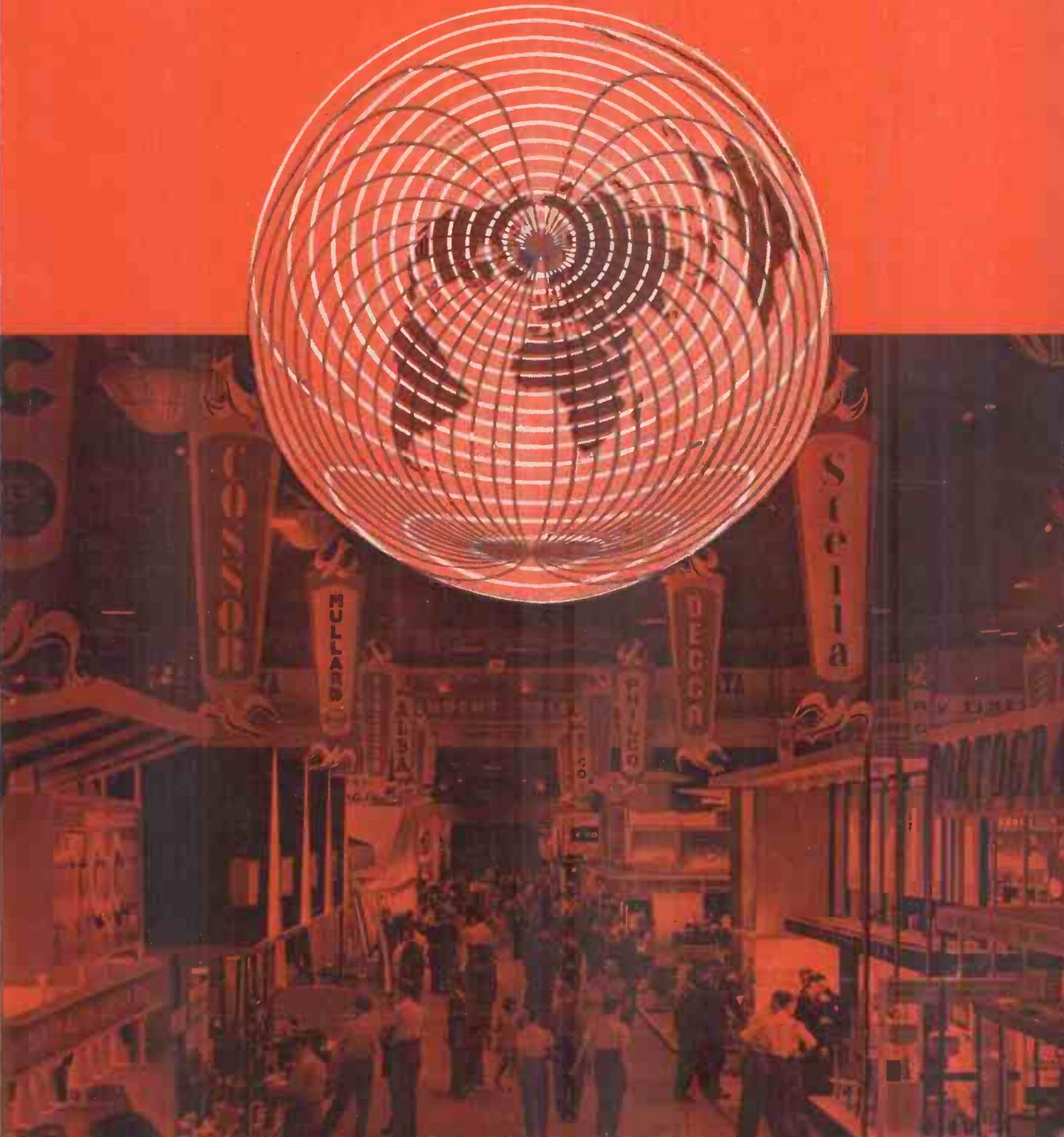


SEPTEMBER 1960 · TWO SHILLINGS

SHOW GUIDE

Wireless World

ELECTRONICS · RADIO · TELEVISION





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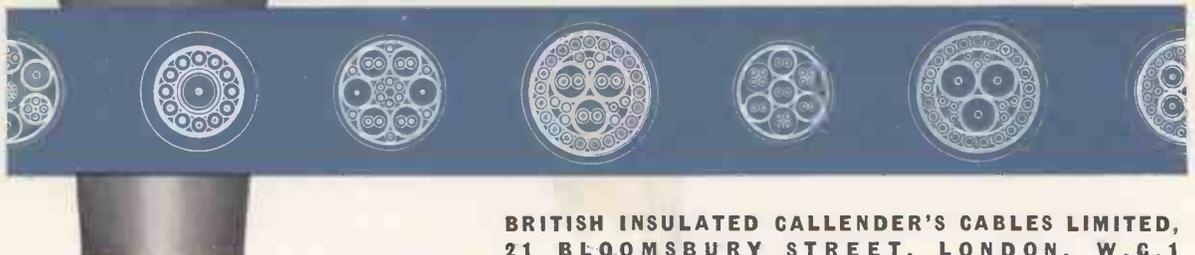
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Wireless World

ELECTRONICS, RADIO, TELEVISION

SEPTEMBER 1960

Managing Editor :

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VOLUME 66 No 9.

PRICE: TWO SHILLINGS

FIFTIETH YEAR
OF PUBLICATION

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

