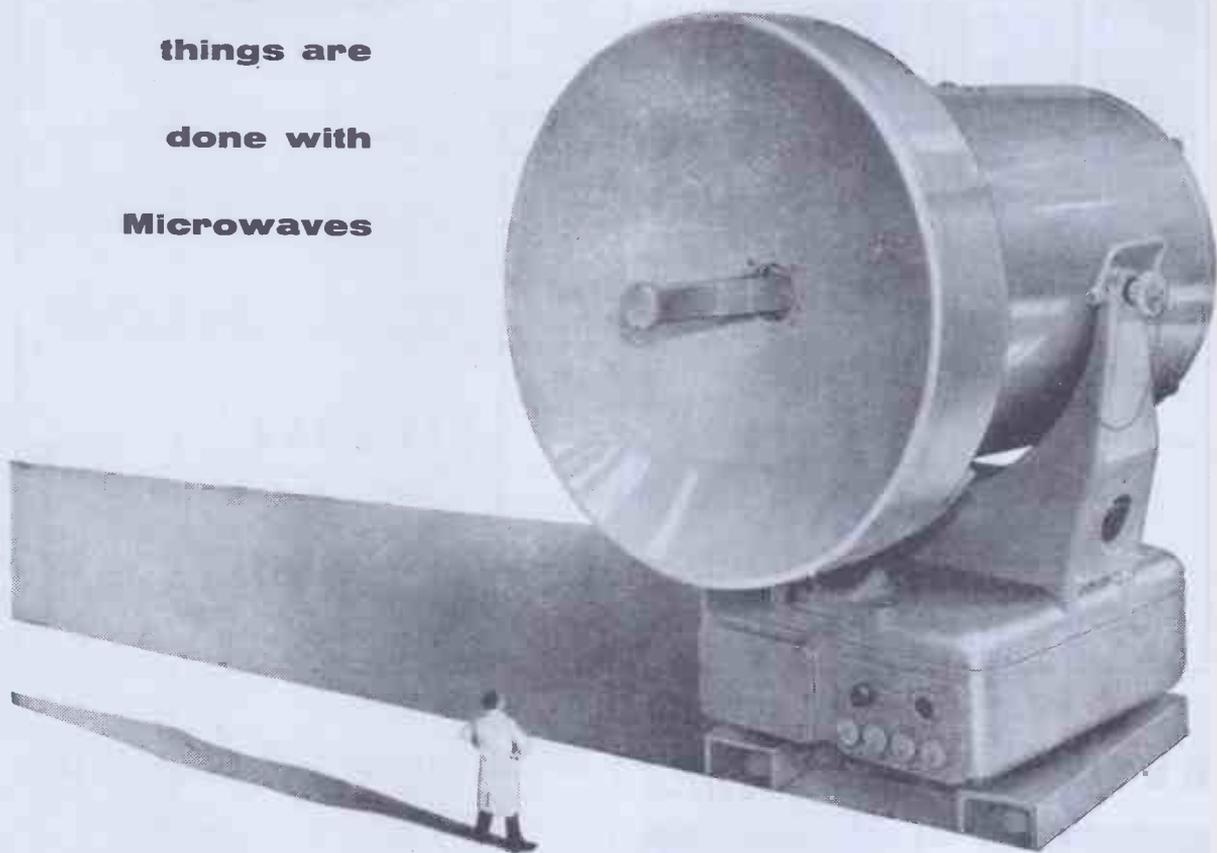
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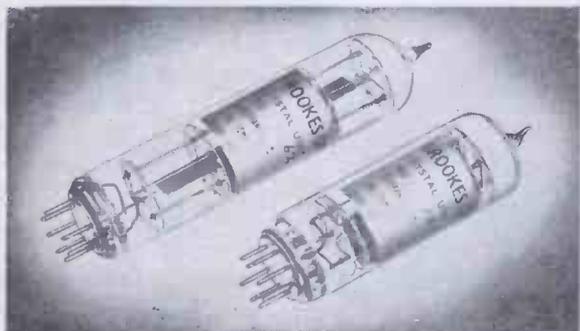
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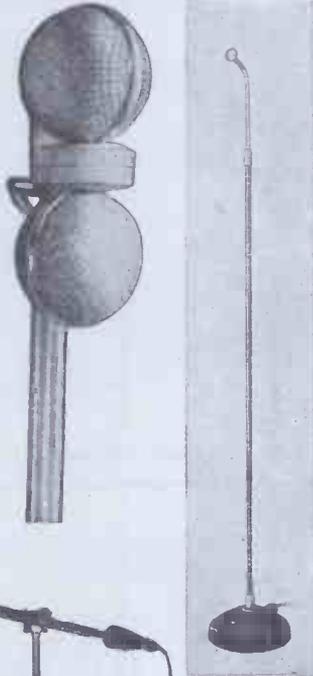
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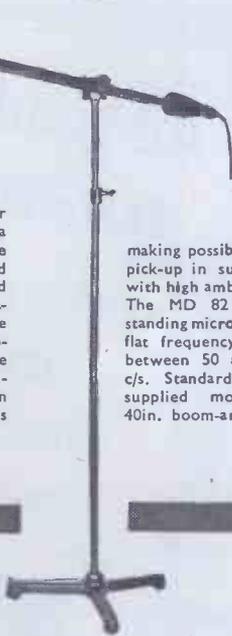
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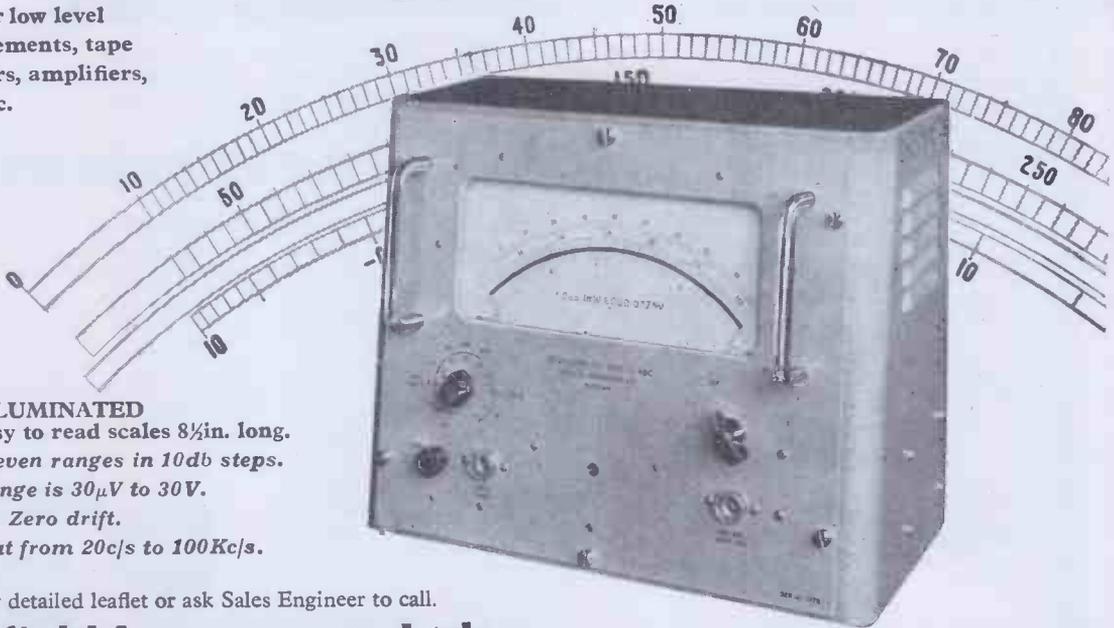
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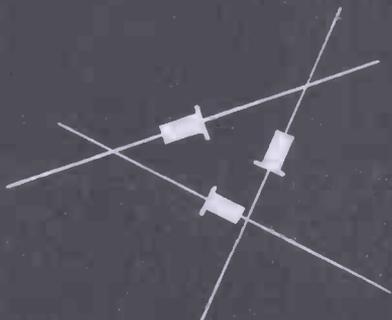
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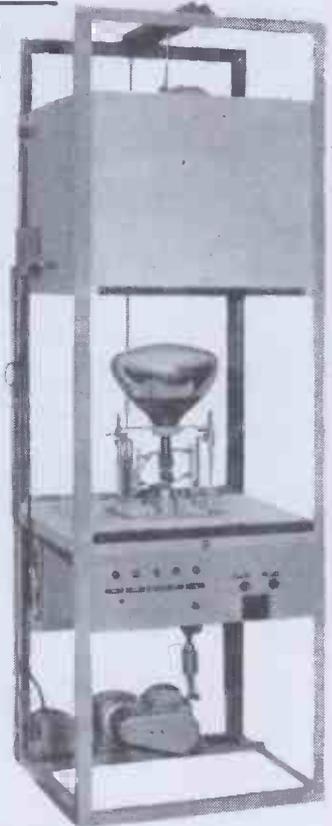


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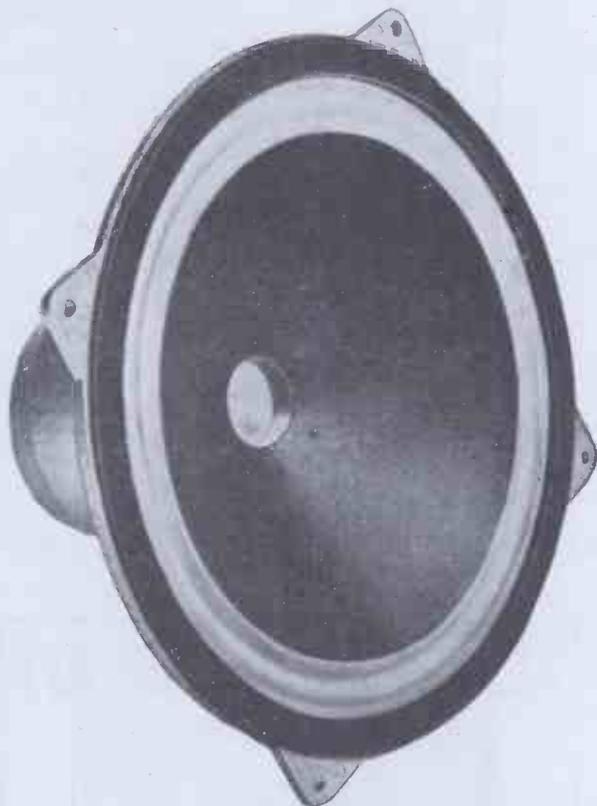
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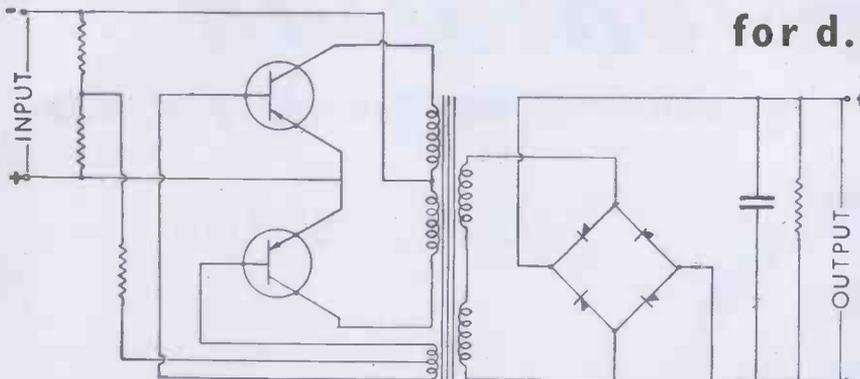
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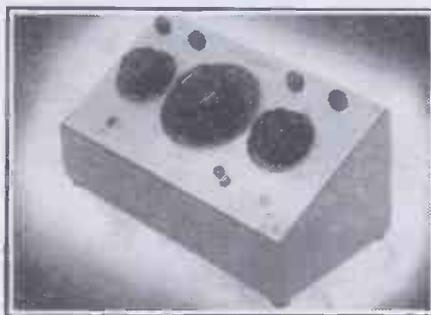
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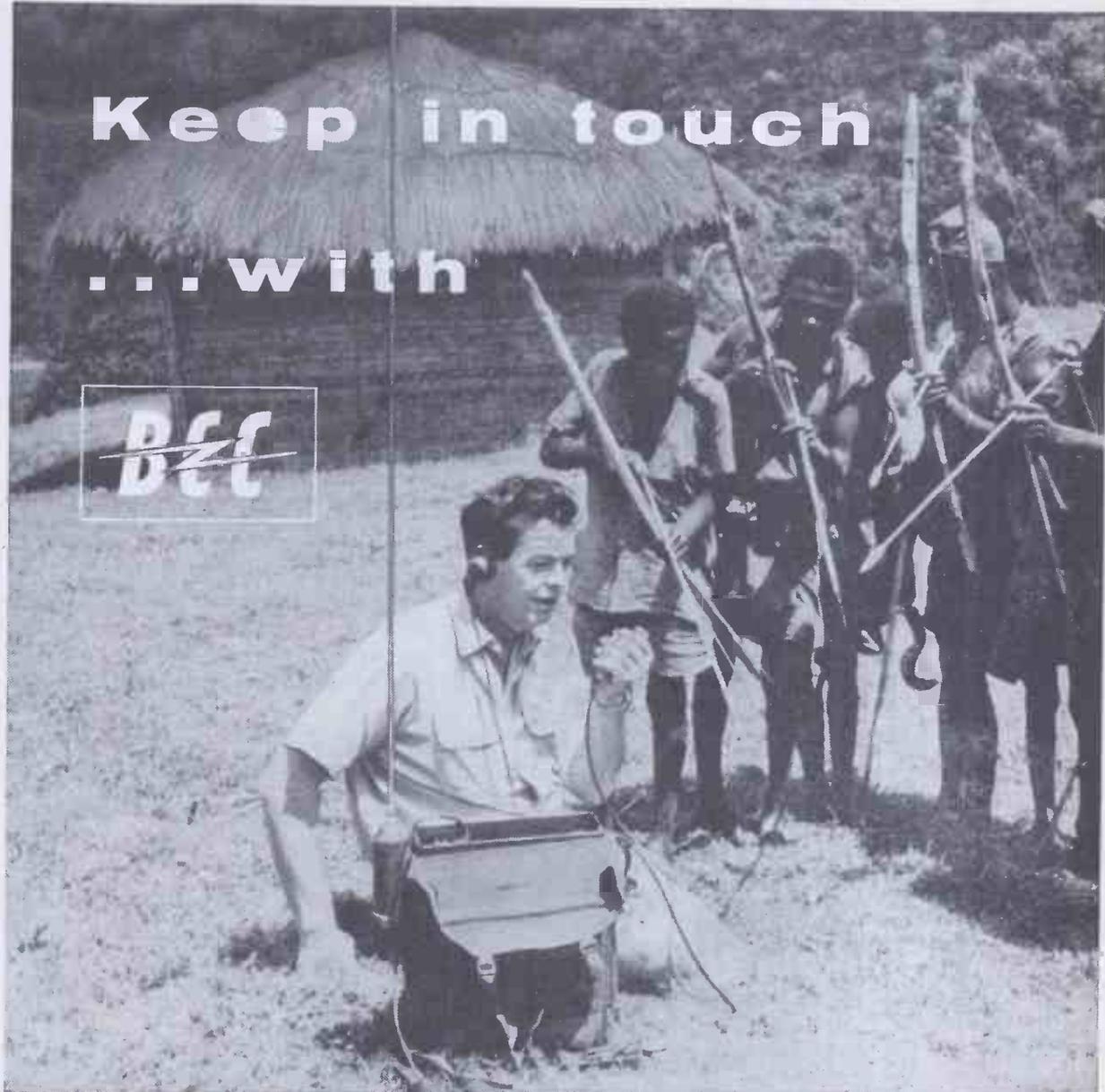
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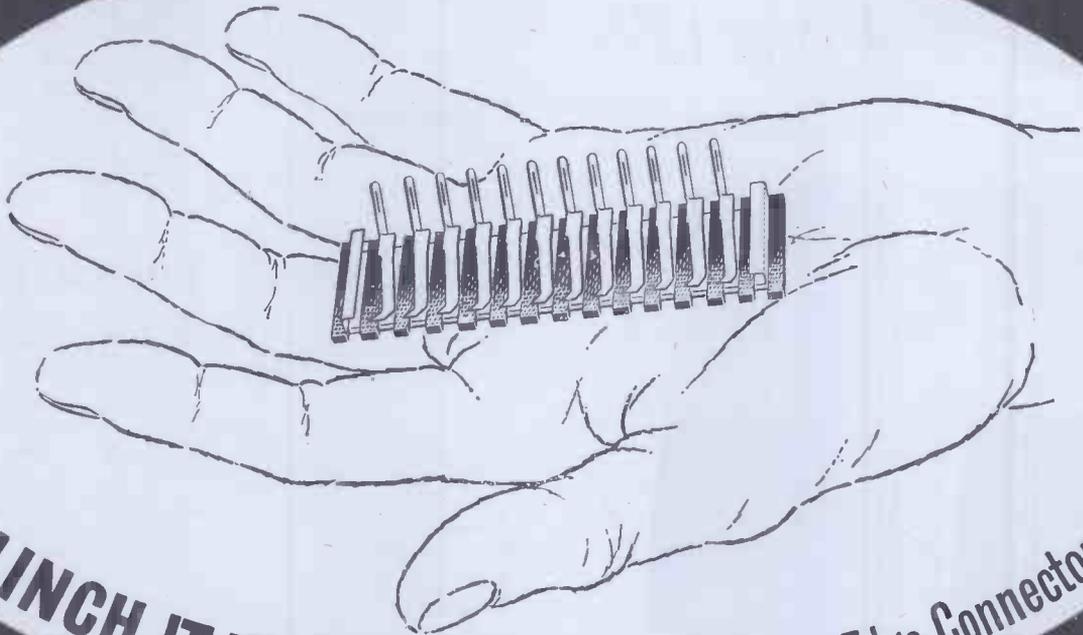
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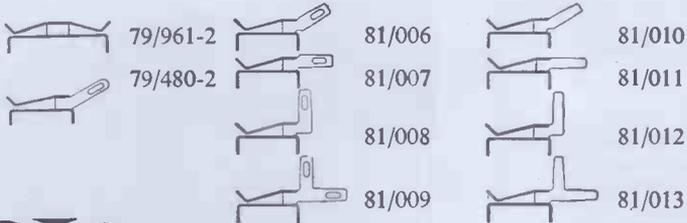


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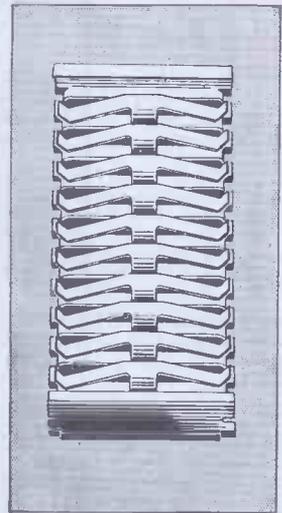
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	235	105-135	9058
	110	105-135	9059
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	235	105-135	9062
	110	105-135	9063

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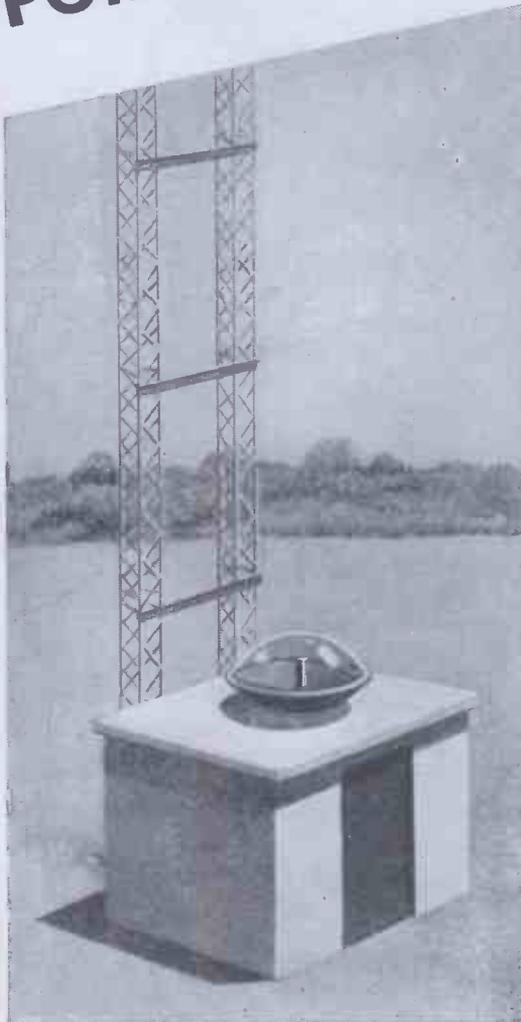


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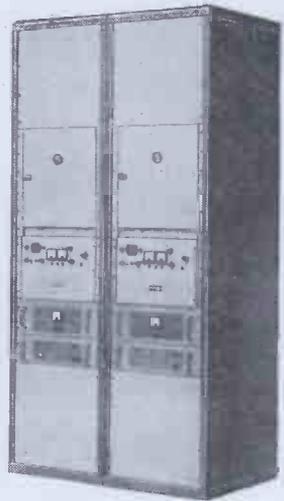
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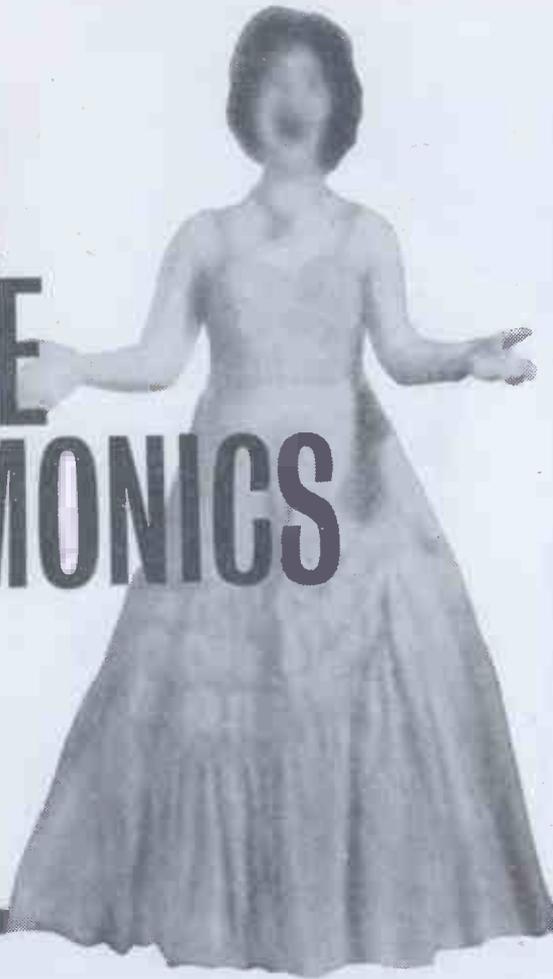
Type	Voltage at -5mA (V)		Temperature coefficient of breakdown voltage (%/°C)	Typical slope resistance at -20mA. (Ω)	Maximum dissipation (mW)	
	min.	max.			at 50°C	at 100°C
SX47	4.4	4.9	-0.04 to -0.01	13	300	150
SX51	4.9	5.3	-0.03 to 0.00	10		
SX56	5.3	5.9	-0.02 to +0.02	6		
SX561	4.8	6.4	-0.03 to +0.04	7		
SX62	5.9	6.5	0.00 to +0.04	4		
SX68	6.5	7.2	+0.02 to +0.05	4		
SX75	7.2	7.9	+0.03 to +0.06	5		
SX82	7.9	8.6	+0.04 to +0.06	7		
SZT1	4.8	6.4	<0.01	7		
SZT2	5.3	5.9	<0.001	6		



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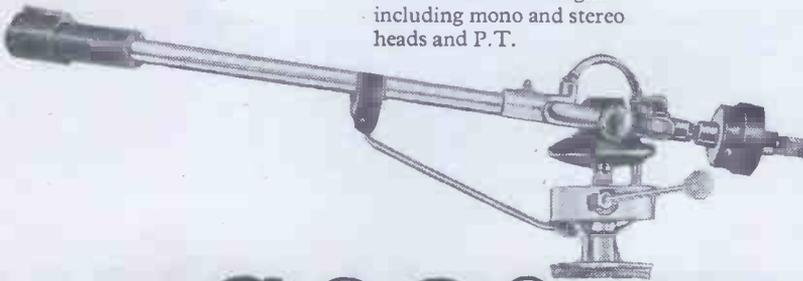
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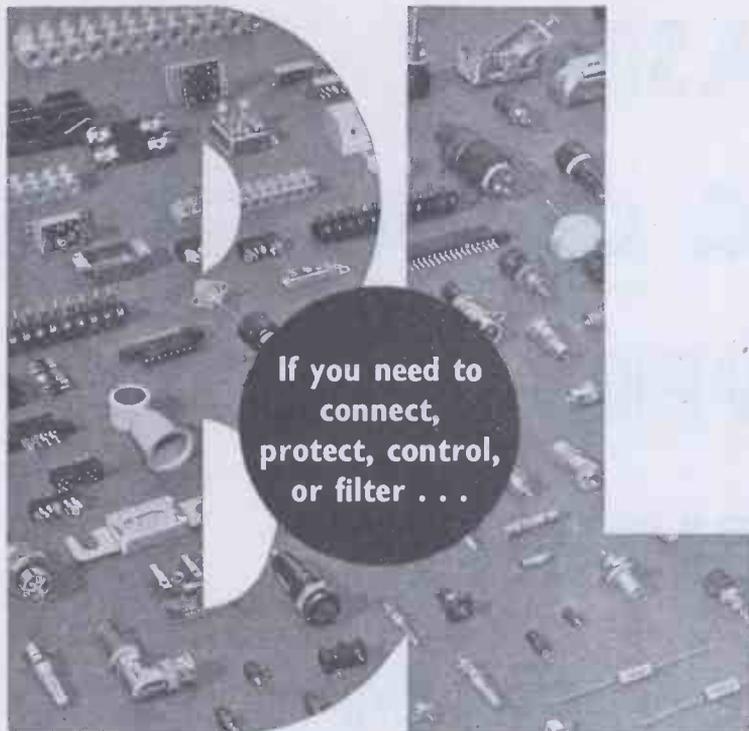
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Transmission Lines

A Transmission Line is an arrangement of conductors for conveying electrical energy from one point to another. Each unit length of the line has a certain capacity and inductance. It also has resistance, but this is normally insignificant compared to the reactive constituents, although it has to be allowed for in calculating loss.

Imagine such a line, infinitely long, being fed with alternating power at one end; the energy would pass continuously along it towards infinity, being dissipated in the line as if its reactive constituents were purely resistive. In other words, the impedance of the line under these theoretical conditions can be defined by Ohm's law as the direct ratio of voltage to current, the value of the equivalent resistance being known as the Characteristic Impedance of the line. It is a function of the distributed capacity and inductance of the line, which are governed entirely by its dimensions and the dielectric constant; it can therefore be calculated by means of a simple formula.

Any practical line has a finite length, and feeds a load which absorbs energy. If all the available energy is to be dissipated in the load (maximum power transference) its value must be the same as that of the characteristic impedance of the line; this can be demonstrated. At any other value of load the line is mismatched, and the balance of energy which is not dissipated in the load is reflected, so that standing waves are set up along the line—this too can be demonstrated, and different voltage and current values will be found at different points along the line corresponding to the standing wave pattern. The ratio of maximum to minimum values is known as the Standing Wave Ratio (S.W.R.), being unity when there is no reflection or standing wave.

We referred to standing wave ratio in the 4th article of this series dealing with coaxial connectors, although the resemblance of a plug-and-socket to a transmission line may not be immediately obvious. However, when it is realised that one-quarter wavelength of a 10,000 mc/s R.F. signal is approximately 2in., which is comparable to the length of many coaxial connectors, it will be apparent that such a connector does indeed constitute a short transmission line at these frequencies, and has a standing wave ratio characteristic which must be taken into account.

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Capacitance μF	Diameter in.	Thickness in.
·001	·180	·075
·005	·365	·060
·01	·510	·060

Film Packs

Capacitance μF	Length in.	Width in.	Thickness in.
·05	·55	·5	·125
·1	·55	·5	·175
·25	·9	·7	·175

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Aspects of design

This is the twenty first of a series of special features dealing with advanced problems in television and radio 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 twenty second of which will appear in the May 1960 issue.

The first 17in. cathode ray tube with 110° deflection angle in the Ediswan Mazda range was the CME1703. This tube permitted a considerable reduction in bulk of television receivers as compared with receivers using 90° deflection tubes. The introduction of the 110° deflection angle necessitated radical changes in the design of deflection components and circuits and it was felt that any further developments to reduce the overall length of the CME1703 should be carried out without change of this deflection angle. From this consideration it follows that any reduction in overall length had to be made by reduction in length of the neck. The length of the neck is determined by (1) the length occupied by deflector coil and picture centring magnet assembly, (2) the length of electron gun and its mounting on the tube base and (3) the minimum spacing between the gun and the deflector coil fields which can be tolerated from the point of view of interaction.

In the CME1705 the length occupied by the gun has been reduced by using a different form of gun from that of the CME1703. The CME1705 uses a non ion-trap electrostatic focus gun with an Einzel or unipotential lens. This scheme is illustrated in Fig. 1. The electron beam is accelerated to final anode potential in a straight tetrode electrode assembly undergoing some pre-focus in the process. The final focusing is carried out by the lens which consists essentially of a break in the final anode cylinder at which point the low voltage focus electrode is introduced. Thus electrons enter and leave the lens at the same potential, the only action being that of focusing.

In practice the two ends of the final anode cylinder on either side of the gap are formed into nozzles facing each other whilst the focus electrode is of much larger diameter. As in any electrostatic focus system departure of the beam from absolute centrality in the lens aperture results in deterioration of focus quality. Hence it is important that any deflecting fields such as stray field from the deflector coil or centring magnets should be very small in the lens region.

The CME1705 uses a non ion-trap gun incorporating a cylinder lens the basic form of which is illustrated in Fig. 2. This arrangement has often been referred to as a tripotential focus gun and differs from the gun of CME1703 in that acceleration and focusing of the beam takes place simultaneously. The cathode, grid and first anode follow normal practice and determine the modulation characteristics. The main focusing lens is formed by interposing the low voltage focus cylinder A₂ between the first and final anodes. This effectively carries out the whole focus operation in what is the pre-focus region of a normal tetrode gun.

This type of gun is more sensitive to variations in potential of the focus electrode than the unipotential gun and a continuously variable focus control such as a pre-set potentiometer is advisable.

21 110° CATHODE RAY TUBES OF REDUCED OVERALL LENGTH

In the CME1705 this gun of short overall length has been mounted as close to the deflector coil and picture centring magnet assembly as interaction effects allow. In addition to deterioration of focus quality, interaction between gun and deflecting fields results in a reduction in deflection sensitivity of the tube. This is illustrated in a diagrammatic form in Fig. 3. This shows a section through the tube neck in a plane containing the tube axis. If the gun is so close to the deflector coil that the electron beam is deflected away from the axis before reaching the main focusing lens, the lens will bend it back towards the axis and so cancel part of the useful deflection. More current has now to be supplied to the deflector coil to set up the required deflection at the screen. This form of interaction affects the frame deflector coil more than the line coil. This is because, being a toroidal winding, the field of the frame deflection winding extends a greater distance behind the coil than the line field.

With the CME1705 this effect became of serious proportions before appreciable deterioration of focus quality had taken place. The length has accordingly been fixed at such a value that very little reduction in deflection sensitivity takes place.

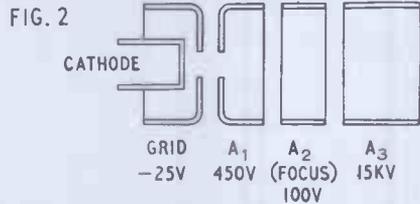
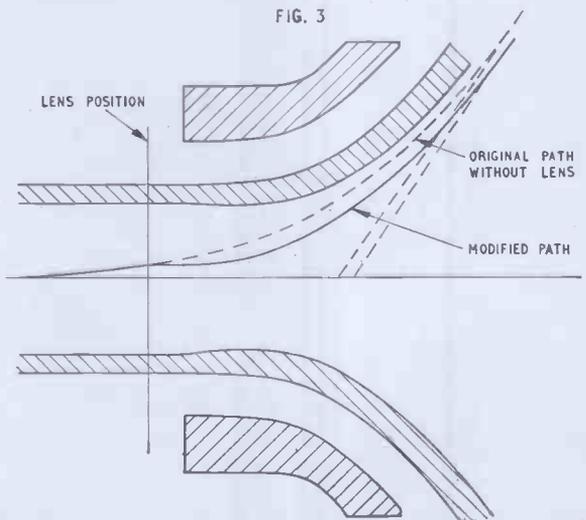


FIG. 2
BASIC FORM OF GUN USING CYLINDER LENS
SHOWING TYPICAL OPERATING POTENTIALS.



Correction to Aspects of Design No. 20. The figure of 5kV for the maximum Heater to Cathode voltage (pulse) rating in the table is a design centre rating, not an absolute maximum value as might be inferred from Section 2. In fact the absolute maximum value is 5.9kV.

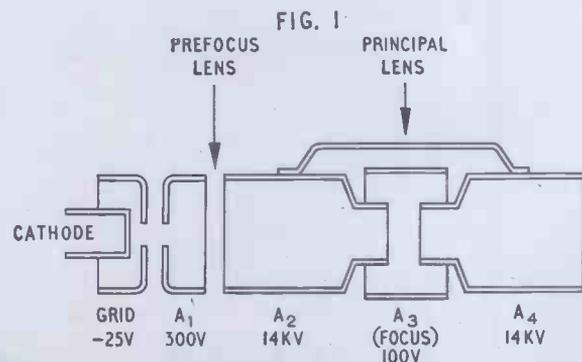


FIG. 1
BASIC FORM OF UNIPOTENTIAL LENS ELECTRON
GUN SHOWING TYPICAL OPERATING POTENTIALS.

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NEW 110° TELEVISION CATHODE RAY TUBES

EDISWAN MAZDA TYPES CME1705 AND CME2104

In order to help designers with "slimmer" styling two new Ediswan Mazda Cathode Ray Tubes which incorporate a shortened gun have been introduced allowing a reduction in the overall length by just over 1 1/4 in. as compared with the CME1703 and CME2101. The length reduction has been made without deterioration in the picture quality and has been limited so that very little reduction in deflection sensitivity takes place. This electrostatically focused gun provides good resolution and uniformity of focus over the whole of the tube face, focus adjustments are recommended to be made with a voltage potentiometer.

GENERAL DETAILS

Rectangular face	Aluminised screen
Electrostatic focus	Silver activated phosphor
Magnetic deflection	Grey glass
Tripotential gun - non ion trap	External conductive coating
Heater for use in series chain	

Heater Current (amps)	I_h	0.3
Heater Voltage (volts)	V_h	12.6

TENTATIVE RATINGS AND DATA

Design Centre Ratings		CME1705	CME2104
Maximum Third Anode Voltage (volts)	$V_{a3(max)}$	16,000	18,000
Minimum Third Anode Voltage (volts)	$V_{a3(min)}$	14,000	15,000
Maximum Second Anode Voltage (volts)	$V_{a2(max)}$	500	500
Maximum First Anode Voltage (volts)	$V_{a1(max)}$	500	500
Minimum First Anode Voltage (volts)	$V_{a1(min)}$	400	400
Maximum Heater to Cathode Voltage - Heater Negative d.c. (volts)	$V_{h-k(max)}$	180	180

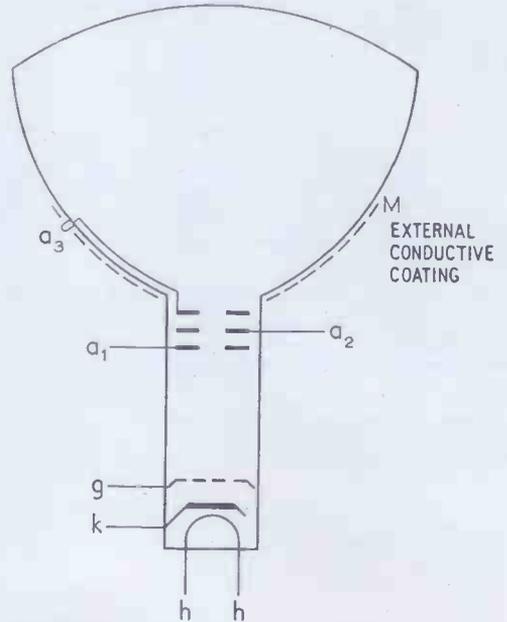
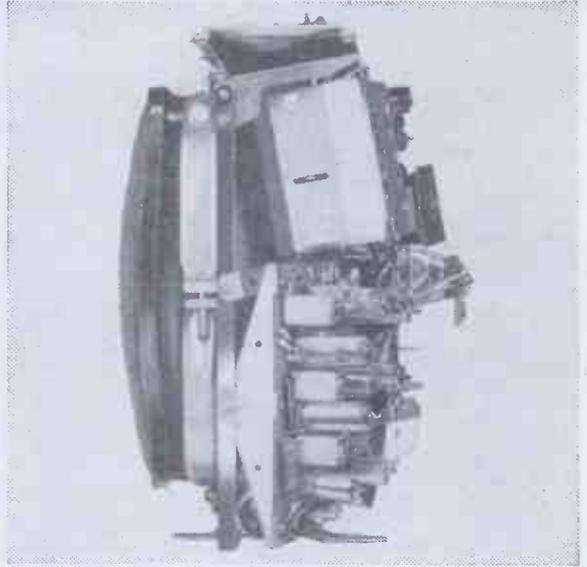
Inter-Electrode Capacitances (pF)		CME1705	CME2104
Cathode to All*	C_{k-all}	5	5
Grid to All*	C_{g-all}	9.5	9.5
Third Anode to External Conductive Coating (approx.)	C_{a3-M}	1,700	2,000
*Inter-electrode capacitances including "Clix" B8H holder VH68/81 (8 pin).			

Typical Operation		CME1705	CME2104
Third Anode Voltage (volts)	V_{a3}	15,000	16,000 17,000
First Anode Voltage (volts)	V_{a1}	450	450 450
Second Anode Voltage for Focus (approx) (volts)	V_{a2}	+100	+110 +190
Grid Bias for cut-off of Raster (volts)		30-72	30-72 30-72
Average Peak to Peak Modulating Voltage for Modulation up to 350 μ A (volts)		33	33 33

Maximum Dimensions (mm)		CME1705	CME2104
Overall Length		290.5	344.5
Face Diagonal		424*	546†
Face Width		400*	518†
Face Height		327*	419†
Neck Diameter		29.4	29.4

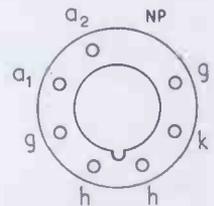
*The maximum dimension at the face seal may be 7 mm larger than this dimension but at any point around the seal the bulge will not protrude more than 3.5 mm
 †The maximum dimension at the face seal may be 3.5 mm. larger than this dimension but at any point around the seal the bulge will not protrude more than 2 mm.

Tube Weight (lbs.)		CME1705	CME2104
Nett (approx)		11 1/2	21
Packed (approx)		16	28



connections
 Side contact a_3 in line with a_2 pin. Tolerance $\pm 30^\circ$

Side Contact: CT8 (Cavity)
 Base: Short B8H (7pin)



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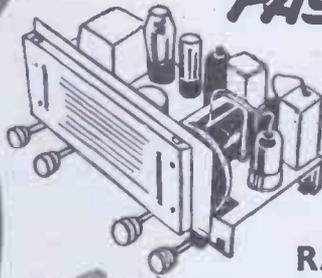
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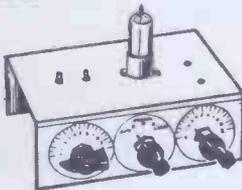
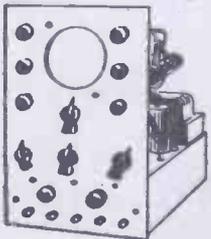
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we can get you out of a stabiliser problem



If you're worried about varying voltages... or if you're in a rage over rectifiers or in a diode of despair—don't worry. We'll get you out of all that! (Why, we've made some of our customers actually beam at tetrodes!) It's because we've experienced over 40 years bottling up valves—Tx, Rx, rf, audio, hard, soft, gov't., special—that problems like this no longer hold any terrors for us. Also, we've everything on the research and production side you could possibly wish for. So the next time you're enveloped in a valve problem, particularly one involving Corona Stabilisers, let us know.

Type	Standard Voltages	Current Range	Size
SC3	350, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000	5 to 100 μ A	1½" + wire ends
SC1	350, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000	10 to 500 μ A	B7G
SC2	2500, 3000, 3500, 4000	25 μ A to 1mA	B9A
SC4	5000, 6000, 7000	25 μ A to 1mA	B9A



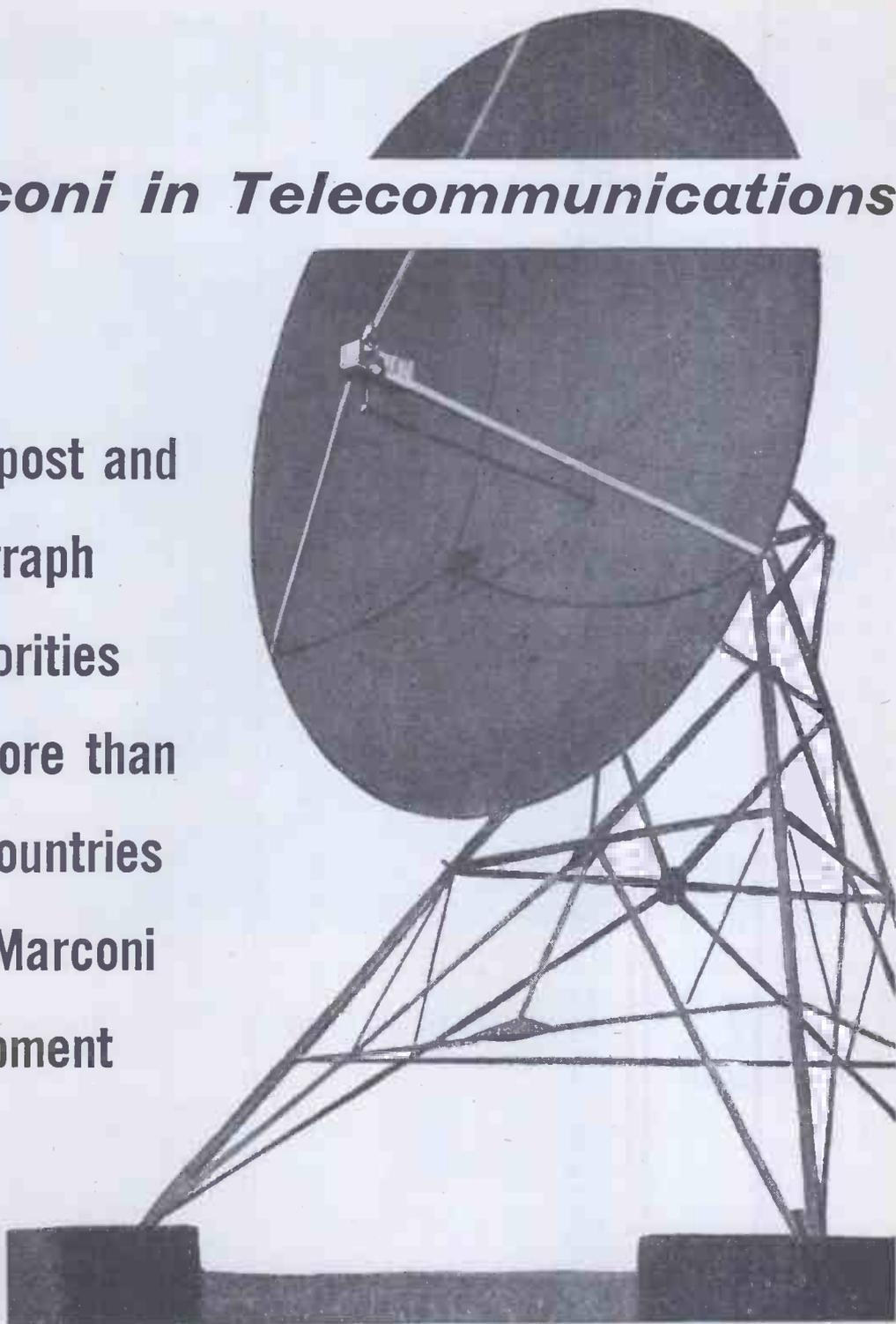
valves are obtainable from
THE M-O VALVE CO. LTD.

BROOK GREEN • HAMMERSMITH • LONDON W.6.

A subsidiary of the General Electric Co. Ltd.

Marconi in Telecommunications

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telegraph
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of more than
80 countries
use Marconi
equipment

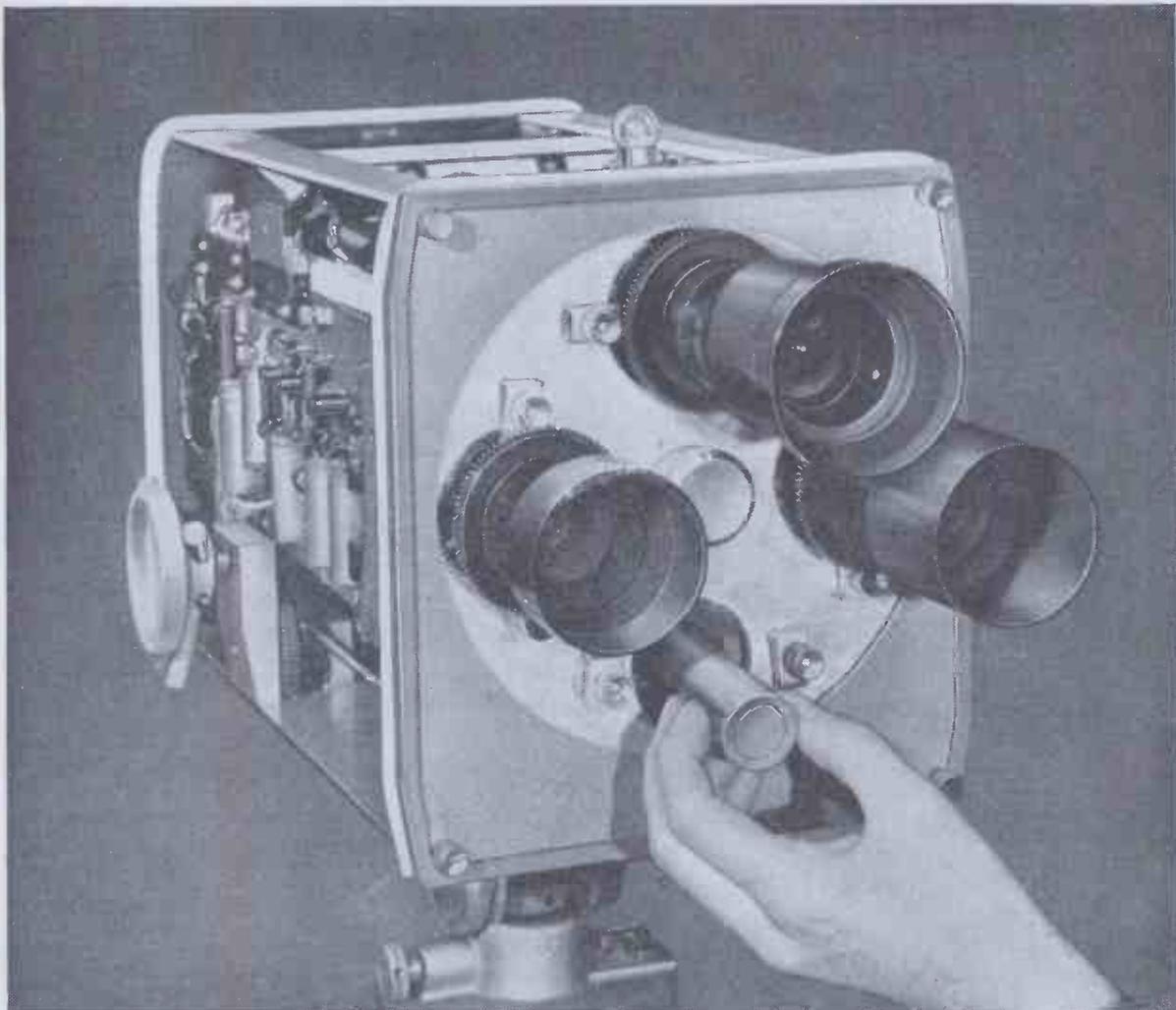


MARCONI

COMPLETE COMMUNICATIONS SYSTEMS
SURVEYED • PLANNED • INSTALLED • MAINTAINED

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND.

M1



Camera Type 201 with panels removed illustrating accessibility

EMI

Leads again with new TV Camera channel

A new vidicon camera channel, which offers considerable economy of operation, and has been specially designed to meet the needs of broadcasting organisations in the United Kingdom and overseas, has now been added to the E.M.I. range.

Known as the Type 201, the new camera channel utilises printed circuits and plug-in techniques to reduce size and weight to a minimum.

The Type 201 is particularly suitable for interviews, live news programmes and other studio work where the use of a larger Image Orthicon or CPS camera is not justified. It produces broadcast quality pictures on 405, 525 and 625 line standards, and is designed for use with E.M.I. vidicon tube 10667S or equivalents.

Used in conjunction with E.M.I.'s control panel type 216, the camera can be operated remotely, allowing several channels to be controlled from a single position.

The Type 201 camera channel has already been ordered by broadcasting organisations in the United Kingdom and overseas.

Type 201 camera channel features include:

- * Four lens turret with precise detent indexing.
- * Optional remote control of focus, turret, and lens aperture.
- * Light weight and compactness. Built-in 7" viewfinder.
- * Two isolated composite or non-composite outputs.
- * Complete accessibility provided by use of detachable printed cards.

FULL PARTICULARS ON REQUEST TO:

E.M.I. ELECTRONICS LTD.

BROADCAST EQUIPMENT DIVISION · HAYES · MIDDLESEX · TELEPHONE: SOUTHALL 2468

EE35



Model W.V.A.

TAPE RECORDERS

The W.V.A. tape recorder now has provision for Stereo plug in heads to enable this recorder to replay Stereo. The regular models are retained with additions and improvements. Our high standard which has made these recorders famous has been maintained, resulting in their being chosen for the foremost musical centre in this country.

30/50 WATT AMPLIFIER

Gives 30 watts continuous signal and 50 watts peak Audio. With voice coil feedback distortion is under 0.1% and when arranged for tertiary feedback and 100 volt line it is under 0.15%. The hum and noise is better than—85 dB referred to 30 watt.

It is available in our standard steel case with Baxendale tone controls and up to 4 mixed inputs, which may be balanced line 30 ohm microphones or equalised P.U.s to choice.



ELECTRONIC MIXER/AMPLIFIER

This high fidelity 10/15 watt Ultra Linear Amplifier has a built-in mixer and Baxendale tone controls. The standard model has 4 inputs, two for balanced 30 ohm microphones, one for pick-up C.C.I.R. compensated and one for tape or radio input. Alternative or additional inputs are available to special order. A feed direct out from the mixer is standard and output impedances of 4-8-16 ohms or 100 volt line are to choice. All inputs and outputs are at the rear and it has been designed for cool continuous operation either on 19 x 7in. rack panel form or in standard ventilated steel case.

Size 18 x 7½ x 9½in. deep.

Price of standard model £49.

Also 3-way mixers and Peak Programme Meters

4-way mixers

12-way mixers, and 2 x 5-way stereo mixers with outputs for echo chambers, etc. Details on request.

Full details and prices of the above on request

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, London, S.W.19

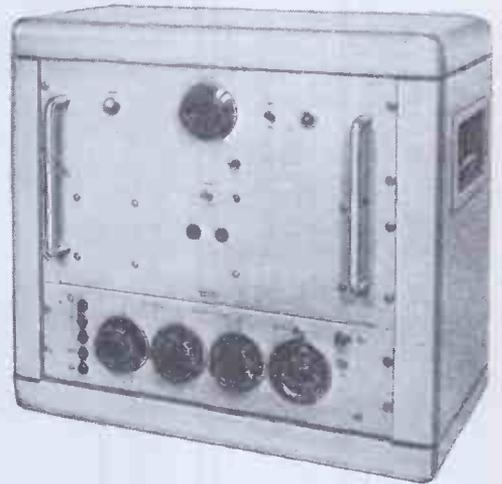
Telephones: LI Berty 2814 and 6242-3

Telegrams: "Vortexion, Wimble, London."

Vortexion quality equipment

**LONDON AUDIO FAIR
DEMONSTRATION ROOM 147**

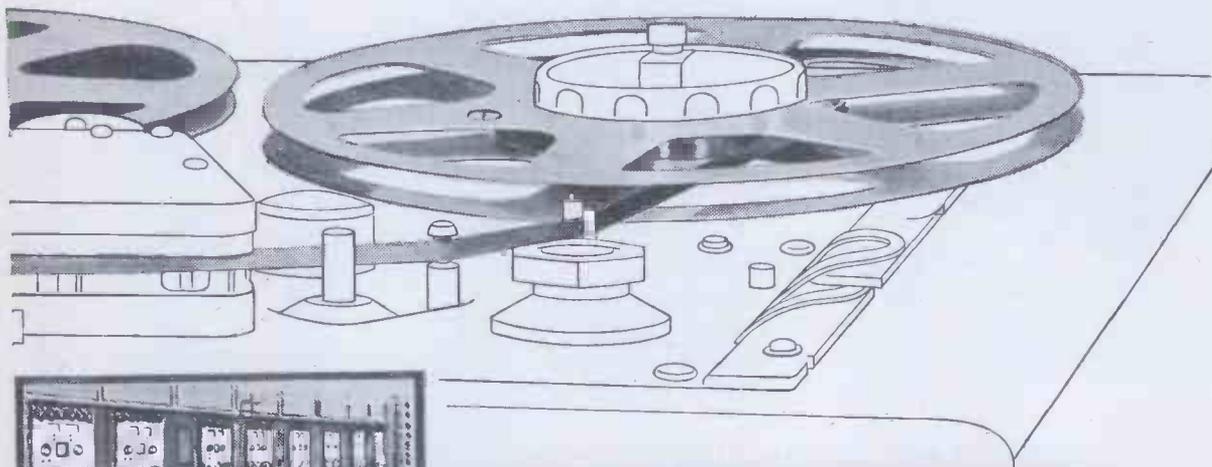
120/200 WATT AMPLIFIER



Will deliver 120 watts continuous signal and over 200 watts peak Audio. It is completely stable with any type of load and may be used to drive motors or other devices to over 120 watts at frequencies from 20,000 down to 30 cps in standard form or other frequencies to order. The distortion is less than 0.2% and the noise level —95 dB. A floating series parallel output is provided for 100-120 V. or 200-250 V. and this cool running amplifier occupies 12¼ inches of standard rack space by 11 inches deep. Weight 60lb.



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Magnetic Recording Tape offering the highest technical standards. First choice of leading recording, broadcasting and television organisations and widely used in science and industry.

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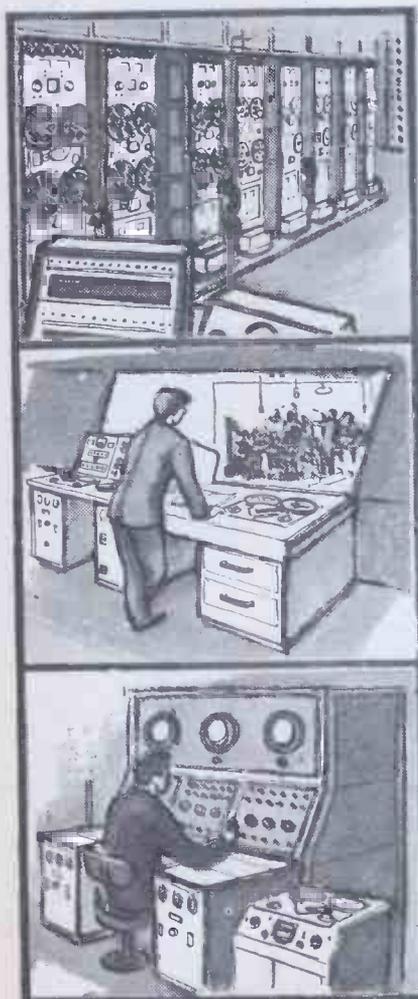
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Sprocketed magnetic recording film designed for all applications where absolute synchronisation is required. 16, 17.5 and 35 mm. Single or double perforation.

"99"

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Produced to the most exacting specifications and available in various standard widths. Electrostatic filtration down to a particle size of .00001 mms. ensures manufacture under cleanest possible conditions.



Britain's Best Hi-Fi Equipment ...

LEAK Amplifiers are the choice of professional engineers such as the B.B.C. (over 500 delivered), the South African Broadcasting Corporation (600), ITV and many other Commonwealth and Overseas broadcasting and TV systems, who use them for transmitting and/or monitoring the broadcasts to which you listen. Also many of the gramophone records to which you listen are cut via LEAK Amplifiers.

The "Point-One Stereo" pre-amplifier is designed so that it can be used with any Leak monaural power amplifier or a combination of any two Leak monaural power amplifiers additionally to its more normal use with the "Stereo 20" or "Stereo 50."

Extract from Test Report by C. G. Gilbert reprinted from the Music Trades Review, also reprinted in our advertisement in the October issue of this magazine. The full two-page Test Report and an illustrated brochure on the amplifiers will be sent you on request.

"The Point-One Stereo" pre-amplifier is probably the most comprehensive unit in existence covering every requirement for stereo tape, disc and radio, plus monaural amplification for any form of input signal ... it is difficult to think of any additional requirement that one would ever wish. The equipment performs with the high performance always associated with the tradition of Leak equipment. It is a fine example of design and construction, and the pre-amplifier can be used with any other Leak main amplifiers. How the pre-amplifier can be sold for a little as £21 can be answered only by Harold Leak ... Summing up, therefore, one can highly recommend the Leak stereo system for use with any current monaural or stereo input whether it be from pickup, tape, radio or microphone."

* The prices are made possible by our world-wide sales

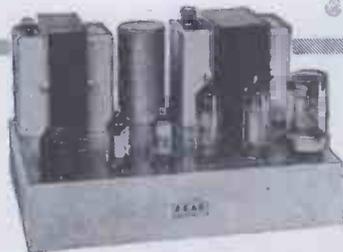
Monaural

VARISLOPE III ●
PRE-AMPLIFIER

TL/12 PLUS ●
POWER AMPLIFIER

SOUTHDOWN ●
CABINET

TOTAL £55 : 13 s.



TL/12 Plus Amplifier 18 gns.



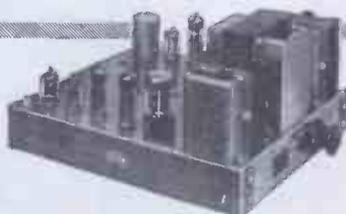
Stereo

● POINT-ONE
STEREO PRE-
AMPLIFIER

● STEREO 20
POWER
AMPLIFIER

● SOUTHDOWN
CABINET

TOTAL £72 : 9s.



Stereo 20 Amplifier 29 gns.



Point-One Stereo Pre-Amplifier £21.

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Please send me Test Report
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£215. 0. 0d.

SX-111 Receiver. Here's a CW/AM/SSB receiver with the essential performance characteristics of the renowned SX-101 . . . at a price that can put it in your shack tomorrow. CW/AM/SSB reception; complete coverage: 80, 40, 20, 15 and 10 metres in 5 separate bands, 6th band tunable to 10 Mc. for WWV. Upper/lower sideband selection; sensitivity: 1 microvolt on all bands; 5 steps of selectivity: 500 to 5000 cycles. Dual conversion, crystal controlled 2nd converter, famous Tee-Notch filter, built-in crystal calibrator.

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Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries. Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions, price 19/6, plus 2/6 post and insurance.



SUPER SENSITIVE (2,000 O.P.V.) MULTIMETER KIT
17 ranges including D.C. volts to 1,000 V. A.V. volts to 1,000 V. D.C. milliamps to 500 ohms, to 3 meg. All the essential parts, including metal case, selected resistors, wire for shunts, selected switches, calibrated scale and instructions, 32/6, plus 2/6 post and insurance.

Morganite Potentiometers

Single and 2-gang types available, standard size with good length spindle, all saw and boxed. Single types, 1/- each, valves available 5K, 10K, 25K, 50K, 100K, 250K, 1 meg., 3 meg. Gang type 3/- each—valves available: 5K + 5K, 100 K + 100K, 1 meg. + 1 meg., 2 meg. + 2 meg.



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P.V.C. covered in 100ft. coils—2/9 a coil or four coils, different colours, 10/- post free.



"Dim and Full" Switch

Particularly useful for controlling photoflood lamps which have only a short life at full brilliance. This toggle switch has three positions: the first position puts two lamps in series at half brilliance for setting up, the second position is off and the third position full brilliance for the operation shots. Also useful for controlling night lights, heaters, etc., etc. Price 3/9 each. Post 9d. Circuit diagram included.

Yaxley Switches

1 Pole 3 Way	1/6
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1 Pole 11 Way	2/6
1 Pole 12 Way	3/-
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2 Pole 6 Way	2/6
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2 Pole 12 Way	4/6
3 Pole 3 Way	1/6
3 Pole 6 Way	3/6
4 Pole 4 Way	4/-
6 Position Shorting	2/-
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6 Pole 3 Way Ceramic	3/6
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9 Pole 3 Way	2/6
12 Pole 2 Way	2/-

Miniature Microphone

American made, Dynamic type. Real bargain at 2/6, plus 6d. postage.



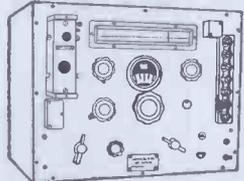
Circular Fluorescent Lighting

Introducing the "Saturn," a wonderful unit which will enrich your room by its elegance and the bright warm light from the fluorescent tube will light up every corner of the room and bring out the richness and colour of your furnishings and decorations.



The top and bottom spheres are available in red, yellow, blue, opal and green to suit your taste. Two models, 40 watt and 80 watt, both approx. 16in. diameter. Price 40 watt £5/19/6, 80 watt £8/19/6, including tube and suspending chain, nothing else to buy. No extra wiring required, simply take down the existing fitting, join the wires of the "Saturn" and that is all. Running cost of the "Saturn" approx. 25 hours per unit for the 40 watt and 12 hours for the 80 watt. Light output of the 40 w. is equivalent to the average 150 w. lamp and the 80 w. equivalent to two 150 w. lamps.

B.29 Receiver



A fine receiver made by the famous Marconi Company. Covers the shipping bands 15 k/c to 560 k/c. in four stages. Has Vernier tuning and all refinements. Works off A.C. mains with internal power pack. A few only, in good working order £15 each. Also some needing servicing £12/10/- each.

Unique Opportunity to build Fine Transistor Set



Constructor's parcel to build Pocket 6 Transistor Set as currently being sold at £17/7/-. Parcel comprises modified, two-tone cabinet as illustrated, tuning dial, two gang tuning condenser, combined bakelite chassis/printed circuit and easy-to-follow circuit. Costing value 57/6—offered while supplies last at only 29/6, plus 2/6 post. Suitable for your own circuit or to build original circuit. All parts available at highly competitive prices. Do not miss this tremendous bargain.

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Line output transformers available from the following receivers, 59/6 each. ARGOSY—T2-T3-CTV617. BAIRD—2014-2017-2114-2117. COSSOR—930-930T-931-933/4/5-937-938-938A-938F-939-939A-939F-943T-946. DECCA—D14-D17-D17C. DEFIANT—TR145T-TR1753. FEBGUSON—306T-308T. H.M.V.—1824-1824A-1825-1825A-1826-1826A-1827-1827A-1829-1829A-1854-1855-1859. MARCONI—VT83DA-VT88DA-VT69DA. R.G.D.—6014T-6017T-7017C-C54. REGENTONE—14T-17C-17 COMB-17T. SOBELL—TS17-T346. Most others available at short notice. Also exact replacement line blocking, frame blocking and frame output transformer—for most makes and types post enquiries please enclose S.A.E.

Useful aids for your workshop

E.H.T. SEALER. This is a highly insulated preparation which is applied by means of a hot soldering iron direct to E.H.T. terminals, solder tags, etc. It hardens immediately after being applied and acts as a permanent seal against corona discharge and surface leaks. 2/6 per stick.
POLYTHENE SPACER WASHERS. These are 3in. diameter, perforated with 1in. hole in centre. Specially useful for the re-insulation of focus coil assemblies. 2/- per dozen.
POLYTHENE TAPE. 2in. wide, 10 thou. thick. Specially designed to replace and/or strengthen insulation of E.H.T. components up to 26 kv. 5/- per roll.
SPONGE CUSHIONING. This is a sponge rubber strip 1/4in. wide x 1/4in. thick for the flexible mounting of C.R.T. tubes and masks. Also acts as a dust seal. 9d. per foot.
RUBBER CORD. Sponge rubber 1/4in. diameter. For sealing around C.R.T. masks. 1/- per foot.
P.V.C. STRING. Strong, flexible, this P.V.C. string can be used for cable forming, binding of ends, marking of wires, etc. 25 yd. roll 3/6.
ANTI-STATIC SCREEN CLEANER. Specially prepared for T.V. tubes and screens. Will clean both glass and perspex and its anti-static qualities will delay the collection of dust. 3/- per tube.
CELLULOSE CEMENT. Specially prepared thick drying cement for the quick and efficient gluing of metal, glass, ceramic, wood, fabrics, etc. When dry it is a very good insulator and is impervious to heat and acid. 4/6 per tin

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Stout, board construction these drawers are ideal for small parts. Supplied complete with simple erection instructions—1/6 each or 12 drawers each 6x2 1/2 x 6 1/2in., 13/6, post 2/-.



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Nicely veneered and polished. Corner fitting (attaches to picture rail). Takes up no floor space. Gives really fantastic results with only low-priced 3in. speaker. Fitting for tweeter. Only 45/- each. Carriage and insurance 3/6

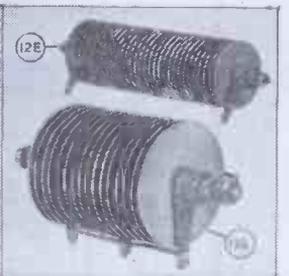


Building a Scope?



3in. oscilloscope tube. American-made type No. 3FP7, octal base 6.3 v. .6 amp. heater, electrostatic deflection, brand new and guaranteed, with circuit diagram of oscilloscope, 15/- each, plus 1/6 post and ins.

Rectifier Bargains



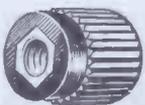
Selenium rectifier type 12, 500 v. ± amp. half-wave, easily rebuilt into full wave or multiple type, contains 30 38 mm. discs. Price 8/6, plus 1/6 post. Type 13, 36 volt 9 amp. easily rebuilt into six full wave charger rectifiers suitable for 6 or 12 volt batteries at 3 amps., contains 24 84 mm. discs. Real bargain at 19/6, plus 1/6 post. Type 14—240 v. ± amp., 7/6.

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Single-strand 18-gauge with P.V.C. covering which makes it rustproof. Extra strong, will stand tremendous strain. Ideal for gardening, clothes lines, indoor aerials, etc., etc. Also being steel alloy and having a resistance of approximately 1/2 ohm per yard this can be used for electrical work, soil heating, wrapping round water pipes, etc. New on drum containing 3,000ft. Price 8/6 plus 3/6 carr.



Insulated Terminal Heads
Always useful—special bargain price 2/- dozen.

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Phone: CRO 6558.
Half day, Wednesday.

Electronics (Finsbury Park) Ltd.,
29 Stroud Green Road,
Finsbury Park, N.4.
Phone: ARChway 1049.
Half day, Thursday.

Electronics (Manor Park) Ltd.,
520 High Street North,
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Covers may be instantly assembled to any chassis mounting plug OR socket for use as free unit, affording flexibility with minimum stock holding.



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Elcom patent locking device may be applied to any units operating under conditions of severe vibrational stress.



Rating: 5 amps per contact, and 1,000 volts under dry atmospheric conditions. 500 volts high humidity.



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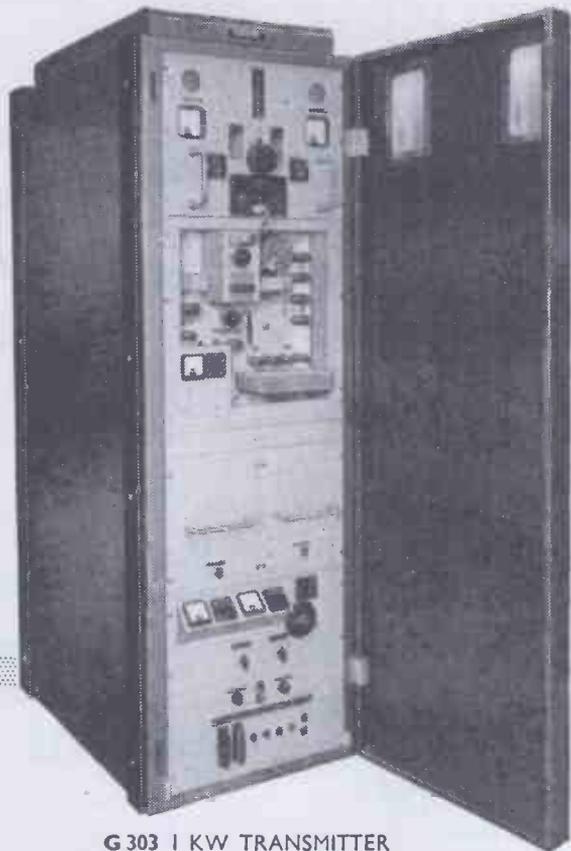
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A new range of VHF/FM broadcasting equipment developed to meet the ever growing demand for high quality equipment at really competitive prices. Redifon can engineer, plan and install complete broadcasting schemes anywhere in the world.

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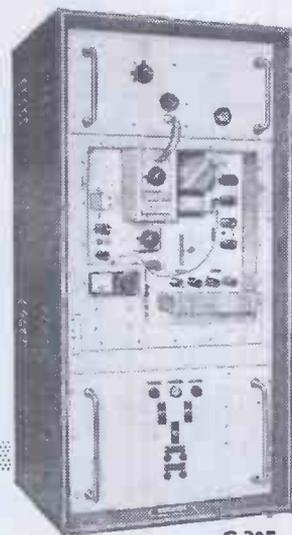
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LINK/MONITOR RECEIVER**

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WEYRAD P.50 TRANSISTOR COILS AND I.F. TRANSFORMERS

FOR 2-WAVE PORTABLE WITH PRINTED CIRCUIT AND ROD AERIAL



P50/1AC M.W. OSCILLATOR COILS. For
176pF TUNING CONDENSER PRICE **5/4d**

P50/2CC 1st and 2nd I.F. TRANSFORMER.
470 Kc/s. OPERATION. "Q" = 150..... PRICE **5/7d**

P50/3CC 3rd I.F. TRANSFORMER. 470 Kc/s
OPERATION. "Q" = 170 PRICE **6/0d**

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flying-lead connections. For 280pF TUNING
CONDENSER PRICE **12/6d**

LFTD2 DRIVER TRANSFORMER. Split Sec-
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PCA1 PRINTED CIRCUIT PANEL, $2\frac{3}{4} \times 8\frac{1}{4}$ in. ready drilled with component positions and references printed
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BOOKLET OF DETAILED ASSEMBLY INSTRUCTIONS AND CIRCUIT DIAGRAMS FOR 6-TRANSISTOR
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**DESIGNED FOR CONSTRUCTING
BAND I & BAND III T.V. AERIALS**



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Selecting at random from our new multi-page catalogue:

- Band III Folded Dipoles (As illustrated).
- Mast Coupling Units for 2" Masts.
- Reflector and director rod holders.
- Insulators, Both Rubber and Plastic
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and 2" Masts.
- Alloy Tubing for Elements, Cross-
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The 'Carol' TR/1 TAPE RECORDER

INCORPORATING THE NEW B.S.R. TAPE DECK. A Quality Tape Recorder at a price that YOU can afford.