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PUBLISHED MONTHLY (4th Monday of preceding month) by **LIFFE & 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 authorized 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**: 62, Buchanan Street, C.1. Telephone: Central 1265-6. **MANCHESTER**: 260, Deansgate, 3. Tel. phone: Blackfrairs 4412. **NEW YORK** OFFICE: U.S.A.: 111, Broadway, 6. Telephone: Digby 9-1197.

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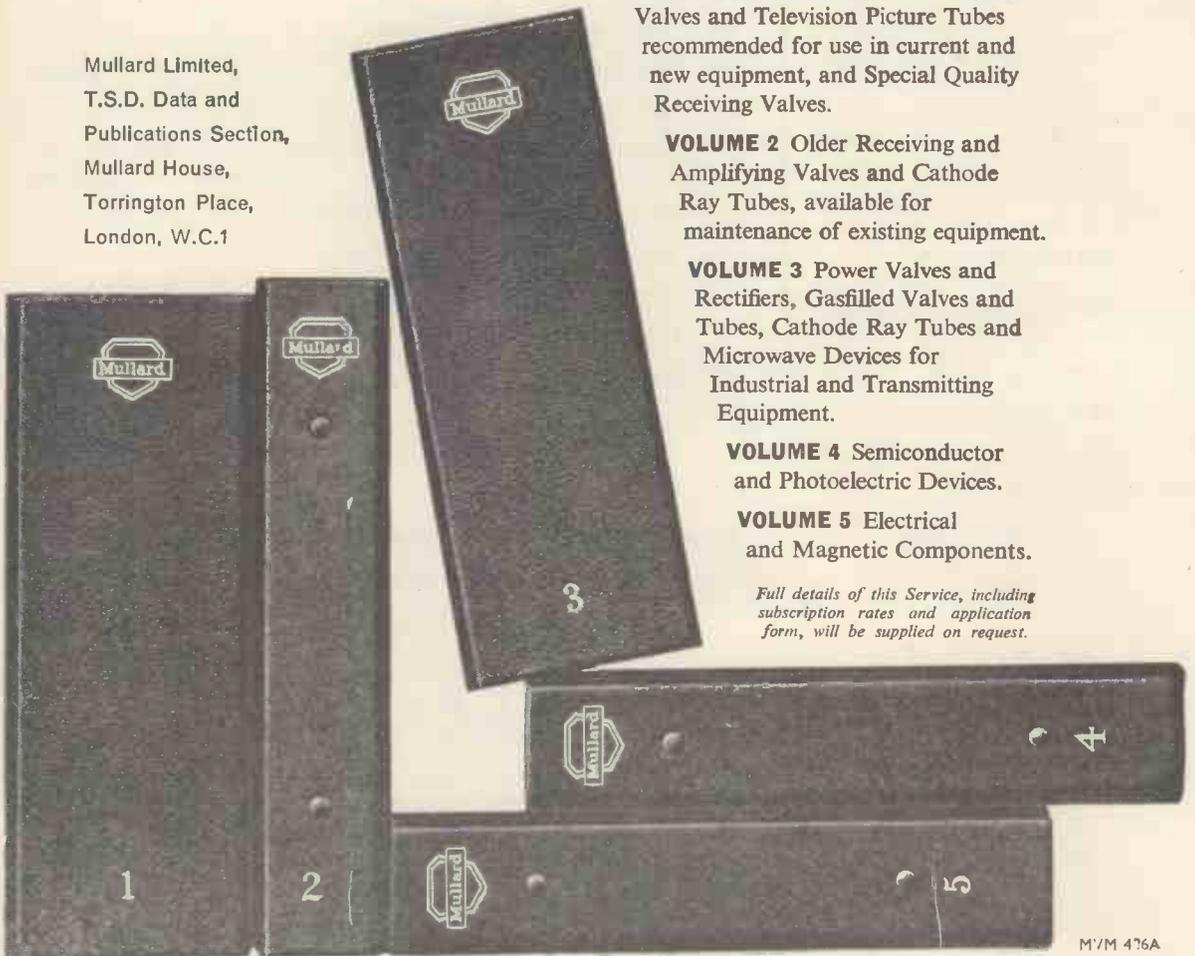
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The National Radio Show