The operation of this Recorder is simplicity itself and the quality in both reproduction and finish, leaves nothing to be desired, the cost being well below present-day prices.

Amplifier Controls. On/off Tone and Volume Controls.
Power Output. 2½ watts.
Valve Line-up. ECC83, ECL82, EZ80.
Overall Size. 13½ x 12 x 8in.
Weight. 20 lb.
Microphone. Acos crystal with stand incorporated and fitted with screened lead and jack plug.

Only 19 Gns. plus 15/- P. & P.

H.P. TERMS: £2 deposit and 12 monthly repayments at £1/12/11.

★ **FEATURES:**
Deck Controls. Record/Playback Switch and rewind switch with interlocking device to prevent accidental erasure.
Speed. Single 3½in. per sec.
Playing Time. 5½in. Standard Tape 1½ hrs. L.P. Tape 2 hrs. 8 mins.
Inputs. Sockets for Microphone, Radio, Gram., etc., with extension Speaker Socket.
PRICE, including Tape and Spare Spool

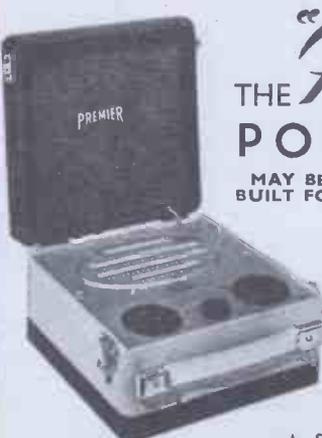
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COMPACT GRAM. AMPLIFIER 2-valve printed-circuit type for use on A.C. or D.C. 200/250 v. mains incorporating modern miniature valves. Output 2 watts, overall dimensions 6½ x 2 x 3½in. Price 59/6, plus P. & P. 2/6.

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THE "Petite" PORTABLE MAY BE BUILT FOR £7-7-0

plus 3/- post & pkg. Batteries extra.
H.T. 10/- (Type B126) or equivalent.
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★ High Q frame aerials.
★ High sensitivity on both wavebands.
★ Medium and long wave superhet circuit.
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★ Size only 8in. x 8in. x 4½in.

★ Weight including batteries 5½lb. ★ 4 valves of the economy type.

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This receiver uses the most up-to-date printed circuit matter and with the aid of the easy to follow point-to-point instructions assembly is simplicity itself. Four first-grade Edison Swan transistors are used, one XA102, two XA101, one XC101 and two diodes. The receiver covers 190/550 metres on medium wave operating on a P.P.4 9-volt battery. When constructed it is housed in an attractive beige leather case. Size 5½ x 3½ x 1½in., weight 17 oz. Ins. books available 2/6. Battery 2/6.

THE "MID-FI" A NEW DESIGN 4½ WATT AMPLIFIER KIT MAY BE BUILT FOR 95/-

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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.



RCA VICE-PRESIDENT 8-10 WATTS PUSH-PULL AMPLIFIER
A compact versatile Amplifier complete with plug-in Power Pack, valve line-up HY90, 2-19A05 and 12AX7, separate bass and treble control, suitable for Speakers of 15 ohms impedance and two 3-ohm tapplings for Tweeters. For use on A.C. mains, tapping 115-160 and 210-250 can also be supplied with Power Pack suitable for AC/DC mains. PRICE COMPLETE WITH ESCUTCHEON AND KNOBS, £6/19/6, 3/3 p. & p.

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THE BEREC BATTERY RECEIVER

For 99/6 plus 5/- pkg. & post

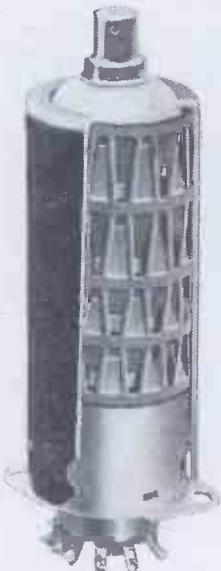
This receiver is ideally suitable for use in the home or where normal electricity supply is not available, remarkable reception on both medium and short wavebands, incorporating latest-type miniature Battery Valves; DK92, DF96, DAF96, DL96 and operates on an external B.103 Battery or equivalent. The receiver is housed in an attractive two-tone metal case. Size 11½ x 7½ x 5½in.
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Full Technical information is available on request.

Joint service numbers have been allocated.



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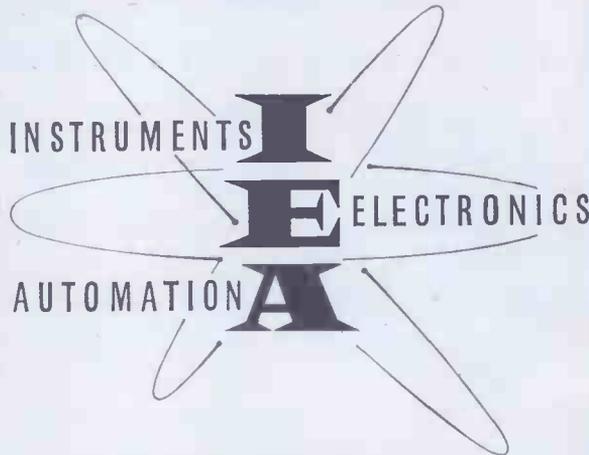
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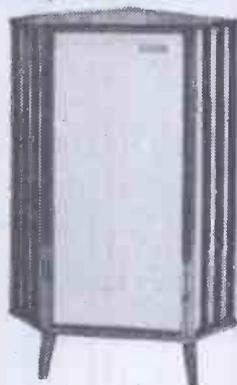
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A bass reflex enclosure employing the Tannoy dual-throated port principle, which makes a notable advance on orthodox reflex cabinets. It is slightly larger than the Chatsworth II model.

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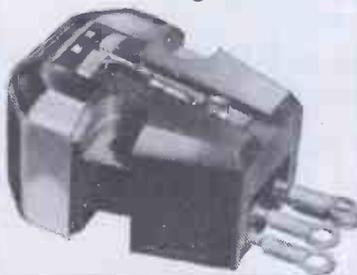
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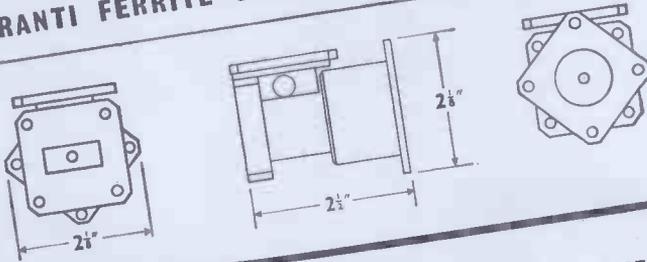
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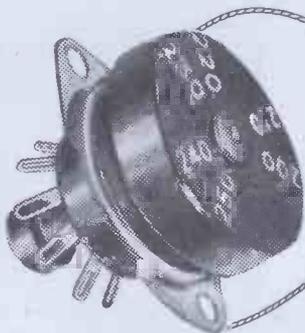


Model 219A. Saves time . . . tests transistor beta in circuit. Measurements made without energizing equipment under test, thereby eliminating spurious signals. Measures both Beta and Collector Current Parameters when transistors are isolated from associated circuitry. Ideal for testing transistor subassemblies as well as individual transistors at incoming inspection stations and on production line. AC or battery. Military and commercial versions.

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Jason kits as advertised.
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Adds a New Dimension to Sound

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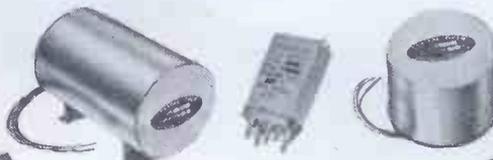
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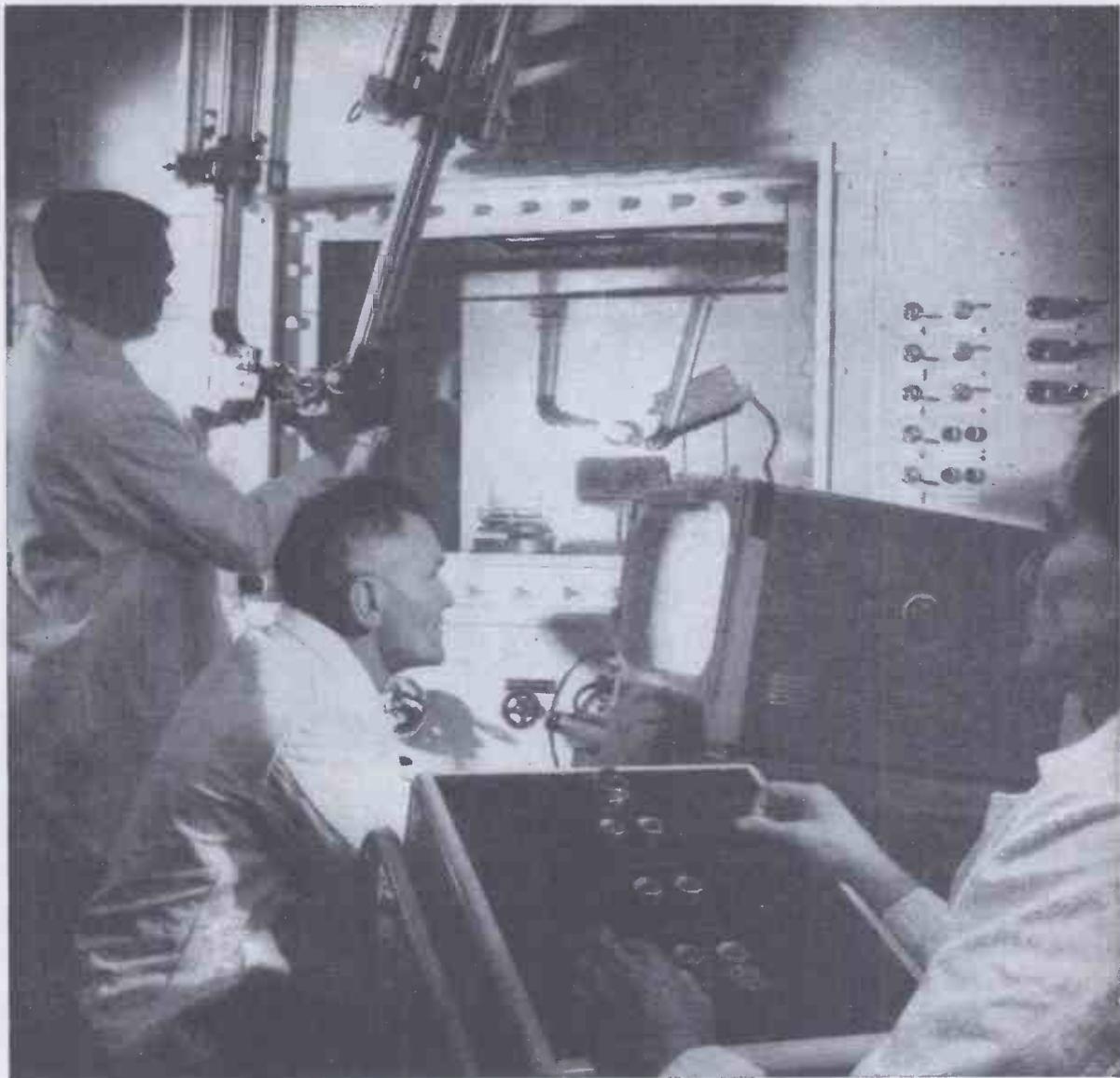


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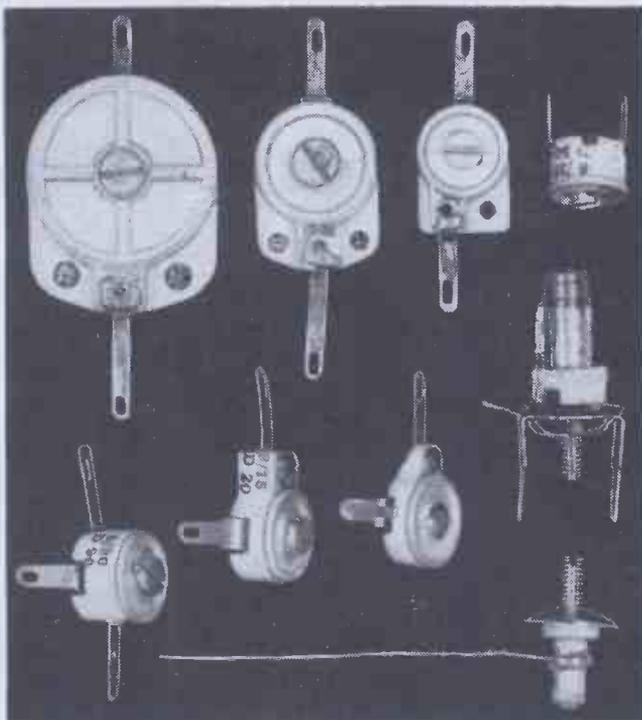
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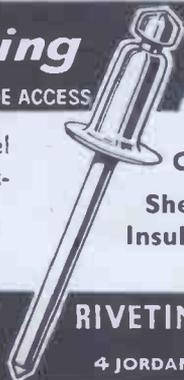
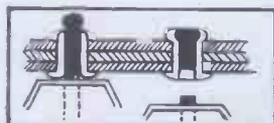
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D.C. current 50µA to 1 amp.
D.C. volts 0.3 v. - 1,000 v. (25 kV by probe).
A.C. volts 10 v. - 1,000 v.

3 resistance ranges from 0-20 meg-ohms (self contained). Metre 40µA 3 1/2 in. arc. Accuracy D.C. 3%, A.C. 4% ohms 5%.

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- 1 Infringing the "Mullard" trade mark.
- 2 Passing off as valves of Mullard Ltd., valves not manufactured by Mullard Ltd.
- 3 Selling or offering for sale in connection with the "Mullard" name, valves not manufactured by Mullard Ltd.
- 4 Applying the "Mullard" name to valves so as to pass off inferior valves as of the quality marketed by Mullard Ltd. under the "Mullard" trade mark.

Bentley Acoustic Corporation Ltd. were also ordered to pay agreed sums in respect of damages and costs.

This action was brought by Mullard Ltd. in the interests of the users of their products, and the Company wish to give notice that it is their intention to take action against any persons or companies who infringe their trade marks.



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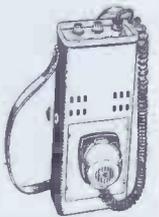
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UNIVERSAL AVOMETER 34 RANGE MODEL D

Ex-Air Ministry, but thoroughly reconditioned and checked. Supplied with internal batteries and instructions. Covers ranges as follows:

D.C. VOLTS	A.C. VOLTS	D.C. Current	A.C. Current
150 mV.	7.5 v.	15 mA.	75 mA.
300 mV.	15 v.	30 mA.	150 mA.
1.5 v.	75 v.	150 mA.	750 mA.
3 v.	150 v.	300 mA.	1.5 amp.
15 v.	300 v.	1.5 amp.	7.5 amp.
30 v.	600 v.	3 amp.	15 amp.
150 v.	750 v.	15 amp.	
300 v.	1,500 v.	30 amp.	
1,500 v.			

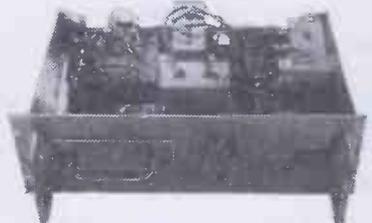
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Frequency range 125-20,000 kc/s. in 2 bands. This is the United States Navy Model of the well-known BC.221 Frequency Meter, but have many additional features which increase their usefulness. Voltage stabilisation circuits and Crystal control ensure extreme accuracy, and in addition they are fitted with an Internal Modulation switch to allow use as a Signal Generator. Size only 8 1/2 in. x 8 in. x 8 1/2 in. Full information on request.

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Utilises 4 valves, 1 each 6Z4G, 6V6G, 6J7G, 6J5G and high quality components such as "C" Core Transformers and Block Paper Smoothing Condensers. A.C. Mains Pack or nominal 110/250 volts. Provision for 600 ohms or High Impedance Input. Output to 600 ohm Line. For normal use only requires changing Output Transformer. Output approximately 4 watts. Designed for Standard Rack Mounting, having grey front panel size 19in. x 7in. All connections to rear panel, front having "On/Off" Switch. Gain Control, Indicator Light. Fuses and Valves Inspection Panel. BRAND NEW IN MAKER'S PACKING. ONLY £4/9/6 (carriage 10/6).

CRYSTAL CALIBRATOR No. 10



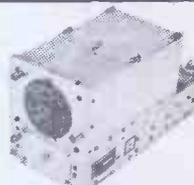
A superb Crystal Controlled Wavemeter just released by the Ministry of Supply. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s. but may actually be used from 500 kc/s. up to 30 Mc/s. Complete with 500 kc/s. Crystal, 2 valve type IT4, 1 or 1R5 and 1 of CV286 (Neon Stabiliser) and Instruction Book. Size 7in. x 7 1/2 in. x 4in., weight 5lb. Used but in first class condition. ONLY £2/19/6. Carr. 3/6.

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In heavy black crackled metal case, designed for use with AR 88 Receiver, or any set with 3 Ohms Output. BRAND NEW IN MAKER'S CARTONS. ONLY 45/- (Post 3/6).

"Q" FIVER COMMAND RECEIVER.



The famous American BC 455 covering 190-550 kc/s. I.F.s being 85 kc/s. Complete with all 6 valves and circuit. Size 11 x 5 1/2 x 5 1/2 in. BRAND NEW IN MAKER'S CARTONS. ONLY 59/6 (Post 3/6).

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The renowned American set designed by Collins for static or mobile use. Coverage 1.5-12.0 Mc/s. in 3 bands. Complete with all 7 valves. Power required 12 v. L.T. and 225 v. H.T. Size 11in. x 13in. x 11in. in black crackled case. IN NEW CONDITION. ONLY £10/10/- (carriage 15/-).

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Made by A. C. Cossor. Incorporates Hard Valve Time Base with speeds of 1.5-40 milliseconds, but simply converted to produce 3 cycles per second to 30 kc/s. Controls include Fine and Coarse Gain, Brightness, Focus, X and Y shifts. Has Power Pack for nominal 115 v. and 230 v. A.C. with adequate fuse protection. Employs 2 1/2 in. tube type ACR10. Grey and black engraved front panel, size 19in. x 17in. For standard rack use if required, depth of unit being 12in. In steel transit case as illustrated. Complete with leads and suggested modification data. BRAND NEW. ONLY £12/10/- (carriage 15/-).

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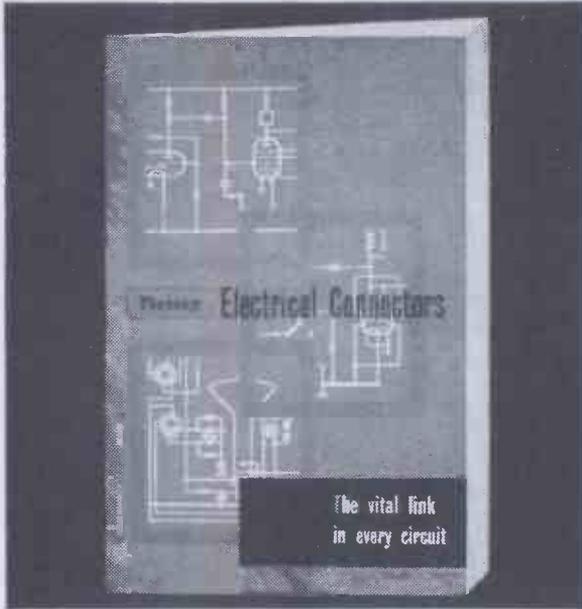
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AVOMETER MODEL D.

£8.19.6 (P. & P. 3/6)

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180 mV.	7.5 V.	15 mA.	75 mA.
300 mV.	15 V.	30 mA.	150 mA.
1.5 V.	75 V.	150 mA.	750 mA.
3 V.	150 V.	300 mA.	1.5 Amps.
15 V.	300 V.	1.5 Amps.	7.5 Amps.
30 V.	600 V.	3 Amps.	16 Amps.
150 V.	750 V.	15 Amps.	
300 V.	1.5 KV.	30 Amps.	
750 V.			Resistance 0-1000 ohms. 0-10 K ohms.

Thoroughly overhauled. Complete with batteries and instructions. An extremely robust meter at a very reasonable price.

CRYSTAL CALIBRATOR No. 10.

A crystal controlled heterodyne wavemeter covering 500 Kc/s. to 10 Mc/s. (Harmonics up to 30 Mc/s.) Requires 15 mA. and 12 v. 0.3 a. D.C. but can be easily modified for 120 v. and 1.4 v. working. Size 7x7x4in. First class condition, complete with valves, crystal, instruction manual and circuit. ONLY 59/6. Post 3/6.

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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. 25 lb. Made 1953. BRAND NEW. Original boxes. 45/- Carr. 5/-.

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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. 43x4½x5½in. high. Wt. 12 lb. Potted. Tag ends. RCA BRAND NEW. Boxed. 29/6, post 3/6.

MARCONI CR100

Completely overhauled. In perfect working order. LOOK LIKE NEW. £21. Later model with Noise Limiter, £25. Carr. Eng. and Wales 30/-. Send S.A.E. for full details.

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A high quality 3 ohm unit fitted into heavy gauge black crackled steel cabinet, size 10½x11½x6in. Fitted with rubber feet and 6ft. lead. Ideal for extension speaker. CR100, etc. In original cartons. BRAND NEW. 45/- Post 3/6.

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IDEAL FOR CROWD CONTROL, FACTORIES, FETES, ETC. CONSISTS OF 4 SPEAKER UNITS AND CONTROL UNIT. COMPLETE WITH MICROPHONE, HEADPHONES AND SPARES. OPERATES FROM 12 VOLTS D.C. (OR 6 VOLTS D.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.

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An absorption wavemeter made by S.T.C. covering the frequency range 100 Kc/s. to 48 Mc/s. with nine plug-in coil units. There are no gaps. Powered by 1½ v. cell and triode valve. Complete with all charts and contained in neat fitted wooden transit case 14 x 13 x 9in. In first-class condition. £4/19/6, plus 5/6 carriage.

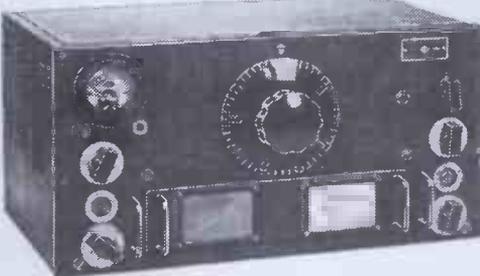


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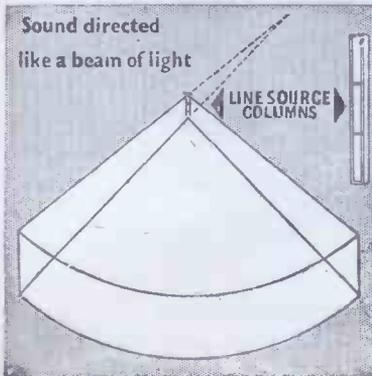


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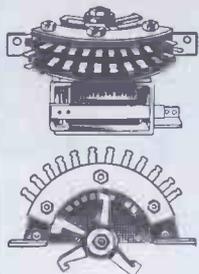
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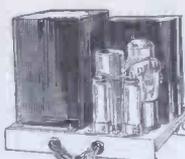
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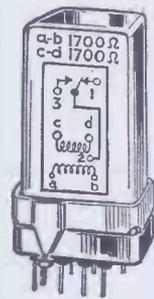
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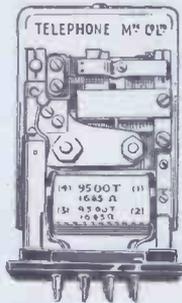
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Input tapped 220-230-240 volts.
Output: 300 V. D.C. at 100 mA.
6.3 V. A.C. at 4.5 amp.
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Rectifier supply 5 V. A.C. at 3 amp. Very conservatively rated. Price 42/6 plus P. & P. 6/6.

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NEW CAR-PENTER'S TYPE POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/-.

DESK TELEPHONE HANDSETS

Brand new (perfect) complete with two-way calling system (buzzer), internal battery. All ready for simple two-wire connection. Price £3/5/- each, or £6/5/- the pair. P. & P. 3/6 each unit.



BRAND NEW FREQUENCY METERS manufactured by Crompton Parkinson. Calibrated 45 cycles to 55 cycles per second. 6" dial. Panel mounting type. In original manufacturer's boxes. PRICE £10.15.0 each. Postage 3/6d.

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. Also 60 watts, 19/6 each. Plug P. & P. 2/-.

AUTO TRANSFORMER

Air cooled, very conservatively rated at 3 kVA., will handle 6 kVA. Tapped 220/230/240/250 volt, 12 amp. 105/110/115/120 volt, 28.5 amp. Brand new. Each one shrouded in a metal case and packed in original manufacturer's wooden case. Price £15. Carr. £1. Nett weight over 2 cwt.



MUIRHEAD PRECISION, 4 bank, 1 pole 24 position Stud Switch. Heavy duty contacts. Brand new. Original boxes. Price 17/6 each. P. & P. 1/-.

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10 WAY STRIP standard Post Office telephone Jack Sockets, spacing allowing Igranac Jack Plugs. New. Price 10/- P. & P. 1/6.

BRAND NEW SOUND POWER OPERATED EX ADMIRALTY HEAD AND BREST SETS. Two such sets connected up will provide perfect intercomm., no batteries required. Will operate up to ½ mile. Original manufacturer's boxes. Price 17/6 each, plus P. & P. 2/-; or 32/6 per pair. P. & P. 3/-.

3000 TYPE RELAYS
6,000 ohm coil 2P c/o..... 10/6 ea.
6000 ohm coil 4P c/o..... 12/6 ea.
300 ohm coil 4P c/o + 2M..... 10/6 ea.
Brand new and boxed. Postage on each relay 1/-.

METERS GUARANTEED PERFECT

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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
Voltmeters	
12 v. D.C. M.C. 2½in. proj. rnd.....	8/6
20 v. D.C. M.C. 2in. fl. sq.....	9/6
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.....	9/6
150 v. D.C. M.C. fl. rnd. 2½in.....	10/6
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50 microamp., scaled 0-100, M.C. 2½in. fl. rnd.....	42/6
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500 microA. M.C. 2in. rnd.....	16/6
Postage on all meters 1/- each.	

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 1½ x ½ x ¾ in. Price 22/6 each.

HIGH SPEED RELAY. Siemens, two bobbins, 1,000 ohms each. New, 10/6 each. P. & P. 1/-.

A VERY SUPERIOR BRAND NEW RELAY IDEAL FOR MODEL WORK. 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/-.

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NEW WIRE WOUND RHEOSTAT ON CERAMIC. 58 ohm 50 watt, complete with instrument knob. Price 8/6. P. & P. 1/6.

W. W. RHEOSTAT. New. 3.5K, 25 watts. Price 7/6. P. & P. 1/6.

W. W. RHEOSTAT. New. 5K, 25 watts. Price 7/6. P. & P. 1/6.

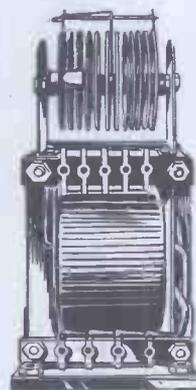
EX P.O. MAGNETIC COUNTER. 3 ohms type for 4½ volt D.C. operation. Price 6/6 each. P. & P. 1/-.

AS ABOVE 500 ohm for 24/36 volt D.C. operation. Price 6/6 each. P. & P. 1/-.

TRIPLE RANGE VOLTMETER. 0-5, 25-250 v. D.C. M/C 3½in. meter 3in. scale, mounted in bakelite carrying case 7½in. x 4½in. x 3in., complete with handle and test leads, 27/6 each. P. & P. 2/-.

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.

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UNIVERSAL AVOMETER MODEL "D"

D.C. VOLTS	A.C. VOLTS	D.C. Current	A.C. Current
150 mv.	7.5 v.	15 ma.	75 ma.
300 mv.	15 v.	30 ma.	150 ma.
1.5 v.	75 v.	150 ma.	750 ma.
3 v.	150 v.	300 ma.	1.5 amp.
15 v.	300 v.	1.5 amp.	7.5 amp.
30 v.	600 v.	3 amp.	15 amp.
150 v.	750 v.	15 amp.	Resistance
300 v.	1,500 v.	30 amp.	1,000Ω
750 v.			10,000Ω
1,500 v.			



Supplied reconditioned as new, with internal battery, instructions and leads £8/19/6 each. P/P. 3/6.

WESTON MODEL 772 TESTMETER



A.C. VOLTS	D.C. CURRENT	A.C. CURRENT
2.5 v.	100 micro/a.	500 ma.
10 v.	1 ma.	1 amp.
50 v.	10 ma.	5 amp.
250 v.	50 ma.	RESISTANCE
1,000 v.	100 ma.	100 ohms
D.C. VOLTS	500 ma.	1,000 ohms
2.5 v.	OUTPUT METER	100k. ohms
10 v.		10 megohms
50 v.		
250 v.		
1,000 v.		

Supplied in perfect working order complete with internal batteries. £7/10/- P/P. 4/-.

BRAND NEW RCA EXTENSION LOUDSPEAKERS



8in., 3 ohm Quality Speaker mounted in attractive black crackle case to match AR88 Receivers, etc.

45/- each. P/P 3/6.

8-RANGE SUB-STANDARD D.C. AMMETERS



Ranges 1.5, 3, 7, 15, 30, 60, 300 and 450 amps. 8in. mirror scale. Meter housed in polished teak case. Supplied complete with all shunts and leather carrying case. £15 each. P/P. 7/6.

VORTEXION PORTABLE AMPLIFIER



Operation from 200/250 volts A.C. or 12 volts D.C. Separate inputs for microphone or gram. Output matched to 7.5, 15, 250 or 500 ohms. incorporates volume control and full switched tone control. Valve line-up: 6Q7, 6J5, 6V6, 6V6, 5Z4. Size 8½ x 6½ x 17½in., not brand new but supplied in perfect working order, fully tested, £9/10/- each. P/P. 6/-.

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Brand new instruments by famous manufacturer. In polished teak case. Moving iron instrument reading A.C. or D.C. volts on 2 ranges 0-160 v. or 0-320 v., 8in. mirror scale. Accuracy within 2%. £5/19/6 ea. P.P. 3/6.



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25 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. 3½in.	62/6
500/0/500 microamp. D.C. M/C. proj. rd. 2½in.	19/6
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 rd. 3½in.	50/-
1 milliamp D.C. M/C. flush sq. 4in.	69/6
200 milliamp. D.C. M/C. flush rd. 2½in.	9/6
15 amp. D.C. M/C. Proj. rd. 2"	9/6
30 amp. D.C. M/C. flush rd. 2½in.	10/6
15 volt D.C. M/C. flush rd. 1½in.	32/6
120 volt D.C. M/C. flush rd. 3½in.	25/-
300 volt A.C. M/I. flush rd. 2½in.	25/-
300 volt A.C. M/C. rect. flush rd. 2½in.	25/-
600 volt A.C. M/I. flush rd. 2½in.	25/-

DON Mk. 5 FIELD TELEPHONES

Ideal for all inter-communication. Buzzer calling. Supplied fully tested, complete with batteries and instructions. 39/6 each, P/P. 3/6 ea., 5/- pr.



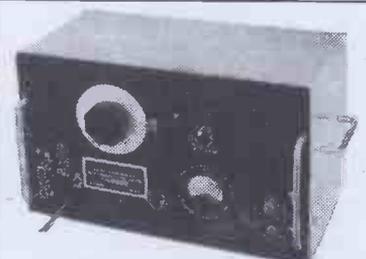
EDDYSTONE MAINS POWER PACKS



200/250 volts input. Output 175 volts 60 mA. and 12 volts 2.5amps. Double choke and condenser smoothed. 5Z4 rectifier. Supplied as new and unused. 22/6 each. P/P. 3/6.

RCA PLATE TRANSFORMERS

Input 200/250 volts. Output 2,000/0/2,000 volts 500 mA. tapped 1,500/0/1,500 volts. Supplied brand new boxed, £6/10/- each. carriage 10/-.



FURZEHILL BEAT FREQUENCY AUDIO OSCILLATORS. Frequency range 0 to 10,000 cycles. Output 10 or 600 ohms. Separate 50 cycles check. Set zero control, 200/250 volt A.C. operation. Supplied in perfect working order, fully tested, £9/19/6 each. P/P. 10/-.

MARCONI TYPE TF340 OUTPUT POWER METERS



Meter calibration 50 MW/17DB F.S.D. Meter multipliers, 0.1-1-10-100. Impedance values, 25-30-40-50-60-80-100-125-150-200 ohms. Impedance multipliers. 0.1-1-10-100. Perfect condition. £9/19/6 each, 7/6 carriage.

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Generator bell ringing. Light and very portable. Ideal for all installations. Supplied complete with batteries, fully tested. As new, 59/6 each, P/P. 3/-, 5/- pr.

PARMEKO TABLE TOP TRANSFORMERS



Input 230 v. 50 c/s. Output 620/550/375/0/375/550/620 volts 250 mA. Also 2-5 v. 3 amp. windings. Size 6½ x 6½ x 5½in. Brand new only, 45/- each. P/P. 5/-.

G.E.C. SELECTEST MULTI-RANGE TESTMETERS



D.C. Volts	A.C. Volts	D.C. Current	A.C. Current
150 mv.	7.5 v.	15 ma.	75 ma.
300 mv.	15 v.	30 ma.	150 ma.
1.5 v.	75 v.	150 ma.	750 ma.
3 v.	150 v.	300 ma.	1.5 amp.
15 v.	300 v.	1.5 amp.	7.5 amp.
30 v.	600 v.	3 amp.	15 amp.
150 v.	750 v.	15 amp.	Resistance
300 v.	1,500 v.	30 amp.	1 K. ohm
750 v.			10 K. ohm

Incorporated overload trip and special safety interlocking switches. Supplied in perfect condition with leads and battery at £7/10/- each. P/P, 3/6.

COSSOR 339 DOUBLE BEAM OSCILLOSCOPES



Operation 110/200/250 volts A.C. Ten position time base, 6 cps. to 250,000 cps. Amplifier 10 cps. to 2,000,000 cps. Perfect working order,

ONLY £15 EACH
Carriage 10/-.

MARCONI TF410C VIDEO OSCILLATORS. Ranges 20 cps. to 30,000 cps. and 30 kc/s. to 5 Mc/s. Variable attenuator. 200/250 v. A.C. Reconditioned, perfect order, £35 each.

MARCONI TF-373 UNIVERSAL IMPEDANCE BRIDGE. Reconditioned to maker's spec. 1,000 c/s. Ranges: 100H. 100 mfd. 1 MEG. 100 Q. 200/250 v. A.C. operation. £35 each.