ONCE again the annual exhibition of the British domestic radio and television receiver manufacturers opens its doors at Earls Court and we are to experience the bustle and excitement, the sights and sounds, both familiar and unexpected, which combine to create the special atmosphere which is associated with this annual event. True things are not as hectic as they are remembered in the early and middle 1930s when the pace of technical development from the primitive to the sophisticated was at its hottest, and we shall not lack the depressive cynicism of those blasé individuals who pretend to find nothing new—"The mixture as before, old boy." But let no one mistake stability for stagnation. A little probing behind the familiar facade has never yet failed to produce more than enough to fill the time of the technically minded visitor with interesting food for thought.

To get the best out of an exhibition in the limited time at one's disposal it should be tackled rather like an examination paper. One should go first for the obvious questions (and here we hope that a study of the guide to the stands given elsewhere in this issue will enable readers to decide their individual priorities); then in the time that remains one makes sure that the manufacturers' stands which have not so far been visited do not spring some last-minute surprises. It is not unknown for manufacturers to withhold information until the opening day, or even to surprise themselves by last minute brainwaves!

Among things we shall look for first are the new transistor v.h.f./f.m. battery sets to see how they compare with the "no-compromise" B.B.C. design now being described in this journal. We shall be interested in the picture quality of 405 lines as displayed on 21-in tubes and how far set makers have been successful in solving the now vital problem of ensuring correct interlace. And, of course, transistors which will be shown in embryo and in their multifarious applications in ways which cannot fail to add something to the knowledge of every visitor, layman, or professional. High-quality sound reproduction enthusiasts will make for the Audio Hall, where they may expect to find new pick-ups of phenomenally light construction and tape recorders with yet wider frequency range and extended playing time. Stereo, after its somewhat strident introduction last year, has now settled into its rightful place as an important but not the only contributory element in the

search for a system of realistic sound reproduction.

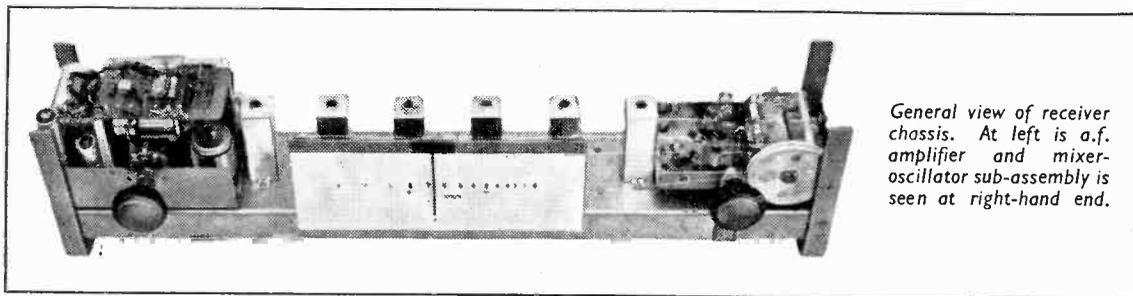
One of the most valuable aspects of the Show is the opportunity which it affords of a glimpse behind the scenes of the sources of broadcast entertainment, to acquaint or remind us of the scale and complexity of the vast fabric of transmission and studio production necessary to put the shortest camera shot on our screens or the briefest news item on our loudspeakers. This is too often taken for granted, as are the lengthy processes of evolving new receiver designs and getting them into quantity production.