MARCONI STANDARD SIGNAL GENERATOR TF-144G. 85 kc/s. to 25 Mc/s. Output 1 microvolt to 1 volt. 200/250 volts A.C. operation. Reconditioned to maker's spec. £55 each.

PHOTO VOLTAGE AMPLIFIERS. These special units contain a 1 microamp. Tinsley mirror galvo and a double selenium photo cell. Brand new, £9/19/6 each. P/P. 7/6.

MARCONI TF-329 "Q" METERS. Range 0 to 500 Q. Frequency 50 kc/s. to 50 Mc/s. 200/250 volts A.C. operation. Reconditioned to maker's spec. £65 each.

MARCONI TF-428 B/I. VALVE VOLT-METERS. 5 ranges A.C. and D.C. 1.5, 5, 15, 50 and 150 volts. Complete with internal H.F. probe. Operation 200/250 volts A.C. Brand new, £17/10/- each. P/P. 10/-.

MINE DETECTORS No. 4a

Complete equipment comprises Search Head, Amplifier Headset, Control Box, Telescopic Rods for Search Head, Search Head Test Unit and Test Depth Measure and Haversack. Operation is from a standard 60 v./1.5 v. combined dry battery. The unit will detect ferrous or non-ferrous metals to a depth of 24in. giving maximum signal but can be used at greater depths giving lower output. Ideal for tracing underground pipes or cables and any hidden metallic objects. Complete equipment supplied brand new in original transit cases complete with circuit and operating instructions.



PRICE
99/6 EACH
Carriage 10/6.

AMERICAN SUPER LIGHTWEIGHT HEADSETS. Res. 50 ohms. Brand new, 15/- P/P. 1/6.

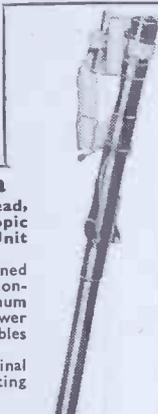
SOUND-POWERED TELEPHONE HANDSETS. No batteries required. 15/- each. P/P. 1/6.

LEACH 12 VOLT AERIAL CO/VER RELAYS. Double pole, 7/6 each. P/P. 9d.

MUIRHEAD PRECISION STUD SWITCHES. 4 bank, 4 pole, 24 positions. New, boxed, 17/6 each. P/P. 1/3.

CR.100 SPARES KITS. Contains 15 valves, resistors, pots, condensers, output trans. etc. All brand new, 59/6 set. P/P. 3/6.

24 AMP. VARIAC TRANSFORMERS. 230v. input. Variable output 185 to 250 volts. Can be used reversely giving 230 volts out with variable input. £12/10/- each. P/P. 10/-.



1,000 WATT MAINS ISOLATION TRANSFORMERS. 230 to 230 volts. Heavy duty, Ex-Admiralty. New, boxed, £5 each. P/P. 10/-.

750 WATT AUTO TRANSFORMERS. Tapped from 110 to 230 volts. Fine heavy duty type, 69/6 each. P/P. 5/-.

AR.88 WAVECHANGE SWITCH. ASSEMBLY. Brand new with screens. 17/6 each. P/P. 2/6.

MARCONI TF-517 SIGNAL GENERATORS. 10-18 Mc/s; 33-58 Mc/s; 150-300 Mc/s. 200/250v. A.C. operation. 65/- each. FOR CALLERS ONLY.

24 VOLT ROTARY CONVERTERS.

Input 24 volts D.C. Output 230 volts A.C. 50 cycles, 100 watts. Housed in metal carrying case with inlet/outlet plugs. Brand new, 92/6 each. P/P. 7/6.



FIELD TELEPHONES TYPE F. Generator

bell ringing, Supplied complete with batteries fully tested and complete with wooden carrying case 59/6 each. P/P. 3/6. 5/- pr



ROTARY CONVERTERS



12 v. D.C. input 230 volt A.C. 150 watts 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance switch, plugs and A.C. mains voltage output check meter. Supplied in perfect condition, individually tested £9/19/6 each. P/P. 10/-.

BC 221 HETERODYNE FREQUENCY METERS

125 kc/s to 20 mc/s

Complete with all valves, crystal, headset and instruction book, but less calibration charts. 100% condition.

SPECIAL PRICE **£14-10-0**
each
Carriage 7/6 extra



LASKY'S RADIO

H.P. TERMS AVAILABLE

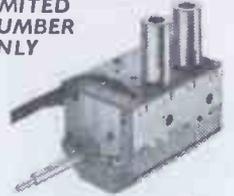
on certain items. Please give details of your requirements.

ALL TYPES OF P.M. SPEAKERS

ROUND				
3 1/2 in.	4 in.	5 in.	6 1/2 in.	8 in.
17/6	19/6	14/6	16/-	16/6
ELLIPTICAL				
7 x 4	9 x 6	10 x 2 1/2	10 x 6	10 x 7
15/6	27/6	27/6	25/-	32/6

Post Extra.

LIMITED NUMBER ONLY



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.

LASKY'S PRICE 39/6
Post free.

The "FIREBALL" TURRET TUNER, covering Channels 1-5 Band I, and 6-13 Band III. Uses PCC84 and PCF80 valves. A cascade Turret Tuner of unique design, compact and lightweight.

LASKY'S PRICE £5.19.6
complete with valves. Post 2/-.



ACOS CRYSTAL STICK MIKE. type MIC.39/1, complete with cable. Listed at £5/5/-.

LASKY'S PRICE 39/6
Post free
Desk Stand 2/6 extra.

ACOS type 33/1. Crystal hand or table Mike, 29/6. Post 1/6.

RIBBON MIKE on table stand. Famous make, high impedance. **LASKY'S PRICE £6.19.6**
Post 3/6.

HIGH FIDELITY TAPE RECORDER HEADS

Leading make, new and unused upper or lower track RECORD/PLAY-BACK, high impedance. Double wound and will reproduce up to 12,000 c.p.s. at 7 1/2 i.p.s. Azimuth adjustments. Output 5 millivolts at 1 Kc. at 7 1/2 i.p.s. ERASE, low impedance.

LASKY'S PRICE 39/6
Per pair
Post 1/3. Worth double. Please specify upper or lower track.

UNIVERSAL SOUND MIXER

3 channels. For use with all tape recorders and audio amplifiers. Size 4 1/2 x 3 1/2 x 3 1/2 in.

LASKY'S PRICE 35/-
Post 2/6.

TEST METERS

Full range of the latest test gear by Avo, Taylor, Pullin. Example: **THE NEW TAYLOR METER.**

Model 127A. Pocket size, high sensitivity, inexpensive. 20,000 ohms per volt. Large easy-to-read-scale. Tests up to 20 meg. with internal batteries. 21 ranges, volts, amps, and ohms. Dimensions: 5 1/2 x 3 1/2 x 1 1/2 in. £10.

Post free. Available no interest on h.p. terms.

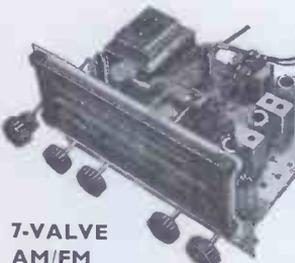
SPECIAL OFFER!



"ALFA" MULTI-RANGE RADIO TEST METER

A.C. & D.C. 3333 ohms per volt. Ohms ranges up to 2 meg. Volts A.C. & D.C. up to 1,200. 300 micro-amps—300 m/a. Decibels, 2 ranges, -20 to +23 db; +20 to +37 db. Accuracy ± 3%. Large full vision dial. Overall size: 5 1/2 x 3 3/8 x 1 3/8 in.

LASKY'S PRICE 89/6
Including Leads.
Post 2/-.



7-VALVE AM/FM RADIOGRAM CHASSIS

Famous make. For 200-250 v. A.C. Output 4 watts matched to 8 ohms speaker. 7 valves: ECC85, ECH81, EF89, EABC80, EL84, EZ80, EM81, magic eye tuning indicator. Covers medium, long and FM bands. Length 12 in., height 7 1/2 in., front to back 8 1/2 in. Limited number only.

LISTED AT 22 GNS.

LASKY'S PRICE £16.19.6
Carr. and Ins. 12/6.
Available on H.P. terms. Brochure on request.

TAPE DECK OFFERS!



Latest B.S.R. "MONARDECK," SINGLE SPEED. 3 1/2 i.p.s., takes 5 1/2 in. spools. Simple controls.

LASKY'S PRICE £9.19.6
Carr. & Insur. free.



Latest COLLARO STUDIO TAPE TRANSCRIBER. 3 motors, 3-speed, 1 1/2, 3 1/2, 7 1/2 i.p.s. takes 7 in. spools. Push-button controls.

LASKY'S PRICE £15.15.0
Carr. & Insur. free.

LATEST MOTEK K.10 DECK, push-button controls, 3 motors, 3 speeds, rev. counter. Freq. response better than 40 to 12,000 c/s. at 7 1/2 i.p.s. 2-tone grey. Few only.

List £22.
LASKY'S PRICE £13.19.6
Carr. & Ins. 12/6.
Suitable Case 39/6.

MAINS MOTORS, shaded pole, ideal for fans, tape recorders, etc. For A.C. mains, 19/6. Post 1/6.

TAPE RECORDER AMPLIFIER for use with Collaro Studio Transcriber. Size 1 1/2 x 5 x 3 in. Uses 3 valves, magic eye, contact cooled metal rectifier. Incorporates mike/gram/radio inputs, ext. l.s. jack, superimposing switch £12/19/6 Complete with matching knobs (Gold/Black). Post 3/6.

TAPE RECORDER BARGAINS

HARTING HM.5 A 2-speed superbly-made high quality Tape Recorder of Continental manufacture. List 85 gns.

LASKY'S PRICE 59 gns.
Complete with Mike and Tape. Carr. and Insur. 25/-.
Further details on request.

"LIGHT" TAPE RECORDER (foreign) 2-sp.d., 3 1/2 & 7 1/2, with inputs for mike and tuner. In blue/grey carrying case. For 200/250 v. A.C. Few only left. £21/19/6. **LASKY'S PRICE 21 gns.**
Including Tape, Crystal Hand Mike and Radio Jack.
Carr. & Insur., 12/6.

SPECIAL OFFER RECORDING TAPE

Famous make. P.V.C. base on latest type plastic spools. Brand new, perfect, boxed and guaranteed.

1,800ft. on 7in. spool.....	32/6
1,200ft. on 7in. spool.....	21/-
1,200ft. on 5 1/2 in. spool.....	22/6
850ft. on 5 1/2 in. spool.....	16/6

SCOTCH PLASTIC TAPE
1,200ft. on 7in. spool..... 25/-

GEVAERT L.P. PLASTIC
1,700ft. on 7in. spool..... 35/-
850ft. on 5in. spool..... 18/6
210ft. on 3in. spool..... 6/6

Post: 1 spool, 1/6
Orders over 60/- post free.
All other makes of tape in stock. Long Play, Double Play, and the American "MYLAR."

TRANSCRIPTION TURNTABLES

COLLARO 4-sp.d. type 4T200 with Studio transcription pick-up.

LIST £19/10/-
LASKY'S PRICE £16.19.6
Carr. paid.

In carrying case, 25/- extra.

GARRARD 301.....	£22 7 3
GARRARD 301 (Strobe).....	£23 18 4
GARRARD 4HF (Stereo).....	£19 4 8
GARRARD 4HF (G.C.8).....	£18 9 9
LENCO GL.56, stereo, bino fluid diamond ...	£23 17 0
PHILIPS.....	£10 10 0

BULK TAPE ERASER

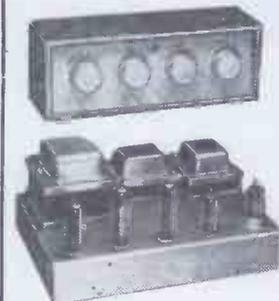
and Head Demagnetiser. Erases a complete reel of magnetic tape in few seconds. **27/6** Post free.

PLASTIC TAPE SPOOLS

3in.	5in.	5 1/2 in.	7in.	8 1/2 in.
2/9	3/3	3/6	3/6	5/6

7in. Metal Spools, 1/9 each.
Post extra.

"Klenza" Tape Kit..... 12/6
Metro Tabs 3/11



MAESTROVOX

10-12 watt HIGH FIDELITY AMPLIFIER AND PRE-AMPLIFIER

LIST 22 GNS.
LASKY'S PRICE £12.19.6

Carr. & Ins. 7/6

Built to latest Mullard circuit and complete with Mullard valves: two EL84 p.p., two EF86, one ECC83 and EZ81 rectifier. Main Amplifier chassis size 7 1/2 in. x 10 in., maximum height 5 in., gold hammer finish. Separate Pre-Amplifier in polished wood case, walnut veneered, with smart maple and gold escutcheon, size 10 1/2 in. x 3 1/2 in. x 4 in. Brand new and unused.

FINEST RANGE OF GRAM AMPLIFIERS IN GT. BRITAIN

We have the type you need. Come and see our range or write for special Amplifier List. Two examples:—

3-WATT GRAM AMPLIFIER
2 valve, ECL82 and EZ80 rectifier, double wound mains transformer 100-250 A.C., tone control, record equalisation switch. Size 7½ x 3½ in. max. height 4½ in. Controls mounted separately. **LASKY'S PRICE** complete with knobs. **55/-**
Post 3/6

MATCHED PAIR FOR STEREO..... 5 Gns. Post 5/-

2-WATT GRAM AMPLIFIER, uses UCL83, contact cooled rectifier. **LASKY'S PRICE** **35/-**
Post 2/6

"LINEAR" AMPLIFIERS

"DIATONIC" 10-14 watt **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.

MULLARD 5-10 KIT

All specified components and your choice of transformers and chokes by Partridge, Haddon, W/B, Ellison or Gilson.

COMPLETE KIT and printed circuit as low as **£9.9.0**
Details on request.

Printed Circuit separately 22/6.
Also available built ready for use. Price according to transformers.

BUILD THE 3-3 AMPLIFIER

Complete kit of parts with 3 Mullard valves EL84, EF86 and EZ81, **£6.19.6** Post free.

All components available separately.

CONVERT YOUR ALL-DRY PORTABLE RADIO TO MAINS 200-250 v.

with the **COSSOR BATTERY ELIMINATOR**. Two separate units identical in size to the B126 and AD35 batteries. 1.5 v. L.T., 90 v. H.T. Suitable for the latest low consumption valves, fully stabilised. New in original cartons. Listed at 63/-.
LASKY'S PRICE **37/6**
Post 1/6

BARGAINS IN 4-SPEED MIXER AUTO-CHANGERS



B.S.R. 4-spd. mixer Auto-Changer type UA8, complete with latest B.S.R. "ful-fi." **£6.19.6**
Carr. & Pkg. 5/-

Ditto, wired for Stereo and with Stereo cartridge, **£7/19/6**.

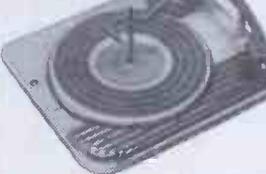


COLLARO. 4 speed. Complete with Studio crystal p.u. and sapphire stylus. **LIST £13/17/-**.

LASKY'S PRICE **£7.19.6**
Post 3/6

Wired for STEREO, complete with Stereo cartridge, **£8/19/6**.

B.S.R. Latest Type UA12



4-speed. Wired for STEREO, complete with stereo cartridge. **£8.19.6**
Post 5/-

GARRARD 4-SPEED MIXER AUTO-CHANGERS

Model 121. Mk. II..... **£10 10 0**
121, Mk. II STEREO... **£11 10 0**
121, Mk. II, with mono-aural and Stereo heads **£12 10 0**
RC.88..... **£12 19 6**
RC.88, STEREO..... **£13 19 6**
All the above Auto-Changers are new and unused in maker's cartons.

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THE FINEST COMPONENTS CATALOGUE

produced for the "ham" or service man. **OVER 100 PAGES, SIZE 8½ in. x 5½ in. COPIOUSLY ILLUSTRATED.**
Price **2/-** Post 6d.

Our latest 12-page "BARGAIN BULLETIN" free with each copy or available separately by post, price 6d.

SINGLE PLAYERS

Auto start and stop, complete with pick-up and crystal cartridge.

COLLARO 4/564, **£6/9/6.** Post 5/-.
GARRARD 4SP., **£6/9/6.** Post 5/-.

GARRARD TA Mark II, wired for stereo, plug-in head. **£8/9/-.** Post 5/-.

SINGLE STEREO PLAYER

E.M.I. 4-spd. wired for Stereo and fitted with Acos stereo t.o. cartridge. **£6.19.6** Post 5/-.

STEREO CARTRIDGES

ACOS type 73-1A turnover, list 52/6.
LASKY'S PRICE **29/6**
Post 1/-.
All makes and types in stock. Write for our bargain list.

PICK-UP CARTRIDGES

ACOS type HGP.59 or HGP.37 turnover crystal cartridge with L.P. and standard styli. List 39/7
LASKY'S PRICE **18/-** Post free.

COLLARO PICK-UP ARMS

Latest type counterbalanced Collaro Pick-Up Arm wired for STEREO and complete with Acos 73-1A stereo cartridge. Ideal for converting your Collaro Record Player to stereo.

LASKY'S PRICE **55/-**
Post 2/-.

Collaro **MONAURAL** Pick-Up complete with Studio 0 cartridge.

LASKY'S PRICE **32/6**
Post 2/6.

B.S.R. type TU9 4-speed Turntable and separate Pick-up. **90/-.** Post 3/6.

LASKY'S RADIO

BUILD A BATTERY TRANSISTOR RECORD PLAYER

FOR ONLY £5.9.6 plus 5/- post.

- ★ Push-pull 500 milliwatts output.
- ★ Smart carrying case, 11 x 8½ x 5 in.
- ★ Garrard Turntable and P.U. type BA1 (45 r.p.m.).
- ★ 4 Transistor Amplifier on Printed Circuit (ready built).
- ★ 7 x 4 in. 30 ohm loudspeaker.
- ★ Uses two 4½ v. AD.28 batteries.

8-VALVE 5-WAVE AM/FM CHASSIS

by Leading Maker

New and unused. Limited number only. Valve line-up: ECC85, ECH81, EF89, EAB80, ECC83 p.p. output, two EL84, EZ81 rectifier. Power pack and amplifier mounted on separate chassis. Covers low, medium, 2 short and VHF/FM bands. Pick-up and extension speaker sockets. Large edge-lit glass dial. Flywheel tuning. For 200-250 v. AC/DC mains.

LASKY'S PRICE **£17. 19. 6**
Carr. 5/-.

Available on Hire Purchase terms.

GRAM LID STAYS, pneumatic, adjustable and self closing. **9/11** pair. Post 1/6.

STANDARD JACK PLUGS, each **2/6**. Post 6d.

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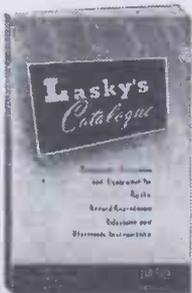
TRANSCRIPTION TURNTABLES
COLLARO, GARRARD, LENCO, CONNOISSEUR.

TAPE RECORDERS
GRUNDIG, ELIZABETHAN, BRENELL, TRUVOX, SOUND, VORTEXION, FERROGRAPH, FIDELITY, HARTING, KORTING, REFLECTOGRAPH, SIMON, STUZZI, TANDBERG, TELEFUNKEN, STELLA, WALTER.

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CABINETS
Wide choice including W/B PRELUDE, G-PLAN, NORDYK and CAPRIOL.

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LASKY'S RADIO

GREAT REDUCTIONS IN TRANSISTORS

P.N.P. Junction types. **AUDIO**, suitable for high gain and low freq. amplifiers, and for output stages up to 250 milliwatts. Double spot—yellow and green. Each **5/-**

R.F. suitable for medium and low freq. oscillators, freq. changers and I.F. amplifiers (1.5 to 8 Mc/s). Double spot—yellow and red. Each **7/6**

Type T81. Suitable for all audio applications. Each **3/6**

Special prices quoted for large quantities.

OC44 15/-; OC45 15/-; OC70 8/6; OC71 8/6; OC72 15/- (Matched Pair 30/-); OC73 14/-; OC16 54/-.

EDISWAN MAZDA TRANSISTORS. The very latest types. XB/102 10/-; XB/103 10/-; XC/101 12/6; XA/101 15/-; XA/102 17/6.

SPECIAL OFFER. Set of 7 Ediswan Transistors: XA/101, XA/102, 2 XB/102, XB/103, 2 matched XC/101. Price 79/6.

CRYSTAL DIODES. General Purpose GEX00, each 1/- . Per doz. 9/- . All other types in stock.

"GOLDTOP" POWER TRANSISTORS

All types in stock. Example:—V15/10P. Ideal for output stage of car radio, will give approx. 3 watts operating from 12 v. Each 15/- post free. Suitable Output Transformer for above, correct ratio, matched to 3 ohms, 9/6. Post 1/- . Driver Transformer, 9/6. Post 1/- .

RESISTORS. The largest stocks of all types, high stability, wire wound, carbon, vitreous enamel, miniature and submin. Millions in stock. Why buy unwanted assortments? We will send you the types and values you actually want.

SUB-MIN RESISTORS, 1/4 watt, most values available. Each 3 1/2d. Per doz. 2/6.

COSSOR 3-WATT AUDIO AMPLIFIER KIT 562K

Everything to build a high quality Amplifier for use with radio, gramophone or mike on 200/250 v. A.C. mains. Valve line-up: 6V4, 6BQ5, EF86. Kit comprises printed circuit, all new valves and components, 2 speakers (10 x 6 elliptical and 4in. treble), escutcheon, knobs, etc., with full assembly instructions, in makers' carton.

Listed at £9/5/-
LASKY'S PRICE **£5.19.6**
Post 2/6.

LASKY'S HIGHLY EFFICIENT EASY-TO-BUILD SETS : TUNERS : AMPLIFIERS

Circuit Diagram and Building Instructions, 1/6 each, post free.

7-TRANSISTOR PORTABLE, 250 milliwatts p.p. output. **NEW CIRCUIT**, medium and long wave.

COMPLETE PARCEL

£10/10/-
Post 3/6

NEW POCKET TRANSISTOR 8/HET RADIO. I.F. 470 K/cs. Medium waveband. Uses 4 transistors and 1 diode. Operates from PP4 9-volt battery.

£7/19/6
Post 3/6

4-TRANSISTOR AUDIO AMPLIFIER, Mk. II, 200/250 milliwatts, with 2 OC72 and 2 yellow/green. Size 5 1/2 x 2 x 1 1/2 in.

£3/19/6
Post 3/6

4-VALVE ALL-DRY SUPERHET PORTABLE. Medium and long wave. Mains/battery **£8/19/6**. Battery version

£7/7/-
Post 3/6

MIDGET T.R.F. for 200-250 v. A.C. mains. Uses two latest double-purpose valves. Plastic case, 8 1/2 x 4 1/2 x 5 in.

£4/19/6
Post 5/-

LASKY'S F.M. TUNER. Printed Circuit version of the G.E.C. 912 "F.M. Plus," using 5 valves.

£7/19/6
Post Free

LASKY'S CAR RADIO

CAN BE BUILT ABSOLUTELY COMPLETE

FOR £12.19.6



- ★ Small size. Will fit any car
- ★ 12 volt operation
- ★ New Hybrid circuit
- ★ Transistor output
- ★ New type Brimar valves
- ★ No Vibrator, 12 volt H.T. & L.T
- ★ T.C.C. Printed Circuit and Condensers
- ★ Tuned R.F. stage
- ★ Medium and long waves
- ★ Permeability tuning
- ★ 7in. x 4in. elliptical speaker.

Instruction Booklet giving full details, illustrations, dimensions, circuit diagram and shopping list, price 2/6 post free (returned if you order).

The "DIODEON"—a 2-stage medium wave receiver using crystal diode detector and transistor in cascade. Chassis shows pictorially all components and connections. Built in minutes! Complete parcel including two U16 batteries.

25/10 Post Free.

EARPHONES. High imp., 14/6. Low imp., 7/6. Post 1/6.

LASKY'S LATEST! TAPE RECORDER KITS!

Look at these star features:—

- ★ Very latest Printed Circuit
- ★ T.C.C. condensers
- ★ Amplifier can be supplied fully assembled and connected to Deck
- ★ New Mullard valves: EF86, ECC83, EL84, EM34, magic eye, EZ80 rect.
- ★ Choice of speaker: 7 x 4, 8 x 5, 9 x 4, 6 1/2 in., 8in., etc.
- ★ Collaro Studio or B.S.R. Monar-deck Tape Deck
- ★ Complete with Acos 39/1 Mike, Tape and Spool
- ★ Choice of Carrying cases.

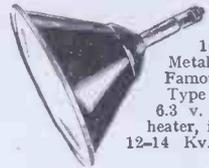
PRICES FROM

20 GNS. **25 GNS.**

(B.S.R. deck) (Collaro deck)
All components available separately
Full details and shopping list post free on request.

G.R. TUBE BARGAINS

NEW, UNUSED AND TAX FREE



16in. Metal Cone. Famous make. Type T001/B. 6.3 v. .3 amp. heater, ion trap, 12-14 Kv. E.H.T.

LASKY'S PRICE **£6.9.6**

Carr. and Insur. 21/-.

FERRANTI, 9in. type T9/3. 4 v. heater, triode, octal base, standard deflection. LIST 9 GNS.

LASKY'S PRICE **50/-**
Carr. & Insur., 12/6

FERRANTI, 13in., types T12/44 and T12/54.

LASKY'S PRICE **84/-**
Carr. & Insur., 12/6

FERRANTI 17in. type TR17/10, 6.3 v. .3 amp. heater. Brand new and unused.

LASKY'S PRICE **£7.19.6**
Carr. & Insur., 12/6.

17in. 90 degrees C.R. TUBES
Seconds but in perfect working order and guaranteed. Price on request.

RE-GUNNED C.R. TUBES GUARANTEED FOR 12 MONTHS

Type	Price	Carr. & Ins.
12in. round	£6 10 0	12/6
14in. rect.	£6 10 0	12/6
15in. round	£6 19 6	21/-
16in. round	£6 19 6	21/-
17in. rect.	£6 19 6	21/-
21in. rect.	£7 19 6	25/-

20,000 VALVES

Mullard, Brimar, G.E.C., Mazda, Cossor, E.M.I., Philips, Pinnacle, Telefunken, etc. Send for our New List of manufacturers' surplus, ex-Govt. and imported Valves at lowest prices.

5 milliamp METER RECTIFIERS. Special offer of limited number at only **8/6** Post 9d.

SPEAKER COVERINGS

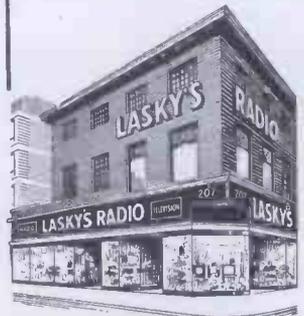
Large stocks of "Tygan" and "Someweave". Any size piece cut. Sample and prices post free.

SPECIAL OFFER OF SOLDER

1lb. reels of Erain 5-core "Savlit" SOLDER. List 15/- . LASKY'S PRICE **10/-** Post 1/6.

ALL TYPES OF CHASSIS

Leading makes including ARMSTRONG, DULCO, EMPRESS, etc.
A.M. chassis (1,2,3,4) from 7 GNS.
A.M./F.M. chassis from 14 GNS.
A.M./F.M. STEREO from 22 GNS.



OPEN ALL DAY SATURDAY

Early Closing Thurs., 1 p.m.

(Both addresses)

TWO ADDRESSES FOR PERSONAL SHOPPERS
207 EDGWARE ROAD, W.2

PADDington 3271/2. Few yards from Praed Street.

42 TOTTENHAM COURT ROAD, W.1

MUSEum 2605. Nearest Stn.: Goodge Street.

Please address Mail Orders to Lasky's Radio, Dept. W,
207 Edgware Road, London, W.2

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

RADIO CLEARANCE LTD.

27 TOTTENHAM COURT RD., LONDON W.1

Telephone:
MUSEUM 9188
EST. 30 YRS

TRADE
ENQUIRIES
INVITED

The oldest Component Specialists in the Trade

ELECTROLYTIC CONDENSERS—WE HOLD THE LARGEST STOCK OF ELECTROLYTICS IN ENGLAND.

ABBREVIATIONS: C. Clip mounting tag ends. P. Prong mounting. T. Tag ended. S. Sleeved. W. Wire ended.
PC. Printed Circuit. R. Reversible polarity. M. Moulded with wire ends.

SINGLES						Capacity (Mfds.)						Capacity (Mfds.)						Capacity (Mfds.)													
Capacity (Mfds.)	Wkg. Volts	Size	Type	Price		Capacity (Mfds.)	Wkg. Volts	Size	Type	Price		Capacity (Mfds.)	Wkg. Volts	Size	Type	Price		Capacity (Mfds.)	Wkg. Volts	Size	Type	Price									
1	275	1x11	W/S	1/-		64	350	1x3	O	2/6		12+28	275	1x2	P	1/6		100+200	250	1x4	C	2/6		100+200	275	1x4	C	5/-			
2	12	13/32x1	M	1/4		75	12	1x11	W/S	1/4		16+18	150	1x1	T/S	1/-		100+250	275	1x4	C	5/-		100+300	275	1x4	C	4/-			
2	275	1x11	W	1/-		80	450	1x3	W/S	2/6		16+18	275	1x2	P	2/-		100+400	275	2x4	C	4/-		150+30	360	1x4	O	5/-			
4	150	1x11	T/S	1/-		100	12	13/32x1	M	1/4		16+18	350	1x2	C/S	3/-															
4	250	1x11	W	1/-		100	12	1x11	T	1/-		16+18	450	1x2	W/S	4/-															
4	150	1x11	W/S	1/-		100	25	1x11	T/S	1/3		20+20	450	1x3	P	2/-															
6	250	1x11	WorW/S	1/3		100	25	1x11	W	1/3		20+20	275	1x2	P	2/-															
8	150	1x11	T	1/4		100	275	1x3	O	1/6		20+20	450	1x3	W	3/6															
8	200	1x11	W	1/-		100	275	1x3	P/S	2/-		20+20	350	1x2	P	2/6															
8	250	1x11	WorW/S	1/3		100	350	1x3	PC	3/-		20+20	150	1x1	W/S	1/6															
8	275	1x11	W	1/3		150	25	1x11	W	1/3		20+20	150	1x2	O	2/6															
8	350	1x2	P	1/6		150	150	1x3	W/S	1/-		20+20	150	1x2	W/S	1/-															
8	450	1x11	W/S	1/11		200	6	1x1	M	1/4		20+20	150	1x2	P	10d															
8	750	1x4	O	5/6		200	12	1x11	W	1/6		20+20	250	1x2	PC	1/6															
10	4	13/32x1	M	1/4		200	25	1x11	T	10d		20+20	275	1x2	O	2/6															
10	15	1x11	T/S/R	1/3		200	35	1x11	C/S	10d		20+20	32	275	1x2	O	2/6														
10	25	1x11	T/S	1/3		200	275	1x3	O	2/-		20+20	350	1x2	O/S	4/-															
10	200	1x11	W	1/3		250	8	1x2	C/S	10d		20+20	350	1x3	P/S	3/-															
10	450	1x2	W	1/9		250	12	1x11	W	1/-		20+20	450	1x3	W/S	4/-															
12	25	13/32x1	M/R	1/6		250	25	1x11	T	1/-		20+20	150	1x2	P	10d															
12	150	1x11	W	1/3		250	25	1x11	W	1/3		20+20	150	1x3	P	10d															
18	275	1x2	T	10d		250	50	1x2	C	1/6		20+20	275	1x2	C	1/6															
18	350	1x2	P	1/-		250	150	1x3	P	1/6		20+20	40	40	275	1x2	C	1/6													
20	6	1x11	W/S	1/-		400	8	1x2	P/R	8d		20+20	40	450	1x3	W	3/-														
20	12	13/32x1	M	1/4		500	6	1x1	T	10d		20+20	50	50	150	1x2	C	3/6													
20	100	1x1	T	10d		500	6	1x2	O	8d		20+20	50	50	200	1x3	P	1/-													
20	450	1x2	W/S	1/3		500	12	1x11	W	1/3		20+20	50	50	150	1x3	P	1/-													
25	25	13/32x1	M/R	1/6		500	12	1x11	T	1/3		20+20	50	50	275	1x2	P	1/9													
25	25	13/32x1	M	1/4		500	12	1x2	O	8d		20+20	50	50	275	1x3	O	1/6													
25	25	1x11	W	1/6		500	25	1x2	O	1/6		20+20	50	50	275	1x3	PC	1/9													
25	50	1x11	T	1/-		6000	6	1x2	O	3/-		20+20	60	60	300	1x2	O	2/6													
25	50	1x11	W	1/9		8000	6	1x3	C/S	3/6		20+20	50+200	275	1x2	C	4/6														
25	350	1x2	P	1/9		8000	6	1x3	C/S	3/6		20+20	60	60	275	1x3	P	2/6													
25	350	1x2	P	1/6		8000	6	1x3	C/S	4/-		20+20	60	60	350	1x4	O	5/6													
32	275	1x2	P	1/6								20+20	60+200	275	1x4	O	3/6														
40	150	1x2	W/S	6d								20+20	60+250	275	1x4	C	3/6														
40	350	1x2	P	1/9								20+20	80+300	275	1x4	C	3/6														
50	6	13/32x1	M	1/4		8+8	350	1x2	C	2/3		20+20	80+300	275	1x4	O	3/6														
50	12	13/32x1	M/R	1/6		8+8	450	1x2	W	2/9		20+20	100+65	250	1x3	P	2/-														
50	12	1x1	W	1/6		8+8	450	1x2	W/S	3/6		20+20	100+100	250	1x2	P	1/-														
50	25	1x1	W	1/6		8+16	450	1x1	W/S	3/6		20+20	100+100	250	1x2	P	1/9														
50	50	1x1	T	1/6		10+10	450	1x2	W/S	2/6		20+20	100+100	275	1x3	O	2/6														
60	275	1x3	W	1/9		12+12	275	1x2	P	6		20+20	100+100	300	1x3	P	3/-														
60	350	1x2	T/S	2/-		12+12	275	1x2	C	2/-		20+20	100+100	300	1x3	P	3/-														
64	275	1x3	P	1/6		12+24	275	1x2	C	1/6		20+20	100+200	25	1x2	P	1/-														

TRIPLES Etc.

8+8+8	350	1x2	P	4/-
16+8+4	275	1x2	P	2/6
16+16+4	275	1x2	C	2/6
16+16+16	275	1x2	O	2/9
20+15+15	450	1x3	P/S	3/6
20+20+20	250	1x3	F	1/-
25+25+25	25	1x2	C/S	1/-
30+30+30	275	1x2	P	2/6
32+8+8	275	1x2	P	2/-
32+16+25	200/275	1x2	P	1/-
32+32+2	275	1x2	C	2/-
32+32+6	275	1x2	C	2/6
32+32+8	250	1x2	C	3/-
32+32+25	275/25	1x3	C	2/-
32+32+32	350	1x2	C	4/-
32+32+50	275	1x4	C	3/6
32+32+70	275	1x4	C	3/6
40+30+20	150	1x3	P	1/-
40+40+12	275	1x2	C	3/6
40+40+20	275	1x2	P	3/-
40+40+20	800	1x2	P	3/-
40+40+32	275	1x2	PC	3/6
40+40+32	450	1x3	P	5/-
50+24+24	275	1x2	P	3/6
50+50+8	275	1x3	P	3/6
50+50+10	150	1x2	O	1/-
50+50+50	350	1x3	P	3/6
80+300+30	275	1x4	C	3/6
100+40+40	450/60	1x4	C	4/6
100+100+50	300	1x3	P	4/6
100+100+200	275	1x4	C	4/6
100+250+250	275	2x4	C	5/-
100+400+16	275	1x4	C	4/-
100+400+32	275	1x4	C	4/-
200+250+250	275	1x4	C	6/-
40+20+10+10	350	1x4	C	3/6

All voltages quoted are WORKING.

STAMPED AND ADDRESSED ENVELOPE with any enquiry please.

The "MIRACLE" Super 3's (All transistor circuit), as advertised in the March issue, Page 165, is still available.

MOULDED TROPICAL PAPER CONDENSERS

Small, non-inductive, insulated, high-grade Capacitors
 150 v. wkg. 15 Mfd. 5% 10d. .22 Mfd. 10% 9d. 1 Mfd. 10d.
 1/3. 2 Mfd. 1/9. 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. 8d. each. 5,200
 pF. 1/-. .022 Mfd., .03 Mfd. 10d. each. .047 Mfd. 2% .05
 Mfd. 11d. each. 1 Mfd. 11d. & 1/2. 2 Mfd. 5% 1/5. .05
 Mfd. 1/6. 5 Mfd. 1/3 & 1/9. 750 v. Wkg., 470 pF. 10% .820
 pF., 1,600 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.
 .3 Mfd. 1/4. .3 Mfd. 10% 1/5.

VALVE HOLDERS

4 pin Ux. 7d. 5 pin Brit. Fax. 2d. 7 pin Brit. Fax. 3d.
 7 pin Brit. Amp. 4d. Int. total Fax. 3d. Mazda Octa
 Fax. 3d. Loctis Amp. 6d. B7G Fax 6d. B7G P.T.F.E.
 8d. B7G Cer. with saddle and valve retaining spring 1/4.
 B8A Fax. 4d. B8A Amp. 6d. B8A Cer. 8d. B9A Fax. 6d.
 B9A Amp. 6d. B8A Cer. 10

HARVERSON SURPLUS CO LTD

Phone : THOrnton Heath 2577 48 BEDDINGTON LANE, CROYDON, SURREY. Phone : THOrnton Heath 2577

The world famous E.M.I. Angel Transcription P.U.

SPECIFICATION
Physical
 Length 15½ inches (40.32 cms.).
 Height 2½ inches (6.41 cms.).
 Width 2½ inches (6.03 cms.).
 Centre of base to stylus tip 12 inches (30.72 cms.). Approx. overall.
Stylus
 A diamond stylus is fitted to the 33½/45 r.p.m. head supplied.
Head Impedance
 1 ohm. (measured at 1,000 c.p.s.).
Frequency Response
 For a constant recorded velocity the frequency response is sensibly level within the following limits: with micro-groove stylus 20—16,500 c.p.s. With standard stylus 20—20,000 c.p.s.
Distortion
 Measured at 400 c.p.s., the total harmonic distortion is less than 5% for a recording level of +20 db referred to 1 cm./sec. r.m.s. transverse velocity.
Sensitivity
 50 mV at secondary of transformer provided from a recording level of +10 db referred to 1 cm./sec. r.m.s. velocity.
Weight at Stylus Point
 Variable from 3—10 grammes as required.



★ (MODEL 17A)

A PICKUP FOR THE CONNOISSEUR ORIGINALLY PRICED AT £17/10/-. WE CAN OFFER THE LAST REMAINING FEW AT

£5.10.0

PLUS P. & P. 5/-

★ WITH DIAMOND STYLUS



500 MICROAMMETER

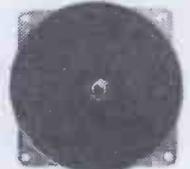
A 4½" Panel mounting 500 Microammeter marked in ohms and ideal for building into a multi-range meter.

PRICE **£2.10.0**
 Plus P. & P. 3/6.

PLESSEY TWEETER

This well-known Plessey 3 ohm Tweeter at our amazing price of ...

12/6 TAX PAID
 Plus P. & P. 1/6.



Another scoop to the first 20 customers, this wonderful cabinet at £12/12/-. P. & P. £1.



A few only left of the cabinet previously advertised at £18.10. P. & P. 25/-.

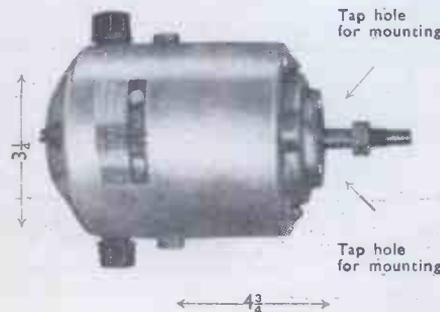
Dimensions: Length 40", width 16", depth 21" without legs.

SUPER SCOOP

A few only pick-up heads for the above Angel P.U.

DIAMOND STYLUS

Cost £8/15/-. Brand new. 78 or 33½-45 at **£2.0.0** P. & P. 1/6.



NOT GOVT. SURPLUS

½ H.P. 220-250 A.C. motor, ideal for lathe, coil winder, drill, saw motor, etc. Don't miss it. Dimensions: 6½ x 3½.

45/- P. & P. 2/3.

NEW and boxed	VALVES	90-day guarantee		
1R5	8/6 6L6G	10/6 EA50	1/6 EV51	12/6
1R6	8/6 6N7M	7/6 EABC80	10/6 E281	8/6
1T1	8/6 6Q7G	10/6 EB91	6/6 HABC90	12/6
2X2	2/6 6SA7M	10/6 EBC33	8/6 HVR2A	7/6
384	8/6 68J7M	10/6 ERC41	10/6 MUT4	10/6
3V4	8/6 68N7	8/6 EBF80	10/6 P61	8/6
5U4	8/6 6V6G	7/6 ECC84	12/6 PCC84	12/6
5Y3	8/6 6X4	7/6 ECF80	11/6 PCF80	11/6
5Z4	10/6 6X5	7/6 ECH42	10/6 PCF82	11/6
6AM6	8/6 12A6	8/6 ECL80	12/6 PCL52	11/6
6BE6	7/6 12AT7	10/6 ECL82	12/6 PEN25	8/6
6BE6	10/6 12AU7	9/6 EF39	7/6 PL82	10/6
6BW6	10/6 12AX7	9/6 EF41	10/6 PY80	8/6
6D6	7/6 12BA6	9/6 EF60	5/6 PY81	10/6
6FQ9	7/6 12BE6	9/6 EF80	10/6 FY82	8/6
6HG7	3/6 12K7	8/6 EP96	14/6 SP61	5/6
6J5M	8/6 12Q7	8/6 FP92	5/6 UB41	10/6
6J6	7/6 35L6	9/6 EL82	5/6 UCH42	10/6
6J7G	8/6 35Z4	9/6 EL41	10/6 UF41	10/6
6K6GT	8/6 80	10/6 EI84	10/6 UL41	10/6
6K7G	5/6 807	8/6 EZ40	8/6 UY41	8/6
6K9G	8/6 944	1/6 EZ80	8/6 U22	10/6



**HARVERSON
T.R.F. EASY
FOUR KIT**

All parts and theoretical wiring diagram.
OUR PRICE

£4.12.6

Plus P. & P. 4/-.

We have made a fortunate purchase of a small quantity of Taylor Meters. There are assorted types—Nos. 90, 90a, 70a and 75a. These are secondhand meters, but are mechanically perfect and fully guaranteed. We regret that we cannot supply leads, or meter No. to your order.

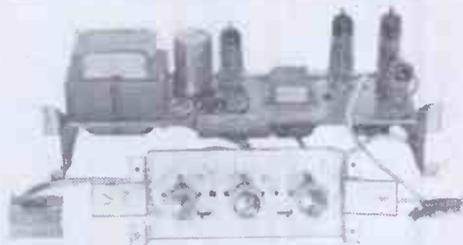
Get them while they last at **£6.0.0** P. & P. 6/-.

Also a few Signal Generators 65A or B at **£8.10.0** P. & P. 6/-.

**8 WATT Push Pull
MONAURAL AMPLIFIER**

By well-known manufacturer—employing four Mullard valves: ECC.83, 2 EL.84 and EZ.80. Bass, treble and volume on remote panel. Elegant knobs. **OUR PRICE**—Plus P. & P. 4/6. **£6.19.6**

Also a few Stereo left.



**LOUDSPEAKER
UNITS**

*All brand new. *Note special prices. *All permanent magnet 3 ohms impedance. Units by Plessey, Goodmans, Lectrona, etc.

	Each
2½ in. Celestion	18/-
2½ in. Rola C25	23/-
3 in. Celestion	17/6
5 in. Plessey	15/-
6½ in. Plessey	17/-
8 in. Goodmans	18/-
10 in. Elac, Plessey	22/-
6 in. x 4 in. Plessey	17/-
7 in. x 4 in. Goodmans	17/-
7 in. x 5 in. Goodmans	17/-
8 in. x 5 in. Goodmans	22/-
10 in. x 6 in. Plessey	22/-
12 in. RA. 10 watt	55/-

P. & P. 2/-.

**SNIPS
in
Mono Cartridges**

Studio P	17/6
Acos HiG	17/6
EV Power Point	12/6
Ronette	18/6
GC2	16/6

All Types Available.

A few only left of this cabinet. Product of a well known manufacturer. Don't miss this wonderful offer.

Length 40 in.
Width 17½ in.
Height 19½ in.

**OUR PRICE
£9.15.0**

Plus P. & P. £1.

6" x 4"
3 ohm Plessey Speaker
12/- Plus P. & P. 1/6.



**F.M.
TUNER
HEAD**

(as illustrated) uses ECC.85, less valve **14/6**

Plus P. & P. 4/6

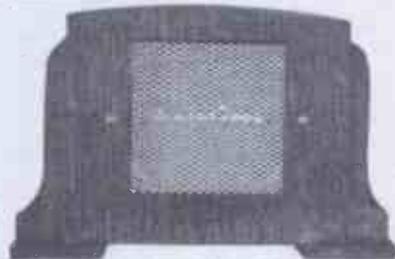
Valve 7/- Plus P. & P. 1/-.

Regret no Circuit

**THIS MONTH'S
BARGAIN**

Ex. Speaker, 5" Goodman unit. Cabinet 8" x 6" x 2". Complete, including lead. P. & P. 2/-.

22/6



We have a number of odd radiogram cabinets too numerous to catalogue. Send us your requirements.

**AMAZING
SCOOP**

Cossor 10 in. Tubes 108K. Brand New, boxed and guaranteed. Manufacturer's Surplus. Equiv. HMV3/16 **21/-** each Plus P. & P. 12/6.

NOTICE

WHY NOT VISIT OUR NEW SHOWROOM. LARGEST WALK AROUND IN LONDON. 1 min. South Wimbledon Tube.

**HARVERSON
83 HIGH ST., MERTON, SURREY.
COME AND SEE US.**

12 ASSORTED POTS. Wire wound and carbon. Switched and unswitched. All useful sizes at 18/- dozen. Plus P. & P. 1/6.

TAYLOR WINDSOR 240A PATTERN GENERATOR. Not New, but perfect. **£8/10/-** each. Plus P. & P. 4/-.

WIRE. Twin padded, grey, with maroon tracer Mains lead—usually 10d. per yd.—Our Price 15/- per 100 yd. coil. P. & P. 3/-.

NEW—The "CONTINENTAL—6" "For Style, Quality Performance and Value for Money"

COMBINED TRANSISTOR PORTABLE/CAR RADIO SUPERHET

SPECIFICATION

- ★ 195 to 560 metres on medium wave.
- ★ 1,150 and 1,800 metres on long wave.
- ★ 400 mW. push-pull output.
- ★ A.V.C. and Car radio. Standard Fitting.
- ★ Slow motion tuning.
- ★ HI-FI SPEAKER.
- ★ Double tuned IF's.
- ★ 6 months' battery life.
- ★ Resistor and Condenser leads pre-trimmed.
- ★ Printed circuit board marked with component numbers.
- ★ EDISWAN TRANSISTORS.
- ★ XA102, 2-XA101, XB103, 2-X3C101, 2-A102S.

TOTAL COST OF ALL SPECIFIED COMPONENTS INCLUDING CABINET, BATTERY, Etc., ONLY £11/10/-. P.P. 3/6.

All components available separately. Send for descriptive leaflet and prices.

A highly sensitive and selective portable fully tuneable on medium and long waves. Performs equally well as a car radio. Low running costs, good looks and ease of construction combine to produce a radio equal to any commercial receiver in the 20 gn. class.

★ Size 9½ x 7 x 3½.
★ Weight 4lb.



2-WATT POWER STAGE
For use with "Continental". Works from 12-volt supply. Overall size 4½ x 3½ x 2½in. All parts with Power transistor, less speaker, 52/6. P.P. 2/-.

TRANSISTOR "8"

STILL AVAILABLE AT £10-19-6 (p.p. 2/6).
FREE BOOKLET ON REQUEST

MAJOR—2

(2-Transistor Pocket Radio)



TOTAL 69/6
1/6

(NOTE. BEWARE OF IMITATIONS)

NEW BOOKLET FREE: All components sold separately
GOOD RECEPTION ANYWHERE!

- ★ 4-stage reflex.
- ★ Medium wave; tuneable.
- ★ Very sensitive
- ★ No aerial or earth
- ★ Complete layout
- ★ Over 6 months on one battery 4½ x 3 x 1½in.
- ★ Weight only 4 ozs.
- ★ Personal phone

MAJOR—3

(3-Transistor Radio)



(See "R.C." Sept., '59)
All parts sold separately).

TOTAL 87/6 P.P. 1/6

RESULTS GUARANTEED ANYWHERE
NEW BOOKLET FREE

- ★ 5-stage Reflex Circuit
- ★ No Aerial or Earth.
- ★ Min. Volume Control.
- ★ 3 Ediswan Transistors
- ★ Medium Wave Tuning.
- ★ Size 4½ x 3 x 1½in.
- ★ Personal phone.

MINOR—1

(1-Transistor Radio)



All components 49/6
P.P. 1/6

Free list on request

THE SMALLEST ON THE MARKET

- ★ 3-stage Reflex
- ★ Medium wave
- ★ Ferrite aerial
- ★ Size 3 x 2 x 1½in.
- ★ Includes personal phone
- ★ Layout diagrams

SQUARE WAVE GENERATOR.

2-Transistor, approx. 8 Kc/s
Output: 15 volt supply.
All Components 20/-, p.p. 1/-.

HEARING AID

3-Transistor: Size 3 x 2 x 2½in.
Includes Xtal Mic. and Earphone, Battery, etc. All Components, 89/6, pp. 1/-.

AUDIO GENERATOR

Ideal for Audio Tests or Morse Code Unit. All parts 25/-, p.p. 1/-.

MULTI-CHANNEL RADIO CONTROL RECEIVER

3-Transistor: Size 2 x 1½ x 1½ in. Weight 1 oz.: terrific performance. All components (less reed unit), 50/-, p.p. 1/-.

RF, IF, AUDIO SIGNAL TRACER

2-Transistor unit. Size 4½ x 3 x 1½in. Headphone output. 37/6, p.p. 1/6 or 32/6, p.p. 1/6 Less Phones.

RF, IF, OSCILLATOR

Harmonic Output 450 Kc/s. to 3 Mc/s or more. Ideal for Radio Testing, etc. All components, 25/-, p.p. 1/-.

"PRACTICAL TRANSISTOR CIRCUITS"

14 Circuits for the Home Constructor, including data, prices and information. 1st Edition, 2/- post free.

250mW POWER STAGE

2-Transistor Push-Pull Amplifier for use with Major 2 or 3 or Similar. All parts with 3-inch Speaker, etc. 59/6, p.p. 1/6.

XTAL OSCILLATOR

General purpose 3 to 12 Mc/s. Osc. Ideal for marker; Transmitter, etc. All parts less Xtal 22/6, p.p. 1/-.

TRANSISTOR PRE-AMP GENERAL PURPOSE PRE-AMP AND MIXER UNIT

All components including screened plugs and sockets, 3 controls, etc. 42/6, p.p. 1/-.

TRANSISTORS PRICES! DOWN!

FROM 5/- EACH
SHORT-WAVE, R.F. AUDIO AND POWER

SB078	20 Mc/s	6mW H.Freq.	10/-
SB305	25 Mc/s	10mW H.F.	15/-
SB231	30 Mc/s	10mW H.F.	22/6
SB231R	50 Mc/s	10mW H.F.	30/-
XB104	1 Mc/s	120mW Audio	10/-
XA104	6 Mc/s	90mW Osc	18/-
XC101	—	165mW Power pr.	32/-
XA103	4 Mc/s	90mW RF, IF	15/-
XC121	—	200mW Power	17/-
XC131	Matched pairs	only 500mW pr.	34/-
OC44	15 Mc/s	60mW Osc.	20/-
OC45	6 Mc/s	60mW RF, IF	18/-
OC71	600 kc/s	100mW Audio	10/-
Red Spot	800 kc/s	125mW Audio	5/-
White Spot	5 Mc/s	125 mW RF, IF	7/6
Photo Transistor	100mW		10/-
V15/10P	10-watt Power		15/-
OC170	70 Mc/s	70mW S. Wave	35/-

FREE DATA & COMPLETE LIST ON REQUEST. ALL GUARANTEED.

CRYSTAL MICROPHONE INSERTS

Acos and other well-known makes.	
lin. square BRAND NEW	7/6
1½in. square	7/6
1½in. round	7/6
1½in. round	8/6
1½in. round	14/-
2in.	12/6
3in. square, ex-units	3/6
ALL GUARANTEED P.P. 6d. any type.	

TRADE ENQUIRIES INVITED ON ALL ITEMS AND DO-IT-YOURSELF UNITS

FREE LISTS
BY RETURN

LARGE RANGE OF VALVES, TUBES, MAINS TRANSFORMERS, QUARTZ CRYSTALS, METERS, TEST UNITS, TRANSISTORS, MINIATURE COMPONENTS, RECTIFIERS, ETC.

ADDRESS



PIRANI HIGH VACUUM TEST EQUIPMENT



PIRANI CONTROL UNIT (1.2mA meter movement). (85/-, p.p. 5/-)

PIRANI DIFFERENTIAL LEAK DETECTOR. (45/-, p.p. 5/-)

PYE SCALAMP GALVANOMETER (Type 2000.) (£15, p.p. 5/-)

PIRANI GAUGE HEAD WITH CALIBRATOR

COMPLETE VACUUM TESTING EQUIPMENT (5 ITEMS AS SHOWN) NEW IN ORIGINAL CARTONS.

£25 - 0 - 0 p.p. 10/-

INCLUDING OPERATING INSTRUCTIONS

(SPARE PIRANI GAUGE HEADS, EDWARDS TYPE M6, LESS CALIBRATOR, 15/- EACH.)

SPECIAL PURPOSE VALVES AND INDICATORS

805 35/-	872A ... 15/-	OB2 ... 10/-	868 10/-	VCR97 ... 40/-
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FREE COMPLETE LIST ON REQUEST. BULK ORDER ENQUIRIES INVITED.

V.H.F. TRANS/RECEIVER TYPE 1986

- ★ 10-CHANNEL CRYSTAL CONTROLLED
- ★ 124.5 to 156 Mc/s NOMINAL COVERAGE
- ★ 9.72 Mc/s IF., 23 Kc/s BANDWIDTH

ONLY £7/19/6

Carriage 10/6.

COMPLETE UNIT WITH 21 VALVES, 24-VOLT POWER UNIT (BUILT-IN) IN METAL CASE: INCLUDES CIRCUIT DIAGRAM AND CONTROL BOX: GOOD NEW CONDITION—LIMITED

A.C., D.C., R.F. METERS

0-6 v.	2 1/2 in.	M.C. (DC) P.	10/-
0-12 v.	2 1/2 in.	M.C. (DC) P.	10/-
0-15 v.	2 1/2 in.	M.I. (AC) F.R.	8/6
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0-300 v.	5 in.	M.I. (AC) P.	50/-
0-1 1/2 kv.	2 1/2 in.	M.C. (DC) P.	15/-
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0-400 UA	3 1/2 in.	M.C. (DC) F.R.	59/6
2 1/2-0-24 mA.	2 1/2 in.	M.C. (DC) F.R.	12/6
0-100 mA.	2 in.	M.C. (DC) F.S.	10/-
0-500 mA.	2 1/2 in.	M.C. (DC) F.R.	12/6
0-750 mA.	2 in.	T.C. (RF) P.	6/-
0-1 amp.	2 in.	T.C. (RF) P.	6/-
0-3 amp.	2 in.	T.C. (RF) F.S.	6/-
0-12 amp.	2 1/2 in.	T.C. (RF) P.	10/-
0-20 amp.	2 in.	M.C. (DC) P.	7/6
0-10 amp.	4 in.	M.C. (DC) P.	25/-

Combined 30-0-30 volt, 3-0-3 volt, 5-0-5 mA basic movement only 12/6.

FREE COMPLETE LIST ON REQUEST

QUARTZ CRYSTALS

FROM 5/- EACH

From 6 Kc/s-47 Mc/s. FT243, FT241, 10XJ and B7G. All types for all purposes. Send for free list.



POCKET MULTI-TESTERS BRAND NEW



MODEL A-10 (500 Micro-amp. Movement). D.C. (2k per volt) 0/10/50/250/500/1,000 v. A.C. (2k per volt) 0/10/50/250/500/1,000 v. D.C. current 0/0.5/25/250 mA. Resistance: 0/10K/1 Meg. Size: 5 1/2 x 3 3/8 x 1 1/2 in. Weight: 17 ozs. Price £4/17/6. P.P. 1/6 inclusive of Test Prods, Instruction Book and Batteries.

MODEL B-20 (100 Micro-amp Movement) D.C. (10,000 ohms per volt) 0/0.5/2.5 volts. D.C. (4,000 ohms per volt) 0/10/50/250/500/1,000 v. A.C. (4,000 ohms per volt) 0/10/50/250/500/1,000 v. D.C. Current, 0/0.1/2.5/25/250 mA. Size: 5 1/2 x 3 3/8 x 2 1/2 in. Weight 24 ozs. Price £6/10/- P.P. 1/6 inclusive of Test Prods, Instruction Book and Batteries.

VALVE VOLTMETER

Type 165-A

D.C. ELECTRONIC VOLTMETER.

6-Ranges. 0-3-10-30-100-300 and 1,000 volts. Input res: 11-meg. constant on all ranges. Sensitivity: 3,666,666 ohms per volt on 3 v. scale.

A.C. VOLTMETER.

5-Ranges: 0-10-30-100-300-1,000 volts. Sensitivity: 1,000 ohms per volt.

ELECTRONIC OHMMETER.

6-Ranges, from 0.1 ohms to 1,000 megohms. Movement. 200 microamperes. D.C. accuracy ±2%.

COMPLETE WITH INSTRUCTION BOOK AND TEST PRODS, BRAND NEW.

Input 110-250 volts A.C.

ONLY £12/10/0 P.P. 3/6

SPECIAL PURCHASE - LIMITED STOCKS



CRYSTAL MICROPHONES

- Acos 39-1 Stick Mic. (with Stand) 39/6, P.P. 1/6
- Acos 40 Desk Mic. 25/-, P.P. 1/6

8-IN. RCA SPEAKER

Complete in Black Crackle Case. 3 ohms Speaker. 45/- P.P. 2/6.

MARCONI No. 19 SET CRYSTAL CALIBRATOR

CRYSTAL CONTROLLED OSCILLATORS: 10 Kc/s., 100 Kc/s. and 1 Mc/s. On/Off MODULATOR. With handbook. Unused. ONLY 79/6. P.P. 2/6.

TRANSMITTER/RECEIVER

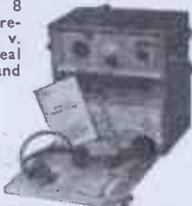
Army Type 17 Mk. II

Complete with Valves, High Resistance Headphones, Handmic and Instruction Book and circuit. Frequency range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles. Power requirements: Standard 120 v. H.T. and 2 v. L.T. Ideal for Civil Defence and communications.

BRAND NEW

45/- P.P. 5/-

44-61 Mc/s. Calibrated Wavemeter for same. 10/- extra. P.P. 2/-.



Calby also 124.

Assembled in Hong Kong.

2000 ohms per v. DC

See p. 145

R.S.C. HI-FI TAPE RECORDER KIT

Build a high quality recorder in the £70 class for only

25½ GNS. Carr. 17/6.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTION, THE LINEAR LT45X HIGH QUALITY TAPE AMPLIFIER, A HIGH FLUX 7 x 4in. LOUDSPEAKER, Reel of Best Quality TAPE. Spare Tape Spool, a Portable Cabinet, size approx. 18 x 13 x 9in., finished in veneered walnut or two-tone revine, and connection diagram for wiring amplifier to transcription.

FEATURES INCLUDE

★ 3 SPEEDS. ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZATION 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.

OR DEPOSIT 3 GNS. and 12 monthly payments of 45/9. Cash price if settled in 3 months.



HI-FI 10 WATT AMPLIFIERS

BRAND NEW BUT IN SLIGHTLY SOILED CONDITION **£5-19-9** 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 15 ohm loudspeaker. Guaranteed, tested, and in perfect working order.

VALVES! Full range at really competitive prices. All guaranteed!

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (especially 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 A.C. 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.

SPECIAL OFFER OF BEST QUALITY RECORDING TAPE. P.V.C. based. On plastic spools. By leading manufacturers. Brand new. 3in. 150ft. 5/11, 5in. 600ft. 15/11, 7in. L.P. 1,700ft. 35/-, 3in. 225ft. L.P. 7/9, 5in. 850ft. L.P. 22/6. EMPTY PLASTIC SPOOLS, 3in. 2/9, 5in. 2/11, 7in. 3/9.

ACOS HI-FI CRYSTAL 'MIKES'

Mic 40 hand or Desk type
29/9 (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 5½ x 4½ x 2½ 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 x 5½ x 2½ 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.



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, 6P61, 6P6 and is especially

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 £4/10/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

EXTENSION SPEAKERS. Handsome bakelite cabinets in pastel colours. All standard 2-3 ohms. 6in. 29/9; 8in. 35/9.

GOVERNOR V.H.F. P.M. RADIO RECEIVER KITS. Brand New Boxed with valves, printed circuit and 10 x 6in. Speaker. For 200-250 v. A.C. mains. Pre-aligned I.F.T.s. Normal price 15 Gns. Our price £8/19/6.

R.S.C. A12 STEREO AMPLIFIER KIT

£3-19-6

Carr. and packing 7/6.

A complete kit of parts to construct a good quality 3 + 3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. 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.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts, 15 ohms (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.

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	H.T. Types H.W.
2/6 v. 1 a. h.w. 1/9	120 v. 40 mA. 3/9
6/12 v. 1 a. h.w. 2/9	250 v. 50 mA. 3/11
Following F.W. (Bridge)	250 v. 60 mA. 4/11
6/12 v. 2 a. 3/11	250 v. 80 mA. 6/11
6/12 v. 3 a. 6/11	250 v. 250 mA. 12/9
6/12 v. 3 a. 9/9	Contact Cooled
6/12 v. 4 a. 12/3	250 v. 50 mA. 6/11
6/12 v. 5 a. 14/6	250 v. 75 mA. 8/11
6/12 v. 6 a. 15/6	F.W. (Bridge)
6/12 v. 10 a. 25/9	
6/12 v. 15 a. 35/9	

JACK PLUGS. Standard type complete with 4ft. screened lead. 1/11 each.

JUNCTION TRANSISTORS. R.F. Type, 11/6. Audio type, 6/9. Power type Goltop V15/10P 2 watts, 17/9. OC71, 10/-, OC72 17/-. XB102 10/-, XB104 10/-, XA101, XA102, OC44 17/6, and many other types.

BATTERY CHARGING EQUIPMENT

Trade supplied. Discounts according to quantity.

All for A.C. Mains 200-250 v. 50 c/s. Guaranteed 12 months

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.	39/9
6/12 v. 4 a.	56/9

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. 1½ a.	12/9
0-9-15 v. 2½ 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

TANNOY RE-ENTRANT LOUDSPEAKERS. 8 watt
7.5 ohms 19/6
Or a pair for 35/-

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.	42/9
(inclusive of ammeter)	
6 v. or 12 v. 4 amps.	53/9
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. 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.

VIBRATORS. Oak and Wearingite, synchronous 7-pin, 2 v. 7/6. 6v. 8/3. 12 v. 4-pin non-synchronous 7/9.
2 v. 16 A.H. EX. GOVT. ACCUMULATORS. New Boxed. Only 5/6 each, 3 for 15/-, plus 3/6 carr.

EX. GOVT. MAINS TRANSFORMERS

All 200-250 v. 50 c/s input.
Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v. 7 a., 5 v. 3 a. 23/9
250 v. 60 mA., 6.3 v. 2 a. 11/9
300-0-300 v. 60 mA., 6.3 v. 2 a. 11/9
265-0-265 v. 150 mA., 6.3 v. 11 a., 5 v. 3 a., 5 v. 3 a. 29/11
350-0-350 v. 100 mA., 6.3 v. 2 a., 5 v. 2 a. 18/9
0-24-26-28 v. 15 amps. A.C. conservative Govt. rating (marked with D.C. rating after rectification) 69/9. Carr. 15/-
0-10-20-25 v. 24 a. (Govt. rating) 79/6. Carr. 15/-
AUTO 500 watts 0-219-229-226-230-233-240 v. 29/9 Carr. 7/6. 50 watts, 0-110/120-230/250 v. 8/11

D.C. SUPPLY KITS. Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s.; 12 v. 1 amp. selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, charge direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number, 33/9.

EX. GOVT. SMOOTHING CHOKES
200 mA., 3-5 H., 50 ohms. Parmeko 8/9; 100 mA., 5 H., 100 ohms 3/11; 150 mA., 10 H., 50 ohms 9/9; 80 mA., 20 H., 900 ohms 5/9; 120 mA., 12 H., 100 ohms 8/9; 50 mA., 50 H., 1,000 ohms 6/9; 100 mA., 10 H., 100 ohms 6/9; 100 mA., 5-10 H., 250 ohms 2/11.

EX GOVT. CASES. Well ventilated, black crackle finished, undrilled cover. Size 14 x 10 x 4in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE. COVER SHOULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post.

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 ohm 2½ in. Perdio 21/9. 5in. Goodmans 17/9. 7 x 4in. R.A. Elliptical 18/9. 6½ in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 25/9. 8 x 6in. Elac with high flux magnet 25/9. 10in. R.A. 25/9. 10 x 6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. R.A. 3 or 16 ohms, 10 watts, 12,000 lines. 59/6.

TWEETERS. 4in. Plessey, 3 ohms, 18/9. R.A. 15 ohm 25/9.

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC83, 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 OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "Lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate such inputs 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/-
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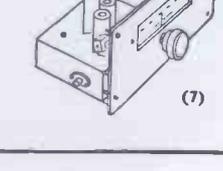
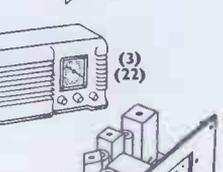
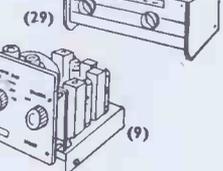
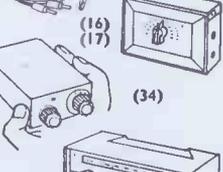
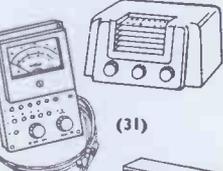
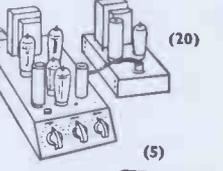
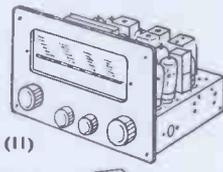
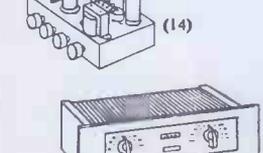
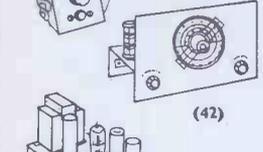
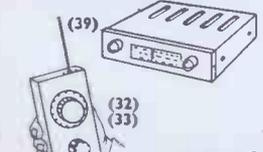
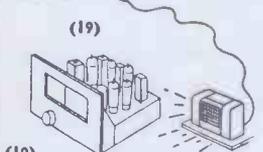
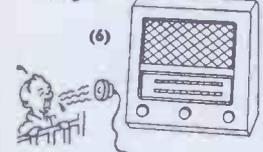
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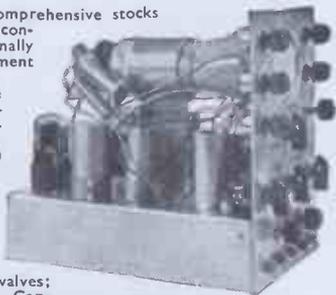
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B.S.R. TU9. 4-speed single-record unit with separate light weight pick-up fitted with T.C.8H. crystal insert and sapphire styli. An ideal unit for a small portable gramophone. Brand new and fully guaranteed. **SPECIAL PRICE: 75/- plus 2/6 P. & P.** or motor and turntable only at 52/6, plus 2/6 P. & P. or Pick-up only at 27/6, plus 1/6 P. & P. **E.M.I. 4-SPEED STEREO SINGLE RECORD UNIT.** Complete with Stereo Head and Sapphire Styli. Brand New and Fully Guaranteed. **ONLY £6/19/6 plus 3/6 P. & P.**

GARRARD RC120/4H. 4-speed auto-changer with GC2 insert. Brand new, fully guaranteed. £8/19/6. P. & P. 3/6. **GARRARD RC.121D MK. II STEREO MONAURAL 4-SPEED AUTO-CHANGER.** Complete with GC8 plug-in Crystal Head and Sapphire Styli for monaural records. Finished in cream. Brand new, fully guaranteed. Limited stocks. **ONLY £11/0/6, plus 5/- P. & P.** NOTE: Garrard L.P. Stereo plug-in head for above available as optional extra for £2/0/11 inc. P.T.

B.S.R. UA8 MONARCH 4-speed Mixer Autochanger complete with turnover crystal insert and Sapphire Styli. Few only, now at £6/19/6, plus 3/6 P. & P. Brand new and fully guaranteed.

THE LATEST COLLARO "CONQUEST" 4-speed autochanger in cream with Studio "O" insert. Brand new, fully guaranteed. £7/19/6, plus P. & P. 3/6.

COLLARO "CONQUEST" STEREO/MONAURAL. Latest type—full guarantee. Brand new. £8/19/6, plus 3/6 P. & P.

DECCA PORTABLE AMPLIFIER. As supplied in famous DECCAMATIC III. Complete with small cream knobs. Full range tone and volume controls. Employs ECL82 valve. Size 3 x 3 1/2 x 8 1/2in. Only 59/6, plus 2/6 P. & P. **SPECIAL CELESTION** 8 x 6in. elliptical high flux loudspeaker 30/-, plus 1/- P. & P. to fit.

VERY ATTRACTIVE PORTABLE CABINET in two-tone rexine covering for accommodating the above items and ancillary equipment. 75/-, plus 5/- P. & P. Note. If the above three items are purchased together they will be supplied at the special inclusive price of £7/2/6, plus 6/6 P. & P.

LATEST COLLARO STUDIO TAPE TRANSPORT. 3 motors, 3-speed: 1 1/2, 3 1/2, 7 1/2 i.p.s., takes 7in. spools. Push-button controls, £15/15/-, plus 5/- P. & P. Usual H.P. facilities.

LATEST B.S.R. "MONAR-DECK." Single speed Tape Deck. Takes 5 1/2in. Spools—3 1/2 i.p.s. At £9/19/6 only, plus 5/- P. & P.