The "sideshows" as they are somewhat unkindly referred to by those engaged in the mainstream of the industry, also play an important part. The Services, both civil and military, give us an insight into those aspects of their work which increasingly involve electronics and communications and which they hope will attract the up-and-coming younger generation whose first interest in such things was perhaps stimulated by tinkering with a simple home-built receiver. We particularly commend the enterprise of B.R.E.M.A. and the R.T.R.A. in staging an exhibit to show the public the why and how of radio and television receiver servicing and to attract the best technical talent to a challenging and important career.

The Radio Show has served for nearly forty years as the focal point of the radio industry where potential customers can see under one roof the choice available to them, where manufacturers and their dealers can do business and where those interested in technical development can take stock, conveniently and at first hand, of the march of events. The Show will lose much of its value if it is not comprehensive and we view with misgiving the decision of one of the large firms, Pye, to hold a separate exhibition this year outside Earls Court. It may be true, as they say, that the Radio Show offers limited scope for a sufficiently comprehensive display of the Group's diverse activities, but that could equally well be said of A.E.I. and many other great firms who are nevertheless content to support the Show and to let us see those sections of their interests which impinge on broadcast entertainment. We hope that any unusual circumstances which may have influenced Pye's decision this year may be circumvented and that next year we shall be sure of finding all the important firms, both great and small, once again under the same roof.

Transistor V.H.F./F.M. Receiver

By R. V. HARVEY*, B.Sc., A.M.I.E.E.



2. Construction and Alignment

A GENERAL view of the receiver chassis is shown in the photograph. The i.f. amplifier occupies about 11 inches along the centre of a brass channel $20 \times 3 \times 1$ in; the r.f. and a.f. circuits are housed in separate units at each end. The left-hand knob is the on-off/a.f.-gain control; the right-hand knob controls the tuning and is coupled to the scale pointer by a cord drive using flying pulleys to obtain the expanded tuning scale as shown in Fig. 2; this layout is convenient for the size of cabinet chosen but these units could be disposed in a more compact form if desired, provided that no liberties are taken with the circuit layout. In particular, the i.f. unit has a maximum gain of 90 dB and is unscreened; any reduction in the spacing of two inches per stage would necessitate some additional screening.

R.F. Unit.—Fig. 3 shows the layout of the r.f. circuits. The unit chassis measures $4\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ in and is supported $\frac{3}{8}$ in above the main chassis by four brass pillars; this gives sufficient clearance for the $2\frac{1}{8}$ -in diameter tuning-drive drum. The tuning coils are wound with the earthy ends uppermost to enable the coupling coils to be added subsequently. The r.f. input coil is wound in a left-hand sense for convenience, and the earth return for the coil and input capacitor is a tag on the input socket. The oscillator transistor is placed close to the tuning capacitor with its base lead adjacent to the oscillator coil, to which it is tapped at the first turn via a 3000-pF ceramic-disc capacitor. The tag on the frame of the tuning capacitor is used as the earth

connection for the oscillator coil, the internal screen of the transistor and the collector-decoupling capacitor. A feed-through capacitor in the centre of the chassis supplies the collector and base circuits; the base-feed choke is detailed in the coil winding data.

The i.f. output tags project through holes in the main chassis and are connected directly to the i.f. input coil and the only earth point for the whole mixer is between the tags. The circuit diagram, Fig. 1, shows an extra pair of capacitors and a centre-tapped choke between the oscillator coupling coils and the mixer diode. This latter circuit may be added at a later stage if required but normally it will not be necessary and it has therefore been omitted from the layout. The tuning-capacitor swing is restricted to 150° by two diametrically-opposed studs, $\frac{3}{8}$ in in diameter, fixed to the tuning drum, which engage with a similar stud projecting from the frame bar of the capacitor.

The r.f. unit has a screening cover. This may be omitted if the wiring is kept close to the chassis but there will then be an increase in both oscillator radiation and i.f. break-through. To prevent microphony due to movement of the oscillator circuit, a liberal application of polystyrene cement to the coils and the mixer crystals is recommended, and the transistor should be fixed to the chassis with a suitable adhesive. The coaxial input socket is connected to a socket at the rear of the cabinet by a coaxial lead; an internal dipole, made by splitting

*B.B.C. Research Department.

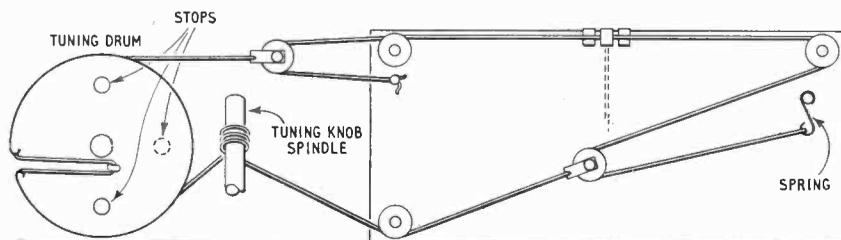


Fig. 2. Arrangement of tuning drive and dial with jockey pulleys to double scale length.

back some twin flex for about two feet and pinning it round the inside of the cabinet back, may be plugged in if desired.

I. F. Unit.—Starting as close as possible to the r.f. unit, the brass channel is drilled for the six coil formers at 2-in spacing between centres. Following each coil a tag-board, $1 \times 2\frac{1}{2} \times \frac{1}{16}$ in, should be mounted under the chassis. The six tag-boards are fixed on $\frac{1}{4}$ in spacers, and each carries six small turret terminals. The first four tagboards carry the four i.f. transistors; the last two carry the limiter, discriminator and first a.f.-stage circuitry. Fig. 4 shows the layout of the first two i.f. stages and Fig. 5 shows the limiter and discriminator. At the end of the i.f. chassis there is a four-pin plug which engages with a socket on the a.f. unit. The pin connections used are:—

1. A.F. output to gain control via C₅₂.
2. Supply for oscillator from Zener diode.
3. Supply for i.f. amplifier.
4. Used as soldering tag for the Zener diode circuit which is mounted on the i.f. chassis for convenience. The earth connection between the two chassis is completed by bolting them together.

A. F. Unit.—The chassis measures $5 \times 3 \times 1\frac{1}{2}$ in and carries a vertical brass partition 3-in square. The output transistors are bolted to this partition with mica plates and nylon screws which are supplied with

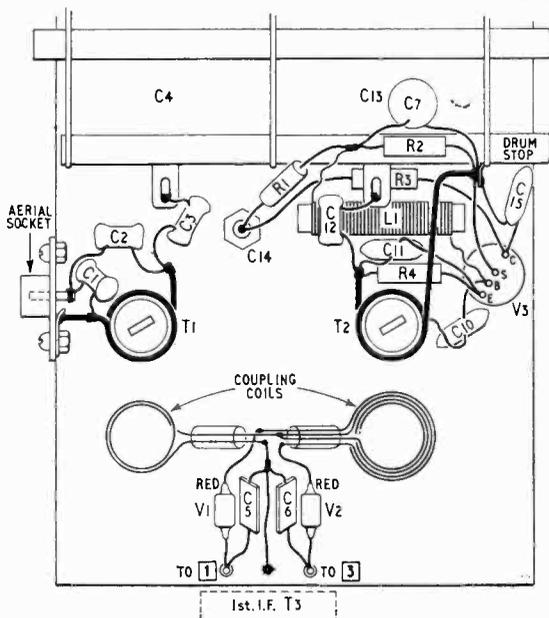


Fig. 3. Layout of r.f. unit. Coupling coils on T₁ and T₂ are shown, for clarity, as if "lifted off" formers.