A COMPACT TEST METER FOR HOME CONSTRUCTION. This is a very sensitive multi-range test meter (500 microamp basic movement) covering the following ranges: A.C./D.C. voltage: 0-10 v., 0-50 v. and 0-500 v. Current: D.C. 0-10 mA., 0-50 mA. and 0-500 mA. Resistance (on internal battery) 2K.ohm to 100K.ohm. Housed in a smart grey stove enamelled case measuring 3 1/2in. x 7in. x 1 1/2in. overall. Brand new best quality components and High Stability resistors are used throughout, resulting in a thoroughly reliable, accurate instrument. NOTE: Meter is supplied with calibrated scale fitted, and all components, including shunt, are prepared for immediate soldering into position. Comprehensive assembly instructions with practical and theoretical diagrams are supplied together with all necessary components at a SPECIAL INCLUSIVE PRICE OF ONLY 59/6, plus 1/6 P. & P. The instruction envelope is available separately if required at 1/6 post free.

PRECISION TEST METER (To build yourself)

Nineteen ranges D.C./A.C. Current and resistance. Designed and produced for us by the famous Pullin Company. All necessary components at Special Inclusive Price of only £5/19/6, plus 2/6 P. & P. Illustrated leaflet with full description available on request.

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 each. Fully detailed and illustrated leaflet available on request.

ALFA POCKET TESTMETER

A most versatile test meter covering 15 ranges. 3,333 o.p.v. basic movement. Ohms ranges: 0-20K, 0-2 Meg. Volts: A.C. and D.C. 6 v., 12 v., 60 v., 300 v., 1,200 v. Current: D.C. 300 microamps, 30 mA., 300 mA. Size only 3 1/2in. x 5in. x 1 1/2in., overall. Supplied complete with instructions and test prods. **ONLY £5/19/6, plus 2/6 P. & P.**

CLYNE RADIO LTD.



162 Holloway Road, London, N.7.
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18 Tottenham Court Road, London, W.1

SEE OVER FOR MORE BARGAINS →

METERS. We carry large stocks of Meters from 25 microamps to 1,500 v. A few of the most popular types are: 25 microamps 2 1/2 in. Flush Round, 65/-; 100 microamps 2 1/2 in. Flush Round Moving Coil at 45/-; 500 microamps 2 in. Flush Round Moving Coil at 18/6; 1 mA. 2 in. Flush Square Moving Coil "Elliott" 1954 manf., 25/-; 50 mA. 2 in. Flush Square Moving Coil 8/6; 1 mA. 2 1/2 in. Flush Round 35/- Send stamp for complete list. We shall be pleased to quote for special meters to your own specification.

SPEAKER BARGAINS

Goodmans Bin. x 2 1/2 in., 3 ohms, 24/- plus 1/6 P. & P. 10 in. Elac High Flux 3 ohm, 39/6 plus 2/6 P. & P. 8 in. Celestion High Flux 3 ohm, 32/6 plus 2/- P. & P. 4 in. Plessey Tweeter, 15/- plus 1/6 P. & P. R. & A. Type 9120, Mk. II, 12 in., 10-12 watts, 3 ohm, 12,000 gauss, 55/- plus 3/6 P. & P. R. & A. Type 8120, Mk. II, 12 in., 10-12 watts, 3 ohm, 10,000 gauss, 39/6 plus 3/6 P. & P. 12 in. Bakers Selhurst, 15 ohms, 15 watts, 30-14,000 c.p.s., 44/10/- plus 3/6 P. & P. All the above brand new and fully guaranteed.

Special! Special! Latest E.M.I. full frequency speaker. Size 13 1/2 in. x 8 1/2 in., 3 ohm speech coil. Double cone. Unrepeatable at 39/6 each only. Plus 3/6 P. & P.

AERIAL TUNING UNIT

ZA0841. This well made ex-W.D unit contains a host of useful components including: 1 mA. 2 in. flush round MJC meter, 1 mA. Westinghouse full-wave meter rectifier, 5-pole 5-way heavy-duty silver plated wavechange switch, 3 in. dia. silver plated rotary tuning indicator, 350 pF tuning condenser with insulated coupler and 3 1/2 in. calibrated dial (0-180 deg.), etc., etc. Contained in strong metal carrying case 9 in. x 9 in. x 8 in. with hinged lid. ONLY 27/6 plus 5/- C. & P.

No. 38 AFV WALKIE-TALKIE
A wonderful offer. This famous transceiver unit, with relay operated SEND/RECEIVE switch, covering 7.4-9 Mc/s band, range approx. 5 miles. Good condition. ONLY 22/6 plus 2/6 P. & P. per unit (less accessories). Quantity Export inquiries welcomed.

"ROLEX" SPECIAL HEAVY DUTY MAINS/BATTERY AMPLIFIER. Very smart unit housed in grey crackle finish case with chrome and cream fittings. For use on A.C. mains 200/250 v. or 6 v. D.C. battery. Valve line-up: 6SK7, 6SN7, 6SL7, 2-6V6, 6X5 and 629C vibrator. 20 watts output to match 4, 8, 16, 250 and 500 ohm speaker systems. Ideal for P.A. work, etc. Size: 13 1/2 in. x 8 1/2 in. x 7 1/2 in. Mike and gram inputs with separate gain controls, tone control. Brand new, fully guaranteed. ONLY 15/15/-, plus 7/6 P. & P.

DLRS BALANCED ARMA-TURE HEADPHONES. Complete with headband and leads, 7/6 pair, plus 1/6 P. & P.

HIGH IMPEDANCE LIGHT-WEIGHT HEADPHONES. Brand new imported type 4,000 ohms. Complete with leads, 15/- plus 1/6 P. & P.

AMPLIYOX HEADSET SPECIAL (not surplus). As used in up-to-date ships, aircraft, etc. Excellent quality super lightweight low impedance magnetic headphones complete with button microphone attached and plastic ear moulds. Absolutely brand new. 45/- pair. Plus 1/6 P. & P.

PNEUMATIC LID STAY with pressure adjuster. Heavy duty 10/- complete. P. & P. 1/6.

VALVES. We have perhaps the most up-to-date valve stocks in the trade. New imported valve types fully guaranteed and P.T. paid and all the usual surplus types at special prices. We also carry a comprehensive stock of all B.V.A. types at current list prices. Send stamp for NEW list now available. Note: Certain American special purpose types can be supplied. Enquiries invited.
RE-GUNNED CATHODE RAY TUBES. (As new.) Guaranteed 12 months. 12 in., 14 in., and 15 in., 45/10/-; 17 in., 46; 21 in., 47/19/6; plus 10/- c. and p.

EXTRA SPECIAL OFFER!!

A small three-valve **PORTABLE RECORD-PLAYER AMPLIFIER** mounted on baffle 12 x 7 in., with High Flux 6 in. 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, 45/12/6 plus 3/6 P. & P.
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 13 1/2 x 8 1/2 in. Fitted with carrying handle, 43/9/6 plus 5/- P. & P.
NOTE. If both items purchased together they will be supplied at a special inclusive price of 48/7/6 plus 6/6 P. & P.



ADVANCE ANNOUNCEMENT!!
TWO NEW COMPETITIVELY PRICED TAPE RECORDER KITS
NOW READY!!

Both 3 watts output, printed circuit construction, valve line-up EF86, EL84, ECC83, EZ80 and EM84 recording indicator. Latest 9 in. x 4 in. High Flux Speaker. Complete with Tape and empty Spool, and Acos 39-1 stick mike with stand. Attractive two-tone Cabinet. Supplied with latest COLLARO Studio 3-speed deck. Total price 25 guineas. Supplied with B.S.R. single-speed deck, total 20 guineas. N.B. These amplifier kits are supplied with basic components already mounted on the printed circuit board. Full assembly instructions are included. Please add 7/6 for packing and carriage. All parts available separately. Full details on application.

A SUPERB TABLEGRAM CABINET! (Limited stocks only.)

This beautiful cabinet, finished in highly polished dark walnut with gold piping, will accommodate any 4-speed single record unit, amplifier and 7 in. x 4 in. elliptical loudspeaker. (The motor-board is supplied cut for the Garrard 4SP player, but is easily modified for the Collaro Junior, B.S.R. TU9, etc.). Overall dimensions are: 15 1/2 in. wide x 13 in. x 7 1/2 in. high. Clearance above motor-board (inc. lid) 3 1/2 in. Clearance below motor-board 3 1/2 in. This is a most attractive proposition for anyone who requires small but good quality equipment. Priced at ONLY 45/-, plus 6/6. (Do not miss this outstanding bargain!!!)

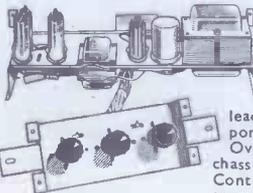


ALLAN DOUGLAS ELECTRONIC ORGAN

Readers will no doubt be pleased to know that our working model of this amazing organ for home construction, may now be heard and seen, at our Hi-Fi Showroom in Tottenham Court Road, W.1. For the benefit of constructors all components, keyboards, chokes, etc., are available ready made. Full constructional details are available in book form at 15/- plus 1/6 p. and p. We shall be happy to forward a complete price list on receipt of a stamp. Please address all organ enquiries for the attention of Mr. L. Roche.

A SPECIAL HIGH QUALITY PUSH-PULL AMPLIFIER
By famous manufacturer

Limited stocks only of this really wonderful quality amplifier employing 4 valves: 2-EL84, ECC83, EZ80. Separate Bass and Treble Controls mounted with Volume control upon loose panel with flying leads. Excellent quality components employed throughout. Overall dimensions: (Main chassis) 12 1/2 in. x 4 in. x 5 in. high. Control panel: 6 in. x 2 1/2 in. Input to match standard high impedance Output approx. 8 watts max. WHILST STOCKS-LAST ONLY 46/19/6, plus 3/6 P. & P. STEREO VERSION—same appearance and valve line-up, only 47/9/6 plus P. & P.



— TRANSISTORS !!! —
SURPLUS—P.N.P.
RED SPOT (Audio/Experimental: Application) 5/- ea.
WHITE SPOT, R.F. up to 2.5 Mc/s 7/6 ea.
STANDARD—
BRIMAR
TS8 18/6 ea.
MULLARD
OC16 Power 3 watt 54/- ea.
OC44 18/6 ea.
OC45 R.F. up to 6 Mc/s 18/6 ea.
OC70 10/- ea.
OC71 10/- ea.
OC72 14/6 ea.
OC72 matched pair 27/- pr.
OC73 12/6 ea.
OC77 18/6 ea.

NEWMARKET
V6/2R R.F. up to 4 Mc/s 19/6 ea.
V6/4R R.F. 4-8 Mc/s 23/- ea.
V6/8R R.F. up to 8 Mc/s 26/- ea.
Audio
V10/15A 12/- ea.
V15/10P (Power) 15/- ea.
MAZDA
XA104 R.F. up to 6 Mc/s 18/- ea.
XA103 R.F. up to 4 Mc/s 15/- ea.
XB104 Audio up to 1 Mc/s 10/- ea.
Attractive discounts for bulk purchases. The above is a selection only. Let us have your enquiries. (ALL POST FREE)

★ BARGAIN CORNER ★

ACOS MIC 39-1. Crystal stick microphone. List price 5 gns. Our price 39/6 plus 1/6 P. & P.
MIC40. General purpose crystal microphone with desk stand. Our price 25/- only plus 1/6 P. & P.
SPECIAL PURCHASE from MINISTRY No. 17 Mk. II TRANSMITTER/RECEIVER.



Built into strong wooden cabinet 15 in. x 14 in. x 9 in. Complete with headphones and microphone. Range 5-8 miles with simple aerial.
Frequency coverage 44-61 Mc/s. (5-7 metres). Uses standard 120 v. H.T. and 2-volt L.T. batteries. In used condition only, at the ridiculous price of 30/- complete, plus 6/6 P. & P. (Batteries not supplied).
ANOTHER PORTABLE CABINET BARGAIN! Ex-leading manufacturer's battery portable, attache type case. Attractive two-tone grey rexine finish. Size closed 13 1/2 in. x 9 1/2 in. x 3 1/2 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.

TRANSFORMER SPECIAL. Supplied quality half shrouded drop thro' Mains Transformer. Input 200/250 v. Output 350-0-350 v. 80 mA.; 6.3 v. 3 amps. 5 v. 2 amps. Ex-equipment but guaranteed O.K. ONLY 9/6 plus 1/- P. & P.
Bin. LOUSPEAKER. Ex-equip. as new. Less transformer. 3 ohm speech coil. In attractive cloth covered cabinet. Ideal for extension speaker. 22/6 plus 1/6 P. & P. Speaker only, less cabinet at 13/6 plus 1/6 P. & P.

BAR GAIN! REPLACEMENT PICK-UP INSERTS. All brand new and fully guaranteed. Complete with Sapphire Styli. **FONOFUID** 21/- each. **B.S.R. Hi-G** with bracket, 18/- each. **E. V. POWER POINT** in Garrard plug-in shell, 118/6 each. **GARRARD GC2** 16/- each. All plus 9d. P. & P.

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SAMSON'S SURPLUS STORES LTD.

LONDON'S GREATEST DEALERS IN RADIO AND ELECTRONIC EQUIPMENT

HEAVY DUTY L.T. TRANSFORMERS

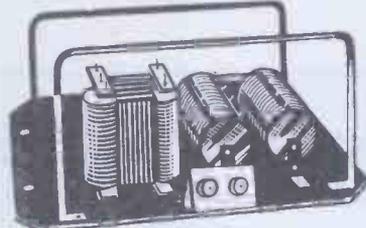
All ratings tropical and in perfect condition.

- No. 1. Pri. 210-230 v. Sec. 10 v. C.T. 5 A. and 5 v. C.T. 10A. Admiralty rating. 27/6, carr. 3/6.
- No. 2. Pri. 230 v. Sec. tapped 4, 6, 11 v. 200 amps. £8/10/-, carr. 7/6.
- No. 3. Pri. 200-250 v. Sec. 50 v. 30 A. £6/10/-, carr. 7/6.
- No. 4. Pri. 200-240 v. Sec. 50 v. 20 A. £4/10/-, carr. 7/6.
- No. 5. Pri. 200-250 v. Sec. tapped 28, 29, 30, 31 v. 21 A. £4/17/6, carr. 7/6.
- No. 6. Pri. 100-250 v. Sec. two separate windings tapped 15, 16, 17 v. 4 A. 35/-, carr. 4/-.
- No. 7. Pri. 220-240 v. Sec. three separate windings 6.5 v. 50 A., 6 v. C.T. 15 A., 6 v. C.T. 2.5 A. £4/19/6, carr. 7/6.
- No. 8. Pri. 220-240 v. Sec. 6.3 v. 15 A. 25/-, p.p. 3/6.
- No. 9. Pri. 220-240 v. Sec. four separate windings 3 x 5 v. C.T. 4 A., 4 v. 4 A., potted type. 32/6, p.p. 3/6.
- No. 10. Pri. 220-240 v. Sec. three separate windings 3 x 6.3 v. C.T. 4 A., potted type. 29/6, p.p. 3/6.
- No. 11. Pri. 115-230 v. Sec. 5 v. 15 A. 15KV. insulation. 37/6, carr. 5/-.
- No. 12. Pri. 220-240 v. Sec. 45 v. 2 A. 17/6, carr. 3/6.
- No. 13. Pri. 200-240 v. Sec. 12 v. 40 A. Built in strong metal case with carrying handle. 52/6, carr. 4/-.
- No. 14. Pri. 200-240 v. Sec. tapped 9-15 v. 4 A. 22/6, p.p. 2/6.
- No. 15. Pri. 220-240 v. Sec. tapped 10, 17, 18 v. 10 A. 52/6, carr. 4/-.

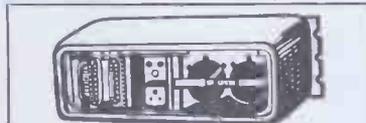


WESTINGHOUSE L.T. SUPPLY UNITS

Type No. 139. A.C. input. 200-250 volts. D.C. output, 36 volts, 18 amps. Continuous Rating at 50 deg. C. Fitted with Input and Output Fuses and Mains On/Off Switch. Size of cabinet. 26 x 19 x 14 inches. £17/10/- Ex Warehouse.



G.E.C. L.T. SUPPLY UNIT. Type O.S. 1773. A.C. input 200-240 v., D.C. output 24 v. 15 amps. Built in metal case 20in. x 15½in. x 10in. Brand new in makers cases. £13/10/- Ex Warehouse.



L.T. SUPPLY UNIT No. 19 YA 8087. A.C. input 100-250 v. D.C. output tapped 12/24 volts, continuous tropical rating, 3 amps. Built-in metal case 17 x 7 x 7 inches, with fuses and switch. An ideal L.T. supply unit for operating relays, contactors, battery charging, etc. In perfect condition £3/17/6. Carr. 7/6.

BRAND NEW AMERICAN SEALED RELAYS

9000 ohms	1CO	1M	15/-
7500 "	1CO	1M	12/6
7000 "	1CO	1M	10/6
5500 "	2CO	Octal base	15/-
270 "	1M	1B	7/6
270 "	2CO		8/6

BRITISH 3000-TYPE RELAYS

6000 ohms	4M	2B	12/6
6000 "	2M	2B	10/6
1000 "	2CO		8/6
250 "	3M	4B	10/6
100 "	3M		8/6
2000 "	1B		6/6
200 "	1M	1B	7/6

BRITISH 600-TYPE RELAYS

750 ohms	1M	5/6
600 "	2CO	5/6
150 "	1CO	5/6

P.p. on all above types 1/6.
All relays guaranteed and checked before despatch.

NUTS, BOLTS, WASHERS. Special bargain offer 5/- carton of 2, 4, 6 B.A. nuts, bolts and washers. P.P. 1/-. **SLEEVEING**, mixed bundle, 1¼-4 mil., various colours. Wonderful offer. 2/6. P.P. 9d.

HEAVY DUTY SLIDING RESISTORS

- (1) 26 ohms 6.5 A., double-tube slider control. 45/-, p.p. 3/6.
- (2) 73 ohms 1-3 A., completely enclosed single-tube slider control. 35/-, p.p. 3/6.
- (3) 120 ohms 1.75-0.9 A., completely enclosed single-tube slider control. 32/6, p.p. 3/6.
- (4) 1.25 ohms 25 A., double-tube slider control. 27/6, p.p. 3/6.
- (5) 0.4 ohms 25 A., geared drive control. 17/6, p.p. 2/6.
- (6) 3 ohms 10 A. 12/6, p.p. 2/6.
- (7) 1.2 ohms 15 A. 10/6, p.p. 2/6.
- (8) 1 ohm 12 A. 8/6, p.p. 2/6.
- (9) 11 ohms 4.5 A. 12/6, p.p. 2/6.

Above four types single tube slider control.

HEAVY DUTY FIXED RESISTORS

- 5.3 ohms 8 A. 10/-, p.p. 2/6.
- 605 ohms 2.8-0.4 A. 10/-, p.p. 2/6.

S.T.C. FIELD TELEPHONES



Type YA7783. Buzzer calling, operates from 4½ v. battery. A self-contained unit which can be easily held in one hand. Ideal for Aerial Riggers, Building sites, farms, workshops, etc. Size 9½in. x 2½in. x 2½in. Supplied brand new, complete with 4½ v. battery. £5/10/- per pair. P.P. 3/6.

TELE "F" FIELD TELEPHONES

Ideal for factories, building sites, farms etc., complete with batteries, bells, magneto and packed in individual carrying case, £7/10/- per pair. Carr. 10/-

BRAND NEW TELEPHONE CABLE

Twin D.8, one-mile drums £7/10/-. Carr. 15/-.
Twin D.3, 500-yd. drums, 35/- Carr. 7/6.
Single D.3, one-mile drums, 85/- Carr. 7/6.
also 1/3rd-mile drums, 27/6. Carr. 5/-.
Commando Assault Cable, P.V.C. covered, 1,000-yd., drums, 8/11, carr. 4/-. Cartons of five drums, 42/6. Carr. 7/6.

SPECIAL OFFER OF COLVERN PRECISION POTENTIOMETERS

- 3 gang 2½in. dia. 500+500+500 ohms. 1000+200+200 ohms. 2000+500+500 ohms. Above types 22/6. P.P. 2/6.



2 gang 2½in. dia.

- 500+500 ohms. 1000+500 ohms. 50K+8200 ohms. 40K+40K ohms. Above types 17/6. P.P. 2/6.

Single gang 4½in. dia. 40K ohms. 15/- P.P. 2/-.

A.M. ACCUMULATORS.

2 volt 75 A.H. at 100-hr. rate. Size 6½ x 6½ x 4in., with carrying handle. New 15/- P.P. 3/6. 4 volt 18.5 A.H. at 12-hr. rate. Size 7 x 4½ x 3½in. New, 8/6. P.P. 3/6. Miniature 2 volt 3 A.H. Size 4 x 1½ x 1½in. Ideal for models, bell circuits, parking lights, etc. Supplied new with charging instructions, 2/6 ea. P.P. 1/6. Three for 6/- P.P. 2/- Six for 10/6. P.P. 3/-. Or twelve in strong wooden crate, connected to give 24 volts 3 A.H. Size 12 x 7 x 4½in., 19/6. Carr. 5/-.

MICA, SILVER MICA, TUBULAR CONDENSERS. Good selection of values. 10/- per carton of 50. P.P. 1/-.



HOOVER BLOWERS

220-240 v. A.C. with twin outlets and air filter. 300 W. Dia. of Motor 7in. Depth 6½in. Brand new. £5/10/-, carr. 5/-.

OIL FILLED HEAVY DUTY L.T. TRANSFORMERS. Pri. 380.400.420 v. Sec. 19 v. 150 amps., single phase. Weight 141 lbs. Supplied dry. Price £10. Carr. 15/-.

ADMIRALTY THREE-PHASE TRANSFORMERS. Pri. 400-440 v. 50 cycles. Sec. 50 v. 6 amps. Completely tropicalised. Size 7½ x 14 x 5ins. weight approx. 60 lbs. Brand new in makers cases. Price 85/-, Carr. 7/6.

HEAVY DUTY AUTO TRANSFORMERS

Tropically rated at 5 KVA. Tapped 250.240.230.220.120.115.110.105 v. Completely enclosed in metal case. Size 23 x 14 x 11ins. Weight approx. 2 cwt. Brand new. Price £15 ex-warehouse.

HEAVY DUTY OHMITE RHEOSTATS.

2 ohms, 7 a., 15/-; 15 ohms, 2.24 a., 12/6; 25 ohms, 0.75 a., 5/6; 350 ohms, 25 watt, 3/6; 1,280 ohms, 0.14 a., 6/6; 25 ohms, 2 a., 15/-; 58 ohms, 0.6 a., 8/6. P.P. on all rheostats, 2/-.

BLOCK CAPACITORS.

T.C.C. Visconol, 8 mfd., 600 v. wkg. at 71 degrees C, 7/6. T.C.C. 4 mfd., 250 v. wkg. at 160 degrees F, 3/6. T.C.C. 0.5 mfd., 2,000 v. wkg. at 71 degrees C, 3/6. Dubilier Nitrogol, 8 mfd., 750 v. wkg. at 71 degrees C, 8/6. Dubilier, 4 mfd., 800 v. wkg., 4/6. Dubilier 2 mfd., 800 v. wkg., 3/6. G.E.C. Pyranol, 10 mfd., 300 v. D.C. Tropical tubular, 3½in. x 2in., 5/6.

AMERICAN CAPACITORS.

10 mfd., 600 v. wkg., tropical, 8/6. 8 mfd., 1,000 v. wkg., tropical, 8/6. Sprague, 2 mfd., 1,500 v. wkg., 5/6. 15 mfd., 1,500 v. wkg., tropical, 15/- P.P. on all types 2/- All capacitors brand new and guaranteed.

4/1

DEPOSIT

Balance at 2/11 a week for 19 weeks

A beautifully styled cabinet, made by a famous manufacturer. Grey polka dot cloth, with clipped lid and carrying handle. Size 16 x 14½ x 8½in. Uses a B.S.R. Monarch U.A.8 player and 6½in. round or 8 x 5in. elliptical speaker. P. & P. and Ins. 4/6. Cash Price 59/6.



RP2

P.L.10 CABINET

39'6

Size 14½ x 12½ x 6in. Takes B.S.R. T.U.9. 4-speed record player unit. 8 x 3in. elliptical speaker. Single control amplifier. Carr. & Ins. 4/6.



PL10

4/7

DEPOSIT

Balance at 3/5 per week for 19 weeks.

A delightful looking cabinet in two tone leatherette. Size 14½ x 17½ x 8½in. Will take B.S.R. Monarch 4-speed auto-changer and 6½in. round speaker. Post Packing and Ins. 4/6. Cash Price 69/9.



RP3

TAPE RECORDER CABINETS 19/6

Suitable for the Truvox Tape Recording Deck. Less front cast speaker panel. Size 13½ x 15 x 8½in. deep. Detachable lid with compartment for spare tape. Covered in green washable plastic material. P. & P. 4/6.



CONTEMPORARY EXTENSION SPEAKER CABINET

ONLY 19'9

Ideal for that extra stereophonic speaker. Covered in smart two tone leatherette colour scheme. Takes an 8in. P.M. Speaker. Size 10½ x 6½ x 15½in. P. & P. 3/9.

DE-LUXE TAPE RECORDER CABINET 29/9 ONLY

Beautifully made Tape Recording Cabinet. Size: 14in. x 11in. x 8½in. Covered in two tone coloured rexine cloth. Stylish design. Carrying handle and detachable lid with lock and key. Easily adapted to Record Player Cabinet. Exceptional value at this very low price. P. & P. 4/6.



NO DEPOSIT — INTEREST FREE — 20 or 36 WEEKS TO PAY! SEND FOR A FREE CATALOGUE—FULL DETAILS ON GOODS AND EASY PAYMENTS

STEREO RECORD PLAYER CABINET WITH EXTENSION SPEAKER CABINET

at the amazing offer of:-

99'6

Portable 1960 show model in two tone colours. Extension speaker cabinet secured in lid (arrow indicates position when fixed). Size 18in. x 14in. x 8½in. high. This stereophonic player complete retails at 35 gns. in the shops today. Ins. & Carr. (with order) 5/6. or initial payment, plus Ins. & Carr. of 6/1 and 19 weekly payments of 4/11.



B.S.R. MONARCH U.A.8. 4-SPEED AUTOCHANGER

£6.19.6

or **Terms**



4-speed auto changer. Incorporating auto and manual control complete with turn-over crystal P.U. and Sapphire stylus. A.C. P. & Ins. 5/6 or initial payment 8/1, plus P. & Ins., and 19 weekly payments of 6/11. T.U.9 B.S.R. 4-speed single player £4/9/6. Collaro Conquest 4-speed Autochanger £8/19/6. Collaro Conquest Stereo Autochanger 11 gns. P. & P. on all the above 5/6.

EXTENSION SPEAKERS 19'9

Polished oak cabinet of attractive appearance. Fitted with 8in. P.M. speaker W.B. or Goodmans of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Ins. & Carr. 3/9.

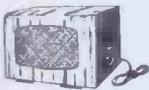
8in. P.M. Speaker 8/9. Std. 2-5 ohms. With O.P. Trans. 10/- P. & P. 2/6.

Elliptical Speaker 19/6. 7in. x 4in.

Elliptical Speaker 22/6. 9½in. x 4½in.

B.S.R. Ful-Fi Crystal Turnover Cartridges. 19/6.

Brand new, including sapphire needles for L.P. and Standard, giving fullest range and finest tone obtainable for any player. Can be fitted to all standard pick-up arms. P. & P. 9d.



AMPLIFIERS

12 MONTHS GUARANTEE ALL PORTABLE AMPLIFIER MK. D.1. 59/6



Brand New. Latest design with printed circuit. Dimensions 7 x 2½ x 5in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

AMPLIFIER MK. D.2. 79/6

Printed circuit. Latest design. Dimensions 7 x 2½ x 5in. A.C. only. Mains isolated. 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve, giving higher undistorted output. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

3 TRANSISTOR AMPLIFIER 79/6

9 volts. 1 control. P. & P. 3/6.

AMPLIFIER MK. D.3. 89/6

De luxe model. Printed circuit. Latest design. Dimensions 7 x 2½ x 5in. A.C. only. Mains isolated. 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume, treble and base control. Knobs 3/6 extra. P. & P. 3/6.

AMPLIFIER MK. D.5. 39/6

Simple circuit employing ELC80 triode pentode output valve giving 2-3 watts output. A.C. only. Mains isolated. Single control for volume and on/off switch with knobs. P. & P. 3/6.

A LARGE SELECTION ASSORTED TYPES AND SIZES PLAYER CABINETS from 19/6.

All rexine covered in modern two-tone colours. Your enquiries invited. Please let us have your requirements.

DUKE & CO. (Dept. C.4.) 621/3, Romford Road, Manor Park, E.12. Tel: ILF 6001/3

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.) **£10.00**

Alternatively we supply ASSEMBLED AND TESTED.... **£11.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

MULLARD'S

PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EP86 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**

Alternatively we supply 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

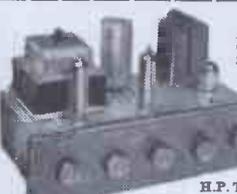
A VERY HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.

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.

COMPLETE STEREO AMPLIFIER

A thoroughly recommended design that very effectively meets the many requests for a low priced but good quality DUAL CHANNEL STEREO PHONIC AMPLIFIER.

Price: COMPLETE KIT OF PARTS **£8.10.0**

Alternatively ASSEMBLED AND TESTED **£10.10.0**

Two Mullard ECL82 Triode Pentode Valves are incorporated in the design, they form a "CLASS A" single ended output stage in each channel. The input sensitivity is 300 mvolts, therefore when used with most STEREO Crystal Pick-ups, or Radio Tuning Units, an output of 2 watts per channel is achieved, or similarly when switched to MONAURAL Pick-up position a combined output of 4 watts is produced.



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 6V4 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 Resine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-stage (plus Rectifier) AMPLIFIER **£4 2 6**

(b) The PORTABLE CARRYING CASE **£3 17 6**

(c) 12in. P.M. SPEAKER..... **18 9** (Carriage and Insurance 4/- extra.)



"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY GOODMANS - WHARFDALE

W.B. STENTORIAN

ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

!! 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 Base 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-amplifiers, 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.



SPECIAL PRICE REDUCTIONS

(c) The COMPLETE KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-Stage Pre-Amplifier Control Unit. **£15.15.0**

(d) 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.

(e) The COMPLETE KIT OF PARTS to build the Dual Channel "3-3" Amplifier and the Dual Channel Pre-Amplifier Control Unit. **£21.10.0**

(f) 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 £1/18/8.

(g) 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**

(h) 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 £1/18/8.

(i) COMPLETE KIT OF PARTS to build Two "5-10" Main Amplifiers (incorporating Parmeko Output Transformer) and the Dual Channel Pre-Amplifier Control Unit. **£31.0.0**

(j) Two "5-10" Amplifiers (Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit both Assembled 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.

STEREO

3-3 MAIN AMPLIFIER

Comprises two "3-3" MAIN AMPLIFIERS on one chassis and is designed to operate with our DUAL CHANNEL PRE-AMPLIFIER for both STEREO PHONIC or MONAURAL operation.

Price: COMPLETE KIT OF PARTS **£10.0.0**

Alternatively ASSEMBLED AND TESTED. **£11.15.0**

H.P. Terms: Deposit £2/7/-, 12 months at 17/4. Its output power is 6 watts (3 watts per channel) and together with our PRE-AMPLIFIER provides a first-class STEREO installation.



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 STEREO PHONIC or 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 mV.



Price: COMPLETE KIT OF PARTS **£12.10.0**

Alternatively ASSEMBLED AND TESTED **£15.0.0**

H.P. Terms: £3 Deposit and 12 months of £12/-. Perfectly suitable for MONAURAL only operation, with one "3-3" or one "5-10" MAIN Amplifier to which the second Main Amplifier can at any time be added thus very easily providing for both STEREO or MONAURAL reproduction.

Recommended combination for STEREO operation:

(a) The DUAL CHANNEL PRE-AMPLIFIER together with the Dual "3-3" MAIN AMPLIFIER.

(b) The DUAL CHANNEL PRE-AMPLIFIER together with two "5-10" MAIN AMPLIFIERS. Assembly Manual is available for 3/- or send S.A.E. for Descriptive Leaflet. When ordering please advise MAKE and MODEL OF AMPLIFIER in use.

!! 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 latest COLLARO "CONTINENTAL" 4-speed MIXER Autochanger, Studio "C" Pick-up. **£8.10.0**



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. **£6.15.0**

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 RC121/4 4-speed Autochanger fitted with latest Crystal Pick-up. **£10. 0.0**

The latest GARRARD TRANSCRIPTION MOTOR "301" with Stroboscopically marked turntable. **£23.18.4**

The new GARRARD Model SHE 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 8/- extra.

DEPT. W. 109 FLEET ST.,

STERN RADIO LTD.

LONDON, E.C.4

Telephone: FLEET STREET 5812/3/4

Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required, alternatively the COMPLETE ASSEMBLY MANUALS containing component Price Lists and practical Drawings, etc., are available at 1/6 each.

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
H.P. Terms: Deposit £8/4/- and 12 months of £3/0/2. **£41.0.0**
- MODEL CR3/T. Incorporates the very popular 3-speed COLLARO Mk. IV "TRANSCRIBER" Deck, which has both upper and lower tape tracks
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7. **£49.10.0**
- MODEL TR3/Mk. VI. Incorporates the New TRUVOX Mk. VI TWIN TRACK 2-speed Tape Deck
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7. **£49.10.0**

and NOW — WE INTRODUCE

- THE MODEL HF/G2P TAPE PREAMPLIFIER
- THE MODEL HF/G2A TAPE AMPLIFIER

Designed to our usual High Technical Standard, being based on the very successful Mullard Tape Designs. They incorporate MULLARD VALVES and only HIGH-GRADE COMPONENTS... AS A RESULT WE PRESENT TWO UNITS METICULOUSLY MATCHED TO CORRECTLY OPERATE

THE NEW GARRARD "MAGAZINE" TAPE DECK

Both Units form an entirely new "Easy to handle" presentation, each is completely self contained with power supply, Loudspeaker (Amplifier HF/G2A only), and all INPUT and OUTPUT sockets being incorporated on the chassis, which itself is constructed to allow for direct attachment to the tape deck (as shown in illustration). Thus the tape deck with the Amplifier (or Preamplifier) fixed to it form ONE COMPLETELY SELF-CONTAINED WORKING UNIT which requires only screwing into a Cabinet and Connecting to the Mains supply.

- Model HF/G2A Amplifier
- A Complete Tape Amplifier—Incorporating...
 - Magic Eye Level Indicator.
 - Volume Control.
 - Superimpose Switch.
 - Effective Tone Control.
 - Monitoring Facilities.
 - Extension Loudspeaker Socket.
 - Inputs for recording from Mike, Gram, and Radio Tuner.
 - Incorporates Loudspeaker and Power Supply on Chassis.

- Model HF/G2P Preamplifier
- Forms the Ideal "Link" to add High Quality Tape Recording facilities to existing Audio Installations, such as our MULLARD RANGE of Amplifiers, and also Admirably suitable to operate through the Pick-up sockets of most Radio Receivers.
 - It incorporates:
 - Magic Eye Level Indicator and Control.
 - Superimpose Switch.
 - Inputs for recording from Mike, Gram, and Radio Tuner. Power Supply on Chassis.

As is usual with GARRARD products this Tape Deck is a Precision Engineered Unit of Excellent quality operating two tracks at 3 1/2 in./sec. speed. It is the "Easiest to Handle" Tape Deck, having only two controls and incorporates the new instantaneous Tape loading Magazine which makes tape loading as simple as putting on a Record.

The EQUIPMENT and DESCRIPTIVE LEAFLETS will be available early in April.

WE OFFER AS FOLLOWS:

- (a) MODEL HF/G2R PORTABLE TAPE RECORDER. Includes spool of L.P. tape and crystal microphone. H.P. TERMS: Deposit £8/12/-, 12 monthly payments £2/8/5. **£33.0.0**
- (b) MODEL HF/G2A/D, comprising AMPLIFIER and TAPE DECK. Includes spool of L.P. tape and loudspeaker. H.P. TERMS: Deposit £5/10/-, 12 monthly payments £2/0/4. **£27.10.0**
- (c) ASSEMBLED and TESTED AMPLIFIER MODEL HF/G2A H.P. TERMS: Deposit £2/18/-, 12 monthly payments £1/1/3. **£14.10.0**
- (d) MODEL HF/G2FP PORTABLE PREAMPLIFIER. Complete in portable case (like HF/G2R). H.P. TERMS: Deposit £2/6, 12 monthly payments £1/18/2. **£30.0.0**
- (e) MODEL HF/G2P-D comprising PREAMPLIFIER and TAPE DECK. Includes spool of L.P. tape. H.P. TERMS: Deposit £5/4/-, 12 monthly payments £1/18/2. **£26.0.0**
- (f) ASSEMBLED and TESTED PREAMPLIFIER MODEL HF/G2P. H.P. TERMS: Deposit £2/12/-, 12 monthly payments 19/1. **£13.0.0**

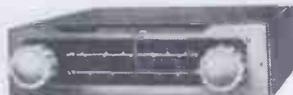
!! RADIOGRAM CHASSIS !!

- ARMSTRONG MODEL A F 298 Complete AM/FM chassis. Separate Bass and Treble controls. **£23.2.0**
- ARMSTRONG "STEREO TWELVE" The most complete A.M./F.M. stereo chassis yet produced. **£37.16.0**
- ARMSTRONG "JUBILEE" An AM/FM chassis with nine valves and with push-pull output stage providing 6 watts. **£29.8.0**
- ARMSTRONG AM/FM "STEREO 44" Provision is made for Stereo and Monaural playback from pick-up or tape. **£28.7.0**

RADIO TUNING UNITS

- The JASON "MERCURY" Switched F.M. TUNER. PRICE ASSEMBLED AND TESTED **£13.10.0**
 - DULCI Model FMT12 A complete self-powered FM Tuner incorporating automatic frequency control. **£24.13.4**
 - ARMSTRONG "S.T.3." AM/FM Tuning Units A self-powered tuner covering VHF, medium and long wavebands with automatic frequency control on VHF. **£27.6.0**
 - DULCI "H4/T" AM/FM Tuning Units A 4-waveband self-powered tuner covering the FM transmissions plus the long, medium and short wavebands. **£25.15.2**
- NEW HIRE PURCHASE TERMS are available on all above. Illustrated leaflets available—send S.A.E. (Carr. and Ins. 5/- extra.)

STERN'S 12 VOLT CAR RADIO incorporating PRINTED CIRCUIT and POWER TRANSISTOR



A versatile design covering both LONG and MEDIUM WAVEBANDS, incorporating Transistor Output thus having very low battery consumption. Is operated direct off 12 volt car battery.

We offer it on the UNIT ASSEMBLY BASIS... consisting of...

THREE SEPARATE FULLY WIRED, ALIGNED AND TESTED UNITS ALL FOR **£15.0.0**

Only 12 solder joints are required to finish the complete receiver.

Send 1/6 for manual containing complete data.

THE "ADD-A-DECK"

incorporating the NEW B.S.R. "MONARDECK" and MATCHED PREAMPLIFIER

Deposit £3/12/-, 12 months £17.17.0 (Plus 7/6 carr. and Ins.)

Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER through which first-class results are obtained. It consists of a single speed Twin Track Tape Deck, incorporating matched Preamplifier, and operates at 3 1/2 in./sec. speed. It uses Sin. Tape Spools, thus providing up to 1 1/2 hours' playing time on L.P. Tapes or 1 hour on the standard 6 in. Tape Spools.

The equipment is supplied fully tested and completely assembled on an attractive wood plinth. It can therefore be "dropped" directly into an existing cabinet and only requires connections to the mains supply and the Pick-up Sockets, for which purposes "floating" leads are incorporated on the Preamplifier.

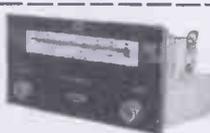


STERN'S MK. II "fidelity" F.M. TUNING UNIT

(Plus 5/- carr and ins)

HIRE PURCHASE: Deposit PRICE **£14.5.0**

£2/17/- and 12 months at £1/0/11. Incorporates the latest MULLARD PERMEABILITY TUNING HEART and the corresponding MULLARD VALVE LINE UP comprising ECC85, 2 type EF85s (or EF89s), EM84, Tuning Indicator, plus 2 type O.A. 79s Germanium Diodes. A really first-class Tuner very attractively presented and comparable to many offered at much higher prices. Power consumption is only 1.5 amps. at 6.3 volts and 25 m.a. at 250 volts.



! HOME CONSTRUCTORS !

YOU CAN BUILD THIS TUNING UNIT FOR ONLY **£10.10.0** (Plus 5/- carr. and Ins.)

Please send S.A.E. for fully descriptive leaflet, or the Assembly Manual is available for 1/6.

Stern's "fidelity" TAPE EQUIPMENT

THE FINEST RANGE OF TAPE EQUIPMENT FOR THE HOME CONSTRUCTOR

A SELECTION OF HIGH FIDELITY PORTABLE TAPE PRE-AMPLIFIERS

Adds "Hi-Fi" Tape Recording to your existing Audio Installation.

IN ALL MODELS WE INCORPORATE THE

TYPE "C" PRE-AMPLIFIER



- and offer it complete in portable case with
- (a) The new "COLLARO" STUDIO 3 speed Deck. Deposit: £7/6/-, 12 months £2/13/6 **£36.10.0**
 - (b) The COLLARO Mk. IV "Transcriptor" 3 Speed Deck. Deposit: £8/6/-, 12 months £3/0/11 **£41.10.0**
 - (c) The new TRUVOX Mk. VI Tape Deck. Deposit: £8/14/-, 12 months £3/3/10 **£43.10.0**
 - (d) The BRENNELL Mk. V 3 Speed Deck. Deposit: £10/6/-, 12 months £3/15/7 **£51.10.0**
 - (e) The WEARITE MODEL 4A Tape Deck. Deposit: £12/4/-, 12 months £4/9/5 **£61.0.0**

STERN'S MULLARD TYPE "C" TAPE PRE-AMPLIFIER—ERASE UNIT

INCORPORATING THE NEW FERROXCUBE POT CORE PUSH-PULL OSCILLATOR and 3 SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.



PRICES . . . INCLUDING SEPARATE SMALL POWER SUPPLY UNIT COMPLETE KIT OF PARTS **£14.0.0** ASSEMBLED AND TESTED **£17.0.0**
 Deposit £3/8/- and 12 months of £1/4/11. Assembled unit only. ALSO AVAILABLE EXCLUDING POWER SUPPLY UNIT FOR **£11.15.0** and **£14.10.0** respectively. (Carr. and Ins. 5/- extra)

Send S.A.E. for leaflet or 2/6 for Complete Assembly Manual. WHEN ORDERING PLEASE STATE MAKE OF TAPE DECK TO BE USED We present this "Hi-Fi" Pre-amplifier strictly to Mullard's specification etc., incorporating ONLY NEW HIGH GRADE COMPONENTS and the SPECIFIED NEW MULLARD VALVES. It comprises a COMPLETELY SELF-CONTAINED UNIT, all components and valves being contained in a well ventilated Box—Chassis neatly finished in Hammered gold with a very attractively engraved PERSPEX FRONT PANEL.

FOR PERMANENT HIGH QUALITY INSTALLATIONS

WE ALSO OFFER (excluding Case) the following

- (a) The COLLARO "STUDIO" TAPE DECK and our Mullard Type "C" PRE-AMPLIFIER and Power Unit Assembled and Tested **£32.10.0**
 H.P. Terms: Deposit £6/10/- and 12 months at £2/7/8.
- (b) As above but TYPE "C" PRE-AMPLIFIER supplied as complete Kit of Parts **£29.0.0**
- (c) The COLLARO Mk. IV TAPE DECK and the MULLARD Type "C" Pre-amplifier and Power Unit assembled, tested **£35.0.0**
 H.P. Deposit £7 and 12 months £2/11/4.
- (d) As in (a) 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**
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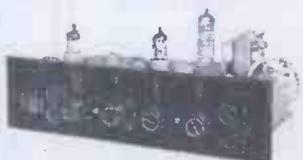
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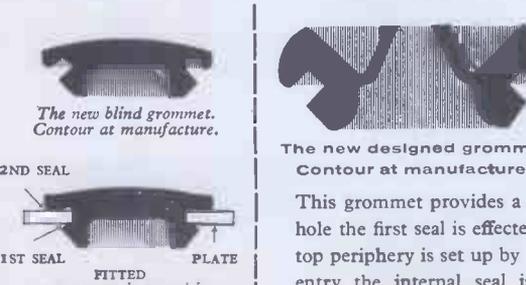
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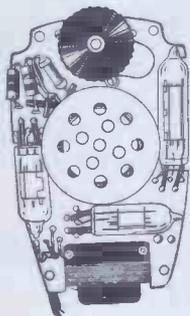
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15CGT	12/6	6K25	7/6	20P4	17/-	EB91	3/9	SMALL	9/-	U18	8/6
1HSGT	9/9	6L8	13/6	20P5	16/-	EB33	5/6	EY66	9/-	U22	6/9
1L4	3/9	6L8	9/9	25A6G	6/9	EB44	6/6	EZ44	7/6	U24	7/6
1N6GT	9/9	6L6G	7/6	25L6G	6/9	EB31	7/9	EZ47	7/6	U25	13/6
1R5	8/9	6L7	9/-	25L6GT	8/-	EBF8	8/6	EZ80	6/9	U26	12/-
1R4	8/9	6L18	9/-	25Z4G	8/-	EBF89	8/6	EZ81	7/3	U31	8/3
1R5	6/6	6L19	11/6	27SU	16/-	EBL21	14/-	GTIC	7/-	U33	11/-
1T4	4/6	6L20	8/6	30P5	7/-	EBL31	16/-	GZ52	8/9	U35	8/9
2D21	4/6	6P25	9/-	30FL1	9/6	ECC52	9/9	GZ54	12/6	U37	28/6
3A4	5/6	6P28	9/-	30P4	12/6	ECC31	9/6	HABC80	9/6	U50	6/-
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3R4	6/6	6Q7GT	9/3	30PL1	10/6	ECC34	9/-	HVR2	7/6	U191	9/6
3V4	6/6	68A7	5/9	35L6GT	9/-	ECC35	6/9	KT33C	6/6	U281	8/6
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6AG7	8/6	6Y6GT	8/6	955	3/9	ECH81	8/3	N7	11/-	UBC41	8/3
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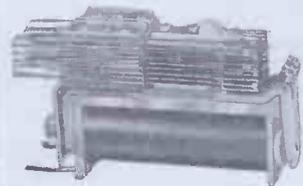
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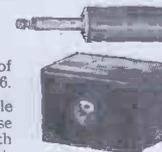
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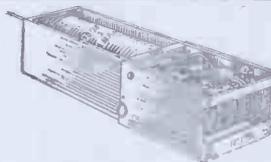
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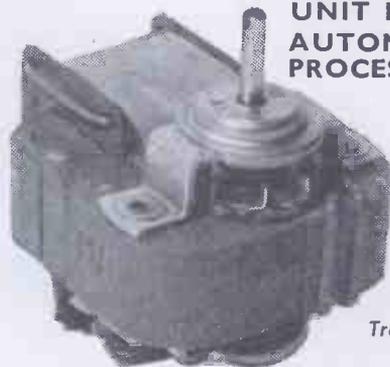
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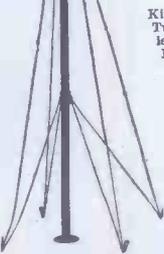
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Full details and stage-by-stage building instructions 2/8 each, post free ("Bantam" 1/8) or free with each unit.

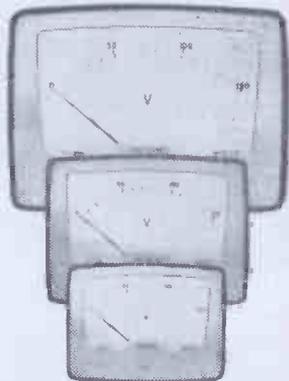
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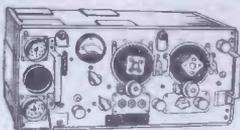
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WIRELESS SET No.19. Mk.II.

As described in "Practical Wireless" March issue, page 961, April issue, page 1027 and continued in May issue.

SET ONLY

65/-

Carr. 10/-

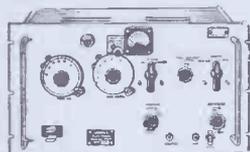
This most famous Army Trans/Receiver covers 2-8 Mc/s. (150-37 metres) in two bands and 230-240 Mc/s. V.H.F. Has an intercom. amplifier. Designed for 12 and 24 volt operation. Uses a 6 valve superhet receiver, I.F. being 465 Kc/s., and a 6 valve transmitter designed for voice and C.W. operation. Incorporates test and tuning meter for voltages, aerial loading and current tests. Panel Controls: Frequency tuning, P.A. loading, Gain control, MCW, CW, R/T switch, Het-tone, netting, off-on, Quench, aerial-AVC-LT-HT-Drive tests. Supplied complete with 15 valves and instruction book.



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1.5 to 12 Mc/s. 7-valve superhet, built like a dream. 12SK7-RF, 12SA7 Mixer, 12A6 Oscillator, 12Q7 Detector, AVC - BFO - 1st AF, 12SK7-I.F.'s. The 12A6 final

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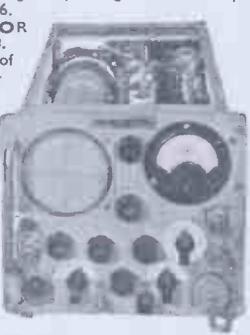
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PRC/6 F.M. HANDIE TALKIE

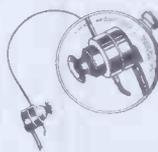
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They're High and Low Impedance!

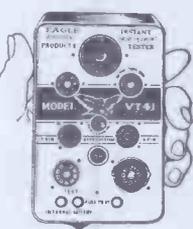
These H.S.30 phones are the smallest used by the U.S. Air Force. 250 Ω imp. using soft rubber miniature ear moulds for maximum music and voice reproduction of the finest quality. Supplied free is a small transformer unit with cord and plug which steps impedance up to 4,000 Ω . **ONLY 15/- P. & P. 2/6.**



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MODEL VT-41
Pocket-size battery operated GIVES INSTANT CHECK OF:

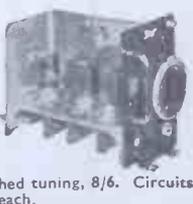
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*International Octal, B.8, B.9, B.7 Battery and Mains types. Beautifully styled—precision made. Supplied complete. Fully guaranteed. **ONLY 30/- P. & P. 2/6.**

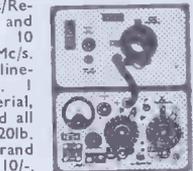
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Within minutes you can extend the frequency of your receiver to cover V.H.F. by using our brand new V.H.F. Converters. R.F.26 covers 50-65 Mc/s, vernier calibrated tuning, 20/-. R.F.25 covers 40-50 Mc/s, switched tuning, 8/6. Circuits supplied. P. & P. 3/6 on each.



PORTABLE TRANS/RECEIVER No. 18

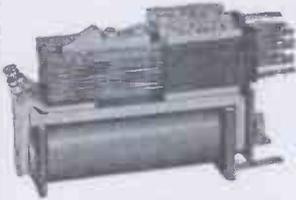
A self-contained Trans/Receiver for Telephone and C.W. Range approx. 10 miles. Frequency 6-9 Mc/s. (50-33.3 metres). Valve line-up: 3 ARP-12, 1 AR-8, 1 ATP-4. Complete with aerial, H.T. and L.T. meter and all accessories. Weight 20lb. Size 8 x 10 x 17in. Brand new only 80/-. Carr. 10/-.



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2. C/O	2/6	8/-
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*Slugged coils extra.

SIEMEN'S HIGH SPEED C/O RELAYS

250+250 ohm Twin Coils 6/6 1,000+1,000 ohm Twin Coils 10/6
 850+850 " 8/6 1,700+1,700 " 17/6

G.E.C. MINIATURE SEALED RELAYS

No.	Ohms.	Build Ups	Voltage	Price
Z.530002	180	4C	12	£1 2 6
Z.530005	2	2C	1.3	12 6
Z.530006	40	2C	6	15 0
Z.530008	670	2C	24	19 6
Z.530010	40	2C 2K	6	17 6
Z.530011	180	2C 2K	12	£1 2 6
Z.530014	2	1C	1.3	10 6
Z.530015	40	1C	6	12 6
Z.530016	180	1C	12	19 6
Z.530018	2,500	1C	48	£1 2 6
Z.530019	2	2C 2K	1.3	14 6
Z.530020	2	4C	1.3	16 6
Z.530022	2	M.B.	1.3	12 6
Z.530023	2	2B 2M	1.3	12 6
Z.530024	40	2M	6	12 6
Z.530025	40	M.B.	6	12 6
Z.530027	180	2M	12	17 6
Z.530028	180	M.B.	12	17 6
Z.530031	670	M.B.	24	17 6

S.T.C. MINIATURE SEALED RELAY

4184GD 700 2C 24 19 6
 1/6 Post & Packing on all relays. Send for lists



ROTARY TRANSFORMERS

Delivery ex stock. Quotations on application.

H.T. 31
 Input 11.5 v.
 Output 250 v. at 120 mA.

H.T. 32
 Input 11.5 v.
 Output 490 v. at 65 mA.

AS SUPPLIED TO GOVERNMENT DEPARTMENTS AND LEADING MANUFACTURERS. NEW AND BOXED.

ROTARY TRANSFORMERS

Made by DELCO
 TYPE 1, 27/6. P. & P. 3/6
 TYPE 2, 37/6. P. & P. 3/6
 Type 1. Dual voltage 12 or 24 v., input 265 v., 120 mA. output; 500 v., 26 mA. output.
 Type 2. 12 v. input 275 v., 110 mA. output; 500 v., 50 mA. output.
 Both types dual output.
 MADE IN U.S.A.



OTHER DYNAMOTORS IN STOCK, SEND FOR LIST

RADIO TRADERS LTD.

23 WARDOUR ST., LONDON, W.1 (Coventry Street end)
 Phone No.: GERrard 3977/8 Grams: "Radiotrade"
 STOCKISTS OF CARR FASTENER COMPONENTS

ALL POPULAR TYPES OF



COMPONENTS SUPPLIED FROM STOCK

TRANSISTORS. A.F. 7/6 each. R.F. 15/- each.

TRANSISTOR CONDENSERS. Miniature Electrolytic Capacitors, 32 mfd. 3 v., 25 mfd. 25 v., 25 mfd. 6 v., 16 mfd. 12 v., 8 mfd. 6 v., 5 mfd. 12 v., 2.5 mfd. 25 v., 1.6 mfd. 6 v., 1 mfd. 12 v. All these types of condensers are 2/6 each. SPECIAL DISCOUNTS FOR QUANTITIES.

THREE ASTOUNDING TV TUBE OFFERS

All brand new in famous makers' cartons
 (1) 17in. rectangular aluminised 6.3 HTRS .3A current; max. anode voltage 16kV. Usual price £17/5/-. OUR PRICE £9/19/6. Crating and carr. 15/-.
 (2) Ferranti T12/44 and T12/54G 12 In. magnetic white fluorescence; 4 v. heater; max. anode 10 kV. As used in many TV receivers. Original price £17/5/-. Our price £4/19/6. Crating and carr. 12/6.
 (3) Ferranti 9in. Tube round white fluorescence, 5 v. heater, max. anode voltage 7 kV. Our price £2/19/6. Crating and carr. 11/6.
JONES PLUGS AND SOCKETS. 4 pin 2/6 pair; 6 pin 3/6 pair; 8 pin 4/6 per pair; 12 pin 6/6 per pair. If cover required send 1/6 extra per cover.

WANDER PLUGS. Red and black doz. 2/-
 PHILIPS TRIMMER TOOLS 1/- each doz. 10/6
 4-WAY PUSH-BUTTON UNITS 2/6 each. Knobs for same, 3d. each.
 POINTER KNOBS. Small black with white line, 7/6 per doz. Small white with black line 8/- per doz. Both types 1/2 in. spindle. Large price reductions for 1,000 lots and over.

CASH WITH ORDER OR C.O.D. ALL ORDERS DEPT. W.1.

ALL ORDERS FOR LESS THAN £2 ADD POSTAGE.

We invite your enquiries for items not listed.

Trade Counter open 9 to 6 Monday to Friday.

Also 9 to 1 Saturday. Callers welcomed.

Large stocks of all types of resistors, condensers, valveholders always available ex stock. Manufacturers' enquiries welcome.



1910

EDGWARE ROAD

1960

THIS IS OUR JUBILEE YEAR BLANK CHASSIS

Precision made in our own works from commercial quality half-hard aluminium of 16 s.w.g. (1/16in.) thickness, these chassis go all over the world (they even go off it—in rockets!). Same day service for ANY SIZE, to nearest 1/16in. and up to 17in. long and 4in. deep, of straightforward two, three or four-sided chassis. Orders for specials dealt with promptly when accompanied by clear instructions or drawings.

SOLDERED CORNERS

While these chassis, owing to their thickness, hardness and efficient folding, will carry components of considerable weight and normally require no corner strengthening, we can do this if required by a special soldering technique at 6d. extra for each corner.

FLANGES

1/2 in., 3/4 in. or 1 in. flanges (inside or outside) 6d. extra for each bend.

PRICE GUIDE (normal chassis only)

Work out total area of material required, including waste, and refer to table below:

48 sq. in.	4/-	176 sq. in.	8/-	304 sq. in.	12/-
80 sq. in.	5/-	208 sq. in.	9/-	336 sq. in.	13/-
112 sq. in.	6/-	240 sq. in.	10/-	368 sq. in.	14/-
144 sq. in.	7/-	272 sq. in.	11/-	and pro rata	
	Post 1/3		Post 1/6		Post 1/9

Discount for quantities. Trade enquiries invited. Spray finishing arranged for quantities of 25 or over.

PANELS

The same material can be supplied for panels, screens, etc. Any size up to 3ft. at 4/6 sq. ft. (sq. in. x 1/4 in.) Post, up to 72 sq. in. 9d., 108 sq. in. 1/3. 144 sq. in. 1/6, 432 sq. in. 1/9, 576 sq. in. 2/-.

287/289 EDGWARE ROAD, LONDON, W.2
 Telephone: PAD 5891/7595

GEE (Bros.) RADIO LTD.

15 LITTLE NEWPORT STREET, LONDON, W.C.2. GER. 6794/1453
ADJOINING LEICESTER SQUARE TUBE STATION—Open 9-6 Weekdays, 9-1 Sat.

P.A. SYSTEM EQUIPMENT FOR INDOOR OR OUTDOOR USE



VORTEXION PORTABLE AMPLIFIER

A first-class amplifier for 200/250v. A.C. or 12v D.C. operation. 10 watt push-pull output matched to 7.5, 15, 250 or 500 ohms. Incorporates inductors for mike and gram, volume control and bass and treble control. Good working order. **ONLY £9/19/6.** Carr. 10/6.



ACCUMULATORS 12 v. 25 A.H. New and unused. Housed in strong wooden case for extra protection, 45/-. Carr. 7/6. 2 v. 100 A.H. 75 actual. Ex-Govt. New and unused. Complete with carrying handle. Size 6½ x 6½ x 3½in., 15/- each. Carr. 3/6. 3 sent for 50/-, or 6 for 24/-. P. & P. 10/-. Ditto 14 A.H., less handle, 5/-. P. & P. 2/-; 6 for 24/-. P. & P. 10/-.

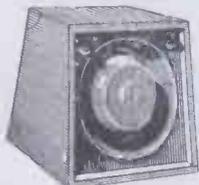
EXPOTENTIAL HORNS by famous manufacturer of P.A. systems. 20 watt, 42in. long, 2½in. dia. horn, 15 ohms speech coil. Good condition £8/10/-. Carr. 10/-. 10 watt, 30in. long, 20in. square flare, 15 ohms speech coil. Good condition, £6/10/-. Carr. 10/-.

VITAVOX PRESSURE UNITS TYPE N Heavy Duty. Special quality. 20 watts P.M. Brand new, 80/-. Ditto but in good order, 40/-. Carr. 5/- on each.



RE-ENTRANT LOUD HAILERS (Ex-Govt.)

Heavy duty 20 watts all-metal 15 ohms. Diameter 15in., length 15in. (approx.) good condition. £6/10/-. Carr. 10/-. Ditto, Brand new, £8. Carr. 10/-.



TRUVOX/TANNOY LOUD-HAILERS

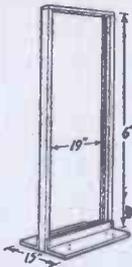
With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in sloped-front wooden case. Brand new 25/-. P. & P. 3/6.

6in. P.M. HEAVY DUTY SPEAKERS. Complete with O.P. trans. in all steel blue-grey double grided cabinet. Size 8½in. square x 4½in. deep. New, 30/-. Carr. 3/6. 8in. Ditto, Size 10in. square x 5½in. deep. New, 35/-. Carr. 3/6.

HEAVY DUTY ALL STEEL TRIPOD STANDS. 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, floodlighting, etc., etc. (as illus. Dec.). **OUR PRICE £3/10/-. Carr. 5/-.**

All items available ex-stock

RECORDING TAPES. Super quality P.V.C. 1,800ft. L.P. 7in. spools, 30/-; 1,200ft. Std. 7in., 19/-; Empty 7in. spools 4/- each. All post paid.



G.P.O. RACKS

19in. Heavy duty, all steel. Standard drilling. 5ft. 6in. angle uprights. £3/10/-. Carr. 15/-. 6ft. channel uprights (as illustrated) £5. Carr. 15/-. 7ft. channel uprights. £6. Carr. 15/-. 19in. x 14in. PANELSHELF in 14 s.w.g. steel. Suitable for above racks. 15/-. P. & P. 5/-.

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/-.

VARIABLE VOLTAGE TRANSFORMER. (BERCO Regulator) Pri. 440 v. 50 cycles, sec. 0-440 v. at 6.5 amps. or can be connected for 230 v. to give 0-230 v. at 12 amps. Brand new and unused £18/10/-. Carr. 10/-.

6 kV/A. AUTO-TRANSFORMER. 230/110 v. 50 cycles (fully tapped primary and secondary). Capable of 25% over actual rating. Brand new and unused, £18. Carr. 20/-. Also 3 kV/A as above. £12/10/-. Carr. 20/-.

20 kV/A AUTO-TRANSFORMER. 230/115 v. 50-60 cycles, by Jefferies Transformer Co., U.S.A. Perfect condition, £20. Carr. £1.

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.

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/-.

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.

AIRCRAFT RADIO RECEIVER. (By R.C.A.) Freq. 195 Kc/s. to 9050 Kc/s. (33-15000 metres) continuous. For 28v. D.C. input with built-in dynamotor. This 6 valve receiver with 2 R.F. stages and 2 I.F. stages with B.F.O. and C.W. is in our opinion one of the finest sets so far released by the Air Ministry. £7/10/-. Carr. 5/-.

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.

TELEPHONE CABLE. Twin one-mile drums (Don. 8), £5. Carr. 20/-. Single one-mile drums (Don 3), 50/-. Carr. 7/6.

TELEPHONE DIALS. Standard (G.P.O.) Pattern. 0-9. Brand new. 30/-. P. & P. 1/-.

AVO VALVE DATA MANUAL. Containing a host of information on hundreds of valves including civilian equivalents of many service types, 21/-. Post free.

TELESCOPIC AERIAL MAST. 20ft., 4 sections of 5ft. each. Independently locking at any height. Tapering from 2in. to ¾in. (less accessories), 50/-. Carr. 5/-.

AERIAL MAST (Army type). 32ft. high. Lightweight kit comprising 10 steel screw-in sections (approx. 1in. dia.). Complete with guys, insulators, pegs, etc. All in canvas carrying bag. **Only £4.** Carr. 7/6.



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 7in. x 7½in. x 4in. A miniature B.C.22 in every respect. A must for every laboratory, etc. **ONLY £4/19/6.** P. & P. 2/6.

BRIDGE MEGGERS

Evershed and Vignoles Series 2 in perfect condition. 250 v. £22, carr. paid. Leather case available at 20/- extra.



C.M.G. 25 PHOTO CELLS (OSRAM). Brand new, 15/-. P. & P. 1/-.

EVERSHED 12 PEN TIME RECORDER. Portable 12-channel instrument for simultaneous recording of 11 events with time marks provided by the 12th pen. Recording is in the form of "on/off" pulses. Speed 2in. per sec. Price unused (less pens), £10. Carr. 10/-.

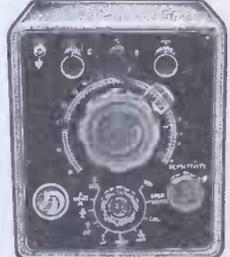
EVERSHED AND VIGNOLES MEGGER

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/-.



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 10mf. Good condition and complete with instruction booklet. £6/19/6. P. & P. 2/6.



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/-.

MARCONI SIGNAL GENERATOR. TYPE TF390G. for 200-250 v. A.C. mains input. Frequency range 4-16 Mc/s. and 32-100 Mc/s. indirect calibration. Output 1µv to 100 MV. 400 c/s internal modulation. In good order. **Only £12/10/-. Carr. 20/-.**

MARCONI VALVE VOLTMETERS TF-428 B/1. 5 ranges A.C. and D.C. 1.5, 5, 15, 50 and 150 v. A.C. mains operation 200/250 v. Supplied in good working order. £14. P. & P. 7/6.



FOR VALVES, TUBES AND COMPONENTS: BY RETURN POST SERVICE

PZ30 19/11	ID6 12/6	6SG7 7/6	35W4 7/6	142BT 3/6	955 4/-	TRAN-
PEN4DD 26/6	IH5GT... 10/6	6SH7 6/-	35Z4GT .. 8/-	185BT 33/2	956 3/6	SISTORS
PEN4YA 12/6	IL4 6/6	6SJ7 8/6	42 8/6	210DDT 4/6	5763 9/-	OC45 ... 23/-
PEN25... 6/-	ILD5 3/6	6SK7 6/-	35Z3 16/7	210VPT... 3/6	9004 5/6	OC66 ... 25/-
PEN46... 7/-	IN5 10/6	6SL7GT .. 8/-	35Z5GT 9/-	301 10/6	9006 5/6	OC70 ... 14/-
PEN383 23/3	IR5 7/6	6SN7GT .. 7/6	50C5 11/6	302 10/6	DIODES	OC71 ... 14/-
PEN220A 4/-	IS4 10/6	6SQ7 9/3	50CD6G 29/10	304 10/6	OA70 4/-	OC72 ... 17/-
PEN45DD26/6	IS5 6/6	6U4GT... 12/-	50L6GT 8/6	305 10/6	OA79 4/-	OC72 ... 17/-
PEN4A 12/6	IT4 6/-	6U5G 8/6	75 11/6	306 10/6	OA81 4/-	XBI02 ... 10/-
PM12M... 8/-	Q226 1/6	6U7G 8/6	77 7/6	807 6/6	CG6E 4/-	XBI04 ... 10/-
QP21 5/-	2P 26/6	6V6G 6/-	80 8/6	954 2/-	CG12E 4/-	
R16 26/6	3A5 12/6	6V6GT .. 7/9				
SP41 3/-	3A8GT... 6/-	6X4 7/6				
SP61 3/-	3D6 5/-	6X5G 7/-				
SP45 10/6	3Q4 8/-	6X5GT .. 7/-				
SP47 10/6	3Q5GT... 9/6	6/30L2 .. 12/6				
T41 23/3	354 7/6	7B6 10/6				
TH41 26/6	3V4 8/6	7B7 8/6				
TP25 10/-	4D1 4/-	7B8 6/-				
U10 10/6	5R4GY 9/6	7C5 8/-				
U14 8/6	5U4G 6/6	7C6 8/-				
U16 12/6	5V4 11/6	7D6 13/6				
U22 8/-	5Y3G 8/-	7H7 9/-				
U25 14/-	5Y3GT .. 8/-	7Q7 9/-				
U26 12/6	5Z4G 9/-	7S7 9/6				
U37 26/6	5Z4M 10/-	7Y4 8/6				
U45 15/-	6A7 10/-	8D2 2/9				
U50 8/-	6A8G 9/-	9D2 3/6				
U76 8/-	6A7C 5/-	10C1 17/3				
U339 12/-	6AG5 5/6	10C2 17/6				
U403 16/7	6AK5 6/6	10D2 12/-				
U404 11/4	6AL5 4/6	10F1 12/6				
U801 29/10	6AM5 7/6	10F3 23/3				
UABC80 10/-	6AM6 4/6	10F9 15/3				
UAF42 9/6	6AQ5 7/6	10F18 15/3				
UAB41 9/-	6AT6 8/6	10L1 15/11				
UBC41 9/-	6AU6 10/6	10LD11 .. 12/-				
UBC81 11/4	6B8G 4/-	10M2 23/3				
UBF80 9/6	6BA6 7/6	10P13 15/-				
UBF89 13/11	6BE6 8/-	10P14 19/3				
UBL21 23/3	6BG6G.. 23/3	12A6 6/6				
UC92 13/3	6BH6 9/-	12AT6 10/6				
UCC84... 10/11	6BJ6 9/-	12AT7 7/6				
UCC85... 10/6	6BR7 12/6	12AU6 8/-				
UCF80... 16/7	6BV6 9/-	12AU7 8/-				
UCH21 23/3	6BW7 8/6	12AX7 8/-				
UCH42 10/6	6C4 4/6	12BA6 9/-				
UCH81 10/6	6C5GT... 6/6	12BE6 9/-				
UCL82 16/7	6C6 5/-	12C8 9/-				
UCL83 13/6	6C9 17/3	12H6 3/6				
UF41 9/-	6C31 7/6	12J5GT .. 10/6				
UF42 17/3	6CD6G 29/10	12J7GT .. 3/6				
UF80 13/11	6D6 5/-	12K7GT .. 7/6				
UF85 9/-	6CH6 10/6	12K8GT 13/6				
UF86 17/11	6F6G 7/6	12K8M .. 12/-				
UF89 9/-	6F6M 7/6	12O7GT .. 7/6				
UL41 10/-	6F1 14/-	12SG7 7/6				
UL44 26/6	6F13 14/-	12SH7 6/-				
UL46 26/6	6F14 26/6	12S17 6/-				
UL84 9/-	6F15 14/-	12SK7 6/-				
UU6 19/11	6F18 15/3	12SL7 8/-				
UU8 26/6	6F23 18/7	12SN7GT 10/-				
UY1N 12/6	6F33 7/6	12SQ7 8/6				
UY41 7/6	6H6 2/6	14S7 17/-				
UY85 7/-	6H6GT .. 2/6	15D2 7/9				
VP13C .. 3/6	6I5GT .. 5/-	19AQ5 .. 9/9				
VP23 15/-	6I5M 6/6	19BG6G 23/3				
VR22(PM2A)	6I6 6/-	20D1 15/3				
VP23 3/-	6I7G 6/6	20F2 26/6				
VU11 2/6	6K7G 4/-	20L1 26/6				
VU12(14) 8/9	6K7M 6/9	20P1 26/6				
VU111 2/6	6K8G 7/6	20P3 23/6				
VU112 2/6	6K8T 7/-	20P5 15/-				
VU113 2/6	6K7GT .. 5/9	20A5G .. 10/6				
VU114 2/6	6K8GT .. 10/-	25L6GT 10/-				
VU115 2/6	6K25 19/11	25Z4 9/6				
VU116 2/6	6L6G 8/-	25Z5 8/-				
VU117 2/6	6L6M 9/6	25Z6 10/-				
VU118 2/6	6L7G 7/6	27SU 19/11				
VU119 2/6	6L1 23/3	30C1 10/6				
VU120A 3/6	6L18 11/6	30F5 10/6				
VU39 9/-	6L19 23/3	30FL1 10/6				
(MU12/14) 8/9	6L20 15/11	30L1 9/-				
6L6G 8/-	6M1 17/3	30L15 .. 23/3				
6L6M 9/6	6N7GT .. 7/6	30P4 15/-				
6L7G 7/6	6P1 19/3	30P12 .. 12/6				
6L1 23/3	6P26 19/11	30P16 .. 9/6				
6L18 11/6	IA3 3/6	30PL1 .. 12/6				
6L19 23/3	IA7GT .. 12/6	30PL13 .. 21/11				
6L20 15/11	IC2 11/6	30PL13 .. 21/11				
6M1 17/3	IC5GT .. 12/6	35L6GT 10/-				
6N7GT .. 7/6	ID5 12/6	25Y5 9/9				
6P1 19/3						
6P26 19/11						
6P28 26/6						
6Q7G 7/6						
6Q7GT .. 9/6						
6SA7GT .. 8/-						

REGUNNED

Television Tubes, 12 Month Guarantee. 12in. to 14in. £5/10/-; 15in. to 17in. £6. Carriage and insurance 10/- extra.