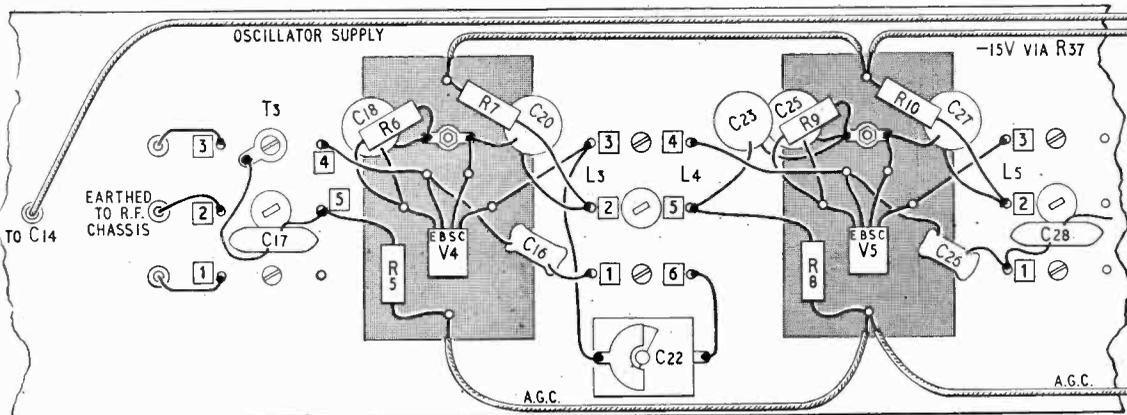


Fig. 4. First and second i.f. amplifier stages: wiring of the following stages is similar.

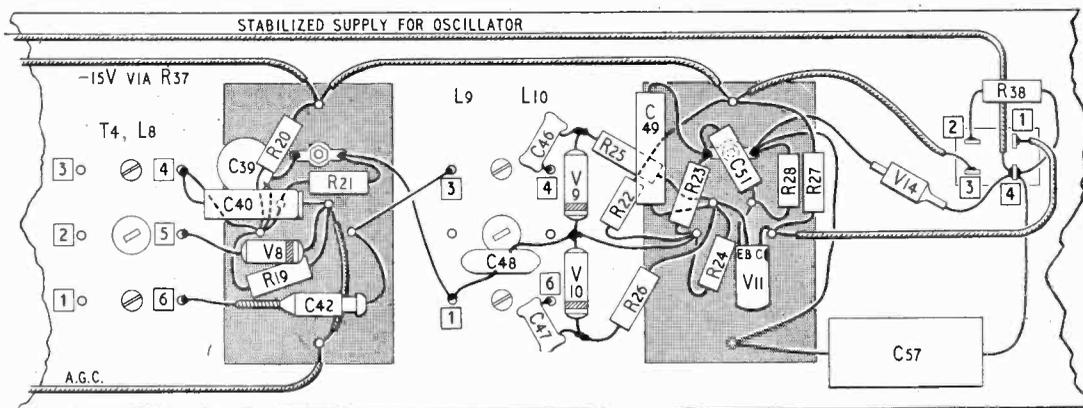


Fig. 5. Limiter, discriminator and first a.f. amplifier layout.

each matched pair of transistors. The power-input plug, loudspeaker socket and the fuse are mounted at the rear of the chassis. A power plug of a polarized type must be used to prevent accidental reversal of the supply; the recommended batteries each require a polarized plug and these should be made up in a power lead with a flying socket connector for the input to the set. An exact layout for this unit is not given as it is not vital to the performance and is determined mainly by the dimensions of the capacitors used.

Alignment

Before switching on for the first time, it is advisable to check that the polarity of the supply and of the electrolytic capacitors is correct. During alignment, any changes to the connections of the circuit should be performed either with the power removed or after careful consideration of the consequences (which may be swift, ominously silent and expensive!).