SCOTCH RECORDING TAPE

1,200ft. reels Standard 23/-, 1,800ft. reels Extra Play 37/6.

DUBILIER Type "C" Controls

500 K, 6/6 each.

METERS Panel mounting. (Round.) Moving coil.

Make	F.S.D.	Res.	Scale	Size	Price
Weston (USA)	1 M/A	150 ohms	0-100	3 1/2in.	27/6
Weston (UK)	1 M/A	75 ohms	0-100	3 1/2in.	22/6
W.D. (UK)	5 M/A	10037 ohms	0-20	2in.	9/-
W.D. (USA)	500 Micro/A	—	0-600	2 3/4in.	15/6

CO-AXIAL CABLE. Semi-airspaced, 75 ohms, 6d yard.

OSMOR JIFFY PUNCH

Type 1, hole size 1/8in. 7/-
 Type 2, hole size 3/16in. 8/-
 Type 3, hole size 1/4in. 9/3

OSMOR CHASSIS CUTTERS

Type 1, hole size 3/8 x 1/2in., 19/9
 Type 2, hole size 1 x 1 1/2in., 21/6
 Type 3, hole size 1 1/2 x 1 1/2in., 24/9

CONVERT YOUR RADIOGRAM WITH ONE OF THESE MODERN AUTOMATIC RECORD CHANGER UNITS

Monarch UA8, 4-speed automatic record changers with Full-Fi turnover crystal cartridge, £6/19/6. Carriage 3/6.

Collaro Conquest, 4-speed fully mixing changer complete with Studio "O" Crystal cartridge, £7/19/6. Carriage 3/6.

Garrard RC120/D, Mk. II, 4-speed unit manual control to enable records to be played singly, £8/19/6. Carriage 3/6.

Garrard RC121, the latest 4-speed automatic record changer, £10/19/6. Carriage 3/6.

HEATER TRANSFORMERS

All 240 v. input, 4 v. 3 amp. 10/-; 6.3 v. 1 1/2 amp. 6/9; 6.3 v. 3 amp. 10/-; 12.6 v. 2 amp. 5/9; 5 v. 2 amp. 10/-; 2 v. 3 amp. 8/3.

RECTIFIERS

RM1 5/3, RM2 6/9, RM3 7/6, RM4 13/6, RM5 19/6, 14A86 19/6, 14A97 19/6, 14A100 19/6, LV77 17/6, 18RA.1-1-16-1 6/-, FC31 (14RA 1-2-8-3) 22/6, FC101 (14RA 1-2-8-2) 16/6.

COSSOR BATTERY ELIMINATOR

Two separate units identical in size to the B126 and AD35 batteries, 1.5 v. L.T., 90 v. H.T. Suitable for the latest low consumption valves, fully stabilised. New in original cartons. Listed at 63/-. Price 37/6. Post 1/6.

Resistors Assorted, 100 for 12/6 Yaxley Switches. Assorted 9/- doz. Post 1/6.

Silver Mica Condensers. Assorted, 100 for 12/6, post 1/-.

Repanco Transistor Amplifier and Feeder Unit Circuits, envelope 1/6. Post 4d.

Repanco Twinette, two transistor Portable Radio Envelope with full instructions 1/3 each, plus 4d. post

Wireless World Guide to Broadcasting Stations, 12th Edition, 3/6. Post 4d.

High Resistance Headphones, 400 ohms, 13/6 pair.

Low Resistance Headphones, 120 ohms, 7/6 pair.

Wing Mounting. Telescopic Car Radio Aerial, 29/6 each. Post 2/-.

Claroast Pots for Stereo Amplifiers etc. All 6/6 each. 50Kx50K Log. 500K x 500KA/Log. 100K x 100K Log. 1 Meg. x 1 Meg. Log. 250K x 250K Log. 1 Meg. x 1 Meg. Linear. 500K x 500K Linear.

CATALOGUE

Our 1960 catalogue is now available, please send 1/- in stamps for your copy.



103 LEEDS TERRACE
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TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 1/-; 20/- add 1/6; 40/- add 2/-; £5 add 3/- unless otherwise stated. Minimum C.O.D. fee and postage 3/-.

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Personal shoppers 9 a.m. to 5 p.m. Mon. to Friday, Saturday 10 a.m. to 1 p.m.

Special Offer!

HIGH QUALITY RECORDING TAPE

By Famous Manufacturers

- Stand. Play, 1,200ft., 7in. reel 22/6 (P. & P. 1/6)
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- Long play, 1,800ft., 7in. reel 32/6 (P. & P. 1/6)
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ALL BOXED AND GUARANTEED NEW STOCK



New additions to GOODMANS speaker range

Latest release of two 10" units

- AXIOM 110 - £5. 10 watts 40-1500c/s
 - AXIOM 112 - £8 10s. 12 watts 40-15000c/s
- also the new Triaxiette Super 8" Unit. £13 10s.

The well known 8" Axiette (£6 12s.) and the 12" Audiom 60 (£9 12s.) as recommended for two speaker systems, are still available, ex stock.

RECOMMENDED RECORD PLAYER BARGAIN

E.M.I.—4-speed Single Player Unit, fitted with latest stereo and monaural Xtal cartridge and dual sapphire stylus. Auto stop and start. A fidelity unit and bargain buy at only £8/19/6 (carr. and insurance 3/6).

SINGLE PLAYERS: BSR (TU9), with Ful-Fi P.U. 90/-; GARRARD (48P), £8/17/6. GARRARD TA Mk. II with plug-in G03 Xtal head, £7/19/6, carr. and insurance 3/6.

AUTOCHANGERS: BSR (UAS), £8/19/6. BSR UAS fitted with Stereo/Monaural cartridge, £7/19/6; COLLARO Conquest £7/19/6; GARRARD (RC121 4D, Mk. II) plug-in head, stereo adapted, 10 gns. Stereo head £2 extra.

RECORD PLAYER CABINETS

Contemporary styled, rexine covered cabinet in two-tone fawn and brown, or mottled red with white polka dot. Size 18½ x 13½ x 8½ in., fitted with all accessories, including baffle board and anodised metal feet. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 x 13in. supplied.

Cabinet Price £3-3-0. Carr. and Ins. 3/6.

2-VALVE 2-WATT AMPLIFIER

Two stage ECL82 with vol. and neg. feedback. Tone controls AC 200/250 v. with double-wound Mains trans. Complete with knobs, etc., ready wired to fit above cabinet.

£2.17.6 P. & P. 1/-.

G. in. Speaker and matching trans., 22/- P. & P. 1/6.

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Bulk Purchase—Brand New

- OA70 3/-
- OC70 8/6 All branded
- OC72 (XC101) ... 10/6 BVA Types.
- OC45 (XA101) ... 14/6 First Grade.
- OC44 (XA102) ... 16/6

NOW! The TOURIST Portable

4 valve. Mod. & L.W., 1½lb weight battery Radio. Size only 8in. x 5½in. x 4in. Weight 3½lb. with battery:—

- Complete receiver component kit 57/6 1/6
- Set 4 miniature valves (36 series) 35/- 9d.
- 5½L. Speaker & O/pout Trans. 21/- 1/6
- Cabinet, Dial and Knobs, etc. 22/6 3/-
- Latest superhet circuitry delayed AVC and A.F. Neg. feedback.

Complete kit—BARGAIN—only

£6.10.0, post free

Terrific performance—

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Staggering Value

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12 v. 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. B.F. stage and permeability pre-aligned Cydon Tuner



Unit provides extremely good sensitivity and signal noise ratio. Printed circuit for easy construction and 7 x 4in. elliptical speaker for fidelity output. Self-contained in neat metal cabinet 8 x 7 x 2½in. with attractive calibrated dial. Speaker and power transistor stage mounted separately approx. 8 x 5 x 3in.

Recommended

Buy Complete Kit Bargain Price

Instruction booklet and parts list available 3/6 post free.

£12.19.6

P. & P. 3/6

NEW BOXED	VALVES	GUARANTEED	ALL
IR5. IT4 7/6	EABC90 9/6	EZS1 7/6	
IR5 7/6	ECC84 10/6	MU14 9/6	
824, 3V4 8/-	ECC90 11/6	PC34 10/6	
6K7 5/6	ECH42 10/6	PCF80 10/6	
6K8 8/6	ECL80 10/6	PCL83 12/6	
6Q7 8/6	EF80 9/6	PL81 12/6	
6Q7 8/6	EF88 13/6	PL82 9/6	
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DAF98 9/-	EL41 10/6	FX80 7/6	
DF98 9/-	EL84 9/6	FX81 9/6	
DK98 9/-	EY61 10/-	FX83 7/6	
DL98 9/-	EY86 10/-	U25 12/6	

Send for list of more valve bargains.

SPECIAL PRICE PER SET
 IR5, IT4, IR5, or 384 or 3V4, 27/6.
 DK98, DF98, DAF98, DL98, 35/-.
 6K2, 6K7, 6Q7, 6V8, 8Z4 or 6X5 35/-.

COAX 80 OHM CABLE.

Stand 3in. diam. Low Loss Semi-Air Spaced Aerialax. Top grade cable— not to be confused with inferior types.

Special Reduced Prices
 20 yds. 12/6, p. & p. 1/6; 60 yds. 32/6 p. & p. 2/-; 40 yds. 22/6, p. & p. 2/6.
 All other lengths 8d. per yard.
 Coax Plugs 1/- Sockets 1/-, Couplers 1/3, Cable End Sockets 1/6, Outlet Boxes 4/6.

JASON FM TUNER UNITS

(87-105 M/cs)

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., post free. Set of 4 spec. valves, 30/-, post free.

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NEW JASON COMPREHENSIVE F.M. HANDBOOK, 2/6 post free. 48hr. Alignment Service, 7/6, p. & p. 3/6.

MULLARD "3-3" AMPLIFIER

Quality built to Mullard's specification, with special specialised O/P Trans. Complete kit with front panel only £8/19/6. P. & P. 3/6.

G.R.T. Heater Isolation Transformers

New improved types—mains prim. 200/250 v. tapped

All Isolation Transformers now supplied with alternative no boost, plus 25% and plus 50% boost taps at no extra charge.

- 2V 2A type ... 12/6 (P. & P. 1/6)
 - 6.3V .6A type ... 12/6 (P. & P. 1/6)
 - 10.5V .3A type ... 12/6 (P. & P. 1/6)
 - 13V .3A type ... 12/6 (P. & P. 1/6)
- Small size and tag terminated for easy fitting. Other voltages available.

RE-GUNNED TV TUBES NOW REDUCED PRICES

... and now 12 months guarantee!

All tubes rebuilt with new heater, cathode and gun assembly—reconditioned virtually as new.

- 12in. £6, 14in. £7, 17in. £8.10.0, etc.

10/- part exchange allowance on old tube

Carr. and ins. 10/-. Comprehensive stocks—quick delivery.

CONDENSERS—Silver Mica. All perf. values, 2 pt. to 1,000 pt., 8d. each. Dico ceramics 9d. each. Tubulars 450 v. T.C.C. etc., .001 mid-.01 and L.350 v., 9d. each. .02-1/500 v., 1/- each. .25 Huns 1/6, 5 T.C.C. 1/9. .001 6 kv. 5/6. .001 20 kv. 9/6

RESISTORS—FULL RANGE 10 ohms—10 megohms 20%, ½ w. and ½ w. 3d., ½ w., 5d. (Midget type modern rating), 1 w. 6d. 2 w. 9d., 10% Hi-Stab ½ w., 5d., ½ w. 7d., 5% ½ w. 9d., 1% Hi-STAB, ½ w. 1/6 (10-100 ohms 2/-).

PRE-SET W/V POTS, T/V Type, 25 ohms—50 K ohms 3/-. 50K—2 Meg. (Carbon 3/-).

SPEAKER FRET—Expanded Bronze anodised metal 8 x 8in. 2/3; 12 x 8in. 3/-; 12 x 12in. 4/6; 12 x 15in., 6/-; 24 x 12in. 9/-; 36 x 12in., 13/6, etc., etc.

TV-GAN FRET (Contemporary nat.), 12 x 12in., 2/-; 12 x 15in., 3/-; 12 x 24in., 4/-, etc.

LOUDSPEAKERS—P.M. 3 ohms, 2½in., Mica. 17/6. 3½in. Goodmans 18/6; 5in. Rola, 17/6. 8in. Elac 18/6; 7 x 4in. Goodmans Elliptical, 18/6. 8in. Rola, 20/-; 10in. R. and A., 25/-; 10in. W.B.-HF1012 99/9. 12in. Plessey 15 ohms with 9/4in. Tweeter and Cross Over Filter, 97/6.

Electrolytics All Types New Stock

TUBULAR	CAN TYPES
25/25 v. 50.12 v. 1/9	8+8/450 v. 4/6
50/50 v. 100.26 v. 2/1	32+32/275 v. 4/6
8/450 v. 2/3	50+50.380 v. 6/6
16+16/450 v. 5/6	60+250.275v.12/6
32+32/450 v. 6/6	100+200.275v.12/6

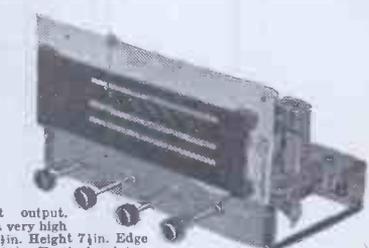
Comprehensive range in stock.

VOLUME CONTROLS—10K—2 Megohms. ALL LONG SPINDLES, MOCCANITE MIDGET TYPE, 1½in. diam. Guar. 1 yr. LOQ or LYN Ratios less Sw. 3/-. D.P. Sw., 4/6. Twin gang controls ½ Meg., ½ Meg. 1 Meg. less Sw., each 8/6.

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve Line-up: ECC85, ECH81, EF89, EABC80, EL84, EM81, EX80.

Three Waveband and Switched Gram positions. Med. 200-600 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 x 6½in. Height 7½in. Edge illuminated glass dial 11½ x 3½in. Vertical pointer, Horizontal station names. G04 on brown background. A.C. 200/250 v. operation. Aligned and tested ready for use. £13.10.0 Carr. & Ins. 5/-



- Complete with 4 Knobs—walnut or ivory to choice.
 - Three ohm P.M. speaker only required. Recommended quality speakers.
 - 8in. Goodmans special cone 21/6
 - 10in. Rola (Heavy Duty) 30/-
- 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.

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 ¼lb. 7d.: 1lb. 1/1; 3lb. 1/6; 5lb. 2/-; 10lb. 2/9.

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etc.

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HI-FI SPEAKERS BY:
GOODMANS
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etc.

HURRY! THE LAST OF THIS AMAZING OFFER FOR THE HI-FI ENTHUSIAST AT ENORMOUS REDUCTION.

THE NEW
RCA
ORTHOPHONIC
AMPLIFIER



12-20 watt output. Distortion: harmonic less than .1% at 10 watts/700 c.p.s. Noise Level: 85 D.B. below rated output. Frequency Response: within 2D.B., 20/2,500 c.p.s., within .5 D.B., 10/6,000 c.p.s. Feedback: 40 D.B. total. Output Impedance: 3.4 ohms, 7 ohms and 15 ohms. Spare Power: 295 v./45 M.A. and 6.3 v. 2.5 amps. for pre-amp, radio tuner and tape amp. A.C. Input: 100/150 v. and 200/250 v. Valve Line-up: two EF86, two KT66 one GZ32. Dimensions: 16½ x 8 x 7½ in. Weight: 32lb.

THE RCA VARIABLE RELUCTANCE PICK-UP

A new design variable reluctance pick-up. Cartridge completely protected from dust, damp and mechanical shock. Embodies an 8-pole balanced design providing the advantages of sensitivity and negligible hum with smooth and extended frequency response. Pick-up arm has simple tracking pressure selector and adjustable pedestal to suit all turntable heights. Fitted with dual sapphire stylus. Tracking pressure: micro-groove 5-7 gms., 78 r.p.m. 9-12 gms. Original price £13/9/6. **OUR PRICE £7/10/-.** Post and pkg. 1/6. The RCA diamond LP stylus will fit most Collaro studio cartridges, brand new in sealed containers. Only 25/- P. & pkg. 1/-.

PRE-AMP.

Input: Mic., radio/ tape high and low level, crystal magnetic p/ups. Tape and Record: output. Bass and Treble: lift and cut continuously variable. Mixing Facilities: mic. input with radio and tape, low and high pass filter. Valve Line-up: one EF86, two ECC81. Dimensions: 12½ x 6½ x 3½ in. Weight: 7lb. **THE COMPLETE EQUIPMENT AT 29 GNS.** Carriage 15/-.

SOMETHING NEW FOR THE SERVICE MAN!

THE POCKET VALVE FILAMENT TESTER

Battery operated, it gives instant check on radio and TV valves, pilot lamps, fuses, continuity of circuit; also built-in 7 and 9 pin valve straightener. The ideal precision instrument for service engineer or amateur constructor. Finished in grey hammer case with gold panel. Fully guaranteed and ready for use. **OUR PRICE 30/-.** Post and packing 2/-.



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.
5½in. reels of 1,200ft. P.V.C. base tape, 25/-, plus 1/6 post and pkg.
New E.M.I. t/up spools in polythene bags, 3/6 each.

ANOTHER OF OUR AMAZING SCOOPS

A Snip for the Constructor.

Build this Cossor Pocket 4 Transistor Superhet Receiver.

Circuit description:

4 transistors (OC44, OC45, OC45, OC72), two OA70 diodes, two AGC systems, coverage 190-550 metres. Power output 30 m/w. Ferrite slab aerial, 2½ in. moving coil speaker, printed circuit, attractive tuning control knob, leatherette case 6 x 3½ x 1½ in. All components including theoretical and point-to-point diagram for easy construction. **ONLY £7/19/6.** Post & Pkg. 2/6. All parts available separately. 9 v. PP4 battery 2/-. Maker's original price nearly £20.



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 mV/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.

REPEATING THIS WONDERFUL OFFER BELOW MFRS. PRICE

The **VERDIK** QUALITY TUNER

10 WATT
PUSH-
PULL
ULTRA
LINEAR
FEEDBACK



ORIGINAL MANUFACTURER'S PRICE 20 GNS.

LIMITED NUMBER ONLY AT **£14.19.6**

Complete Post & Pkg. 7/6 Fully guaranteed



AMPLIFIER AND PRE-AMPLIFIER

Beautifully finished in Grey-Green Stove Enamel. Provision for tuner, bass and treble, 5-position selector for radio, mic., tape, LP and std. records.

This offer for limited period only. Made by famous manufacturer. Stereo amplifier on compact chassis, 3 watts each channel, separate balance and tone controls, volume and switch, 3 ohm impedance, designed for crystal pick-up, channel reverse switch, separate power pack. Our price £6/19/6. P. & pkg. 4/6.

Convert your T.V. Limited number of Cossor turret tuners, 2 valve cascade R.F. amplifier using (1) 7an7 valve, (2) freq. changer 8AB, output from converter, sound 10.1 Mc/s., vision 13.6 Mc/s. Fitted with aerial panel, fine tuning control. Brand new in maker's carton with full instructions and circuit. Original price 7 gns., our price 39/6. P. & pkg. 2/-. Can be used in sets made by Cossor, Argosy, Baird, Decca, Murphy, Peto Scott, Philips, Philco, Regentone, RGD and Scella. Available for London and Birmingham channels.

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit and for C.R. Tubes with falling emission. Full 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, 10/15p. Optional boost 25%, 50%, 75%. Type B. Mains input. Low capacity. Multi Output 2, 4, 6.3, 7.3, 10 and 18 volts. Optional Boost 25% and 50%. Suitable for all Cathode Ray Tubes 21/-.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., 1/2 w., 44/-; 1 w., 44/-; 1 w., 6d.; 1 1/2 w., 8d.; 2 w., 1/-.

HIGH STABILITY. 1/2 w., 1/2, 2/-, Preferred values 100 to 10 meg. Ditto 5%, 9d., 100 to 5 meg.

5 watt } **WIRE-OUND RESISTORS** { 1/3
10 watt } 25 ohms-10,000 ohms. { 1/6
15 watt } 25 ohms-10,000 ohms. { 2/-

15,000 ohms-50,000 ohms, 5 w., 1/9; 10 w., 2/3
High Quality—WOUND POTS, 3 w. WIRE WOUND POTS, 4 w. Pre-set Min. T.V. type Standard size Pots, long Knurled Slotted knob, Spindle High Grade. All values 100 ohms to 60 K., 3/- ea., 30 K., 50 K., 4/-, 6/6; 100 K., 7/6.

Ditto, 1/2 w. Carbon Track W/W EXT. SPEAKER 30 K. to 2 Meg., 3/6. CONTROL 100, 3/6. **OR TRAY FORMERS.** Heavy duty 230 v. 28 w., 17/6. Multi-rod push-pull, 16. Miniature 3V4, etc., 4/6. Hygrade Push-pull 10 watts, 15/6. MULLARD "510" 6k or 8k 30/-, L.F. CHOKES 15/10H 60/65 mA., 5/-, 10H 85 mA., 10/6. 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 22/8

MINIATURE 220 v. 20 mA., 6.3 v. 1 a. 10/8

MIDGET 250 v. 45 mA., 6.3 v. 2 a. 15/6

6in. x 4in. Rola, 13/6. 7in. x 4in. Rola, 21/-

STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a. 17/6

HEATER TRANS., 6.3 v. 1 1/2 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

ALADDIN FORMERS and cores, 3in., 8d.; 4in., 10/6.

0.3in. FORMERS 8937 or 8 and Cans TVI or 2, 3in. sq. x 2 1/2in. or 3in. sq. x 1 1/2in., 2/- with cores.

SLOW MOTION DRIVES. Epicyclic ratio 6:1, 2/3.

SOLOID. Midget Soldering Iron, 230 v. 25 w., 2/6.

REMPLOY INSTRUMENT IRON. 230 v. 28 w., 17/6.

WAINSLIP DROPPERS. 3x1 1/2in. 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 1x1 1/2in. ACOS CRYSTAL DESK MIKE. Bargain 35/-.

MIKE TRANSF. 50:1, 3/9 ea.; 100:1 Potted, 10/6.

LOUDSPEAKERS P.M. 3 OHM. 5in. Rola, 17/6.

6in. x 4in. Rola, 13/6. 7in. x 4in. Rola, 21/-

10in. x 6in. Rola, 27/6. 8in. Rola, 13/6.

6in. Rola, 18/6. 8in. Rola, 21/- 10in. Rola, 30/6.

HI-FI TWEETERS, 4in., 25/- 12in. Piesley, 30/-

12in. Baker 15 wt. 3 ohm and 15 ohm models, 105/-

12in. Baker form suspension 15 w. 15 ohm, 28.

12in. 15 ohm Piesley 10 wt., 45/-.

I.F. TRANSFORMERS 7/6 pair

465 kcs. slug tuning miniature can 2 1/2 x 1 1/2in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.

Wearite M800 L.F. Miniature 465 kcs., 12/6 pair.

Weymouth I.F. Standard size 465 kcs., 12/6 pair.

CRYSTAL DIODE G.E.L., 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. 865 pf. Miniature, 1 1/2in. x 1 1/2in. x 1 1/2in., 0.005 Standard with trimmers, 9/-, less trimmers, 2/-. Midget 7/8; Single 60 pf., 2/6;

100 pf., 150 pf., 7/-. Solid dielectric 100, 300, 500 pf., 3/6.

VALVE HOLDERS. Box Int. Oct., 4d. EF50, EA50, 6d.

B12A, CRT, 1/3. Eng. and Amer., 4, 5, 6, 7 pin, 1/4.

MOULDRED Mazda and Int. Oct. 6d., B7G, B8A, B8G, B9A, 9d.

B7G with can, 1/6; B12A, 1/3. B9A with can, 1/9.

CERAMIC, EF90, E7C, B9A, Oct. 1/-, B7G, B9A, Can, 1/-

SPEAKER FRET. Gold Cloth 17in. x 25in., 5/-, 25in. x 35in., 10/-, Tygan 54in. wide, 10/- ft. 27in. wide, 5/- ft. Samples, S.A.E.

WAVECHANGE SWITCHES

2 p. 4 way, 3 p. 2 way, short spindle 2/6

2 p. 4 way, 2 water, long spindle 2/6

2 p. 6 way, 4 p. 2 way, 4 p. 3 way, long spindle 3/6

2 p. 4 way, 1 p. 12 way, long spindle 3/6

Wave change "MAKITS" 1 water, 8/6; 2 water, 12/6;

3 water 16/-; 4 water 19/6; 5 water 23/-; 6 water 26/6.

TOGGLE SWITCHES. E.F.P., 2/-; D.F., 3/6; D.F.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.

EDISWAN TRANSISTORS JUNCTION TYPE P.N.P.

AUDIO XB102, for amplif. R.F. XA104 frequency and output stage up changer up to 4 Mc/s. 18/-

to 250 milliwatts in push-pull. PRICE 10/- XA103 IF amp. etc. up to 3 Mc/s. 15/-

Gottop Power V16/10P, up to 10W with heat sink, 20/-.

1960 RADIOGRAM CHASSIS



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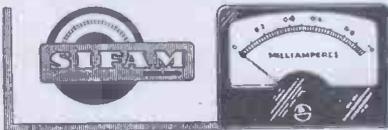
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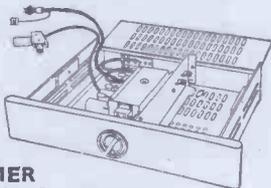
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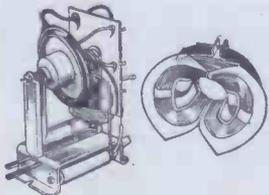
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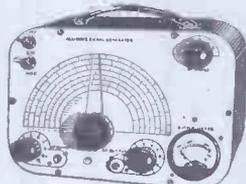
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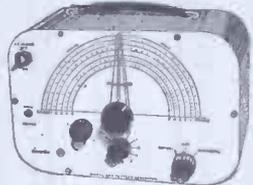
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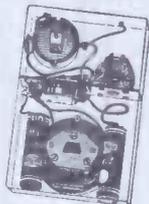
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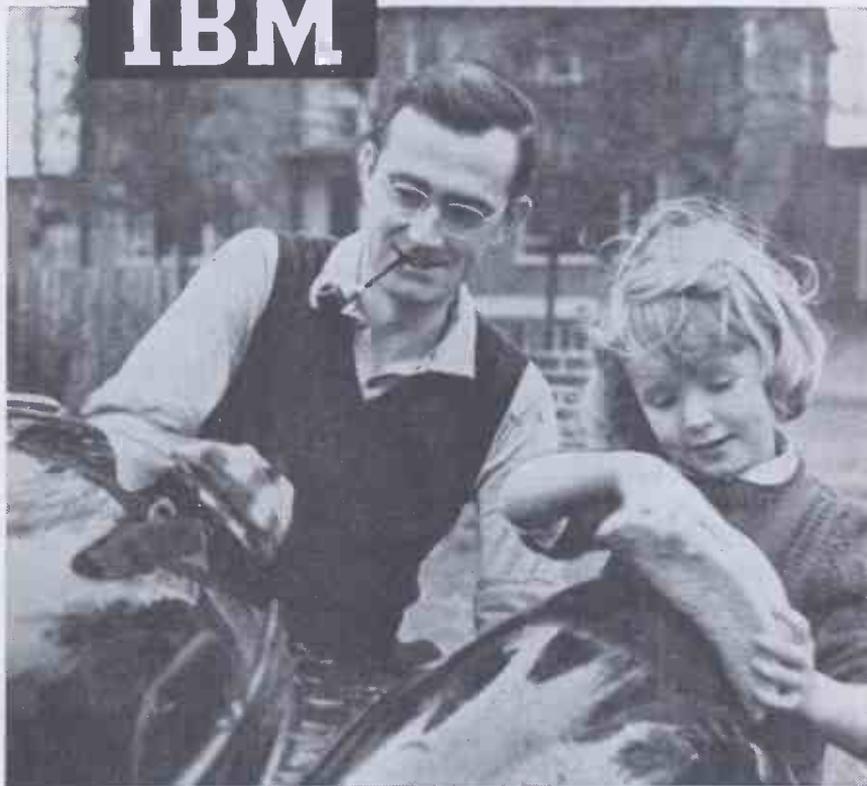
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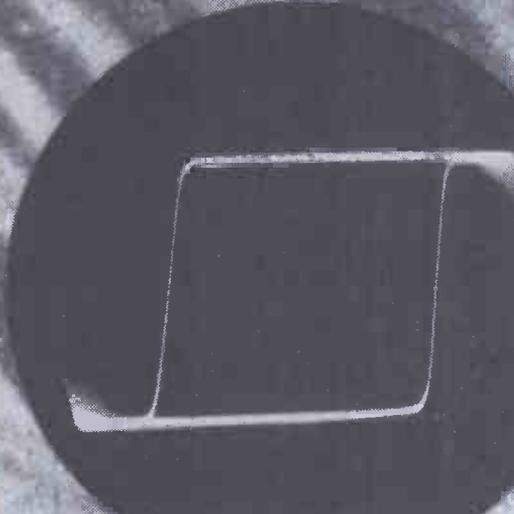
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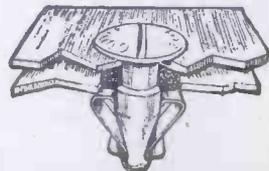
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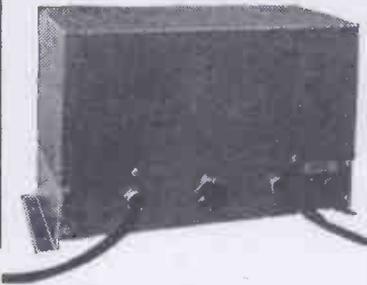
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 1087WB, 2 CO, 160 Ω, 24 V., 95 mA. pull-in, 15 mA. drop-out, 2 1/2 in. x 1 1/2 in. x 1 1/2 in. 5/6, p.p. 1/6
 1220, 2 M, 160 Ω, 24 V., Heavy Duty, 90 mA. pull-in, 20 mA. drop-out, 3 1/2 in. x 1 1/2 in. x 1 1/2 in. 7/6, p.p. 1/6
 1227/893, Canned, 2 M., 24 V., 160 Ω, 80 mA. pull-in, 25 mA. drop-out, 3 1/2 in. x 2 1/2 in. x 2 in. 7/6, p.p. 1/6
 2026, 2 M., 2 B., 160 Ω, 24 V., 160 mA. pull-in, 20 mA. drop-out, 3 1/2 in. x 3 1/2 in. x 1 1/2 in. 7/6, p.p. 1/6

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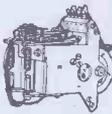
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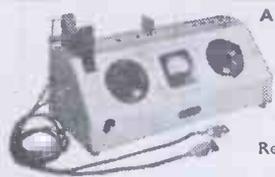
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Screen coating gives blue-white short persistence and yellow long persistence, trace. Average operating condition: V(a3) 4,000 v., V(a2) 2,000 v., V(a1) 360-700 v. Cut-off voltage 45-75. Sensitivity 80-100 v. D.C. per inch on "Y" and 70-80 v. D.C. per inch for "X" axis. Heater 6.3 v. 0.0 A.

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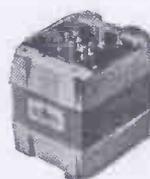


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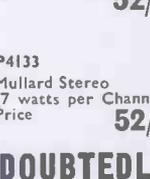
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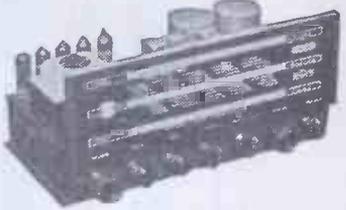
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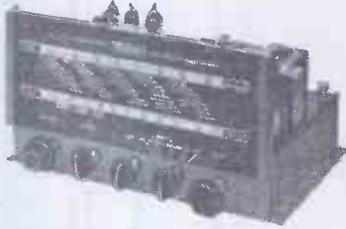


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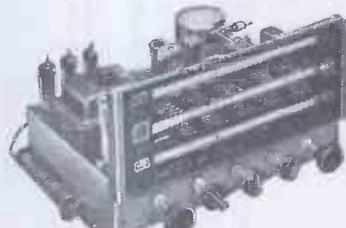
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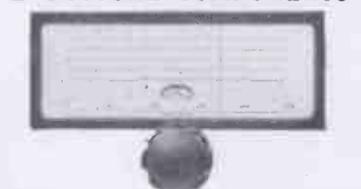
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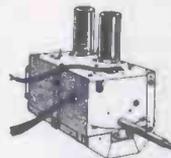
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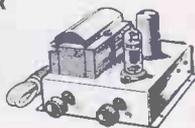
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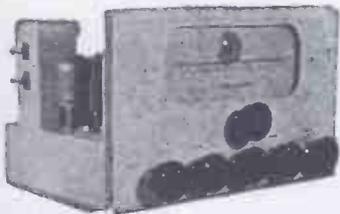
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The work covers a wide field and includes the investigation of problems relating to the Board's V.H.F. and U.H.F. radio systems, remote control, indication and telemetering systems and radio interference from high voltage plant.

Candidates should possess qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

The salary will be within the range £925—£1,170 per annum in accordance with Class AX/EX, Grade 6 of Schedule B to the National Joint Board Agreement.

Applications should be submitted on the standard form which may be obtained from the Secretary, South of Scotland Electricity Board, Inverlair Avenue, Glasgow, S.4. and returned, quoting reference number E14/60, not later than 30th April, 1960.

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High Stability Communications Receiver

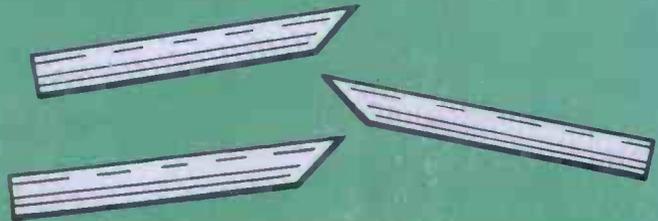
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Laboratory engineers and technicians are invited to write on their company's letter heading for the latest edition of *Modern Solders*, which contains a wealth of information on melting points, gauges, alloys, etc.