A. F. Unit.—Disconnect the feedback network, $R_{34}C_{55}$, from the a.f. output and connect it to earth. Disconnect C_{52} from the gain control. R_{39} and R_{41} must then be adjusted so that the quiescent current in the output transistors is between 5 and 10 mA. These currents are best measured by connecting a meter of 1000-ohms resistance across the one-ohm emitter resistors, $R_{44}R_{45}$, and adjusting for between 5 and 10 μ A.

Connect a tone source of 6.8-k Ω impedance to the "live" end of the gain control through an 8- μ F blocking capacitor, and an oscilloscope across a 15-ohm resistor in place of the loudspeaker. If the transformer secondary windings are correctly connected, an input e.m.f. of 70 mV r.m.s. should produce an output of 11 volts peak-to-peak and an increase of input above this should produce a symmetrical flattening of peaks. If there is noticeable cross-over distortion at low input levels, this may be minimized by a further adjustment to R_{39} and R_{41} . Reconnect the feedback network; if the transformer primary sense is correct the gain will fall by 16 to 18 dB.

I. F. Amplifier and Discriminator.—Disconnect the a.g.c. line from C_{40} and connect it to a potential divider consisting of 10 k Ω from the supply and 1.5 k Ω to chassis. Short-circuit L_8 , replace C_{40} by a 100-pF capacitor and connect the junction of this and R_{19} to an oscilloscope via a 10-k Ω resistor. Connect a f.m. signal generator, using a 0.01- μ F isolating capacitor, to the collector of V5. Set C_{33} to half-capacitance and tune L_6 , L_7 and T_4 for maximum response at 10.7 Mc/s. Increase C_{33} in stages, adjusting L_6 and L_7 until the response curve is just over-coupled and adjustment of either L_6 or L_7 produces a tilt of the response symmetrical about the centre frequency. Transfer the signal generator connection to the base of V4, set C_{22} half way and tune L_3 , L_4 and L_5 for maximum at 10.7 Mc/s. Increase C_{22} in stages till the response shows 1-dB peaks at 10.7 Mc/s \pm 60 kc/s, as shown in Fig. 6, and responds to adjustment of L_3 and L_4 by a symmetrical tilt. At each adjustment, vary the input level to ensure that the last i.f. stage, V7, is not over-loading. Replace C_{40} , insert a 1-mA meter in series with R_{19} , measure the response point by point and compare with Fig. 6.

To align the discriminator, transfer the oscilloscope to the a.f. output (top of C_{49}). With the f.m. signal generator set to the centre of the i.f. pass-band, 10.7 Mc/s, and deviated \pm 200 kc/s, set C_{42} to half way and tune L_9 and L_{10} to obtain a symmetrical response of the general shape of Fig. 7. Adjust the discriminator coupling in stages by moving L_9 along the coil former until with further adjustments to L_9 and L_{10} , the response is symmetrical and linear over \pm 120 kc/s. Insert a microammeter between R_{24} and R_{25} and, for constant current in R_{19} , measure the discriminator load current, point by point, over the frequency range \pm 200 kc/s and compare with Fig. 7.

Limiter and Third-Harmonic Filter.—Remove the short-circuit from the third-harmonic filter, L_8 , C_{41} , and re-tune the limiter transformer, T_4 , for a maximum current in R_{19} ; set the input level to make this current 200 μ A. Connect the oscilloscope via a 100-k Ω resistor to the junction of V9 and R_{25} . Apply 100% amplitude modulation to the signal and display the amplitude response of the limiter. The reader should refer to J. G. Spencer's article* for curves showing limiter characteristics in various conditions. L_8 must be adjusted to give a curve with a top as flat as possible, consistent with the knee of the curve occurring at a low value of instantaneous input. If the knee shows at less than 70% modulation or more than 80%, the discriminator coupling capacitor C_{42} should be decreased or increased accordingly. This last adjustment is a matter of compromise in that a greater absolute sensitivity can be obtained by increasing C_{42} at the expense of a lower a.m.-handling capacity by the limiter. The procedure for aligning the discriminator should be checked after completing the limiter and coupling adjustments; the a.g.c. line is then re-connected.

The above alignment may, if desired, be performed at an input frequency of 90 Mc/s after adjusting the r.f. circuits.

R.F., Oscillator and Mixer Circuits.—Break the earth connection between Pin 2 of T_3 and chassis,

*Wireless World, Vol. 65, p. 493 (November 1959).

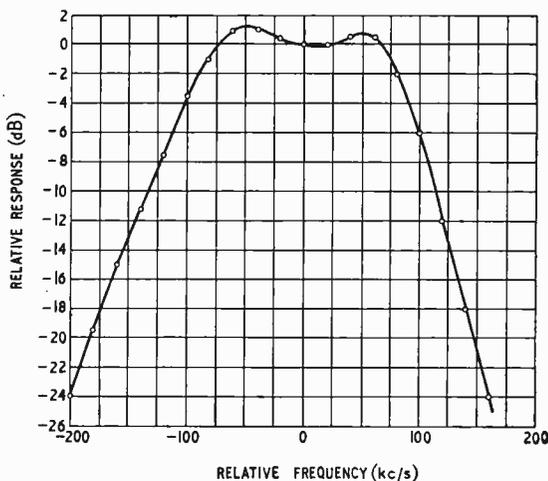


Fig. 6. Overall frequency response preceding limiter.

insert a 0.01- μ F disc capacitor and connect across it a 1-mA meter to measure the mixer current. Set the tuning capacitor to half-mesh, remove the dust core from T_1 and set the core of T_2 so that it protrudes $\frac{1}{2}$ in from the top of the former. Adjust R_1 to give maximum mixer current; this should be at least 150 μ A, at a collector current in V3 of about 1 mA. Insert the core into T_1 from the top until a dip occurs in the mixer current reading, then unscrew the core three turns. Connect a f.m. signal generator to the aerial socket and set its output to 1 mV at 91 Mc/s. Adjust T_2 core until the signal is heard and then set T_1 for maximum limiter-load current. The tuning range should be adjusted in this way so that at 87 Mc/s the capacitor is at 160° and at 100 Mc/s it is at 10° from minimum capacitance.

Resistors

The resistors used in the original receiver were 10% $\frac{1}{4}$ W Erie Type 16, except R_{44} , R_{45} and R_{46} .

R1*	56k Ω	R15, 20,		R24, 29	8.2k Ω
R2	2.2k Ω	21, 27,	} 6.8k Ω	R25, 26	100k Ω
R3	100 Ω	34		R28	1.2k Ω
R4	150 Ω	R16	5.6k Ω	R32	390 Ω
R5, 8, 31	3.3k Ω	R17	1.5k Ω	R35	47k Ω
R6, 9, 13	4.7k Ω	R18, 39*	} 560 Ω	R37	47 Ω
R7, 10, 14	1.8k Ω	41*		R38, 46	680 Ω
R11, 33	22k Ω	R19, 22	10k Ω	R40, 42	22 Ω
R12	15k Ω	R23, 30, 36	1k Ω	R43	10 Ω

*Adjust on test, see alignment instructions.

The volume control is 5 k Ω log, or semilog, law potentiometer with switch. Resistors R_{44} , R_{45} and R_{46} are one ohm in value and are made by winding a $13\frac{1}{2}$ -in length of 26 s.w.g. insulated (double-cotton-covered) Eureka wire as a self-supporting coil.

Fixed Capacitors

Many of the capacitors listed below were chosen not only for a particular value of capacitance but for other features such as temperature coefficient or size. If it is desired to use a component produced, for instance, by another manufacturer, a careful check should be made to ensure that all

C1	100 pF Erie N750/BD
C2, 16, 24,	} 6.8 pF Erie NPO/AD
29, 36	
C3, 12	18 pF Erie N750/AD
C5, 6	470 pF T.C.C. 101 SMP
C7, 10,	} 3000 pF Erie K7004/831
11, 15	
C8, 9	47 pF Erie NPO/AD
C14	4700 pF T.C.C. CTH315/LT
C17, 18, 20,	} 0.01 μ F Erie K7004/811
23, 25, 27,	
28, 30, 32,	
35, 37, 38,	
39, 48	

C19, 21,	} 330 pF T.C.C. 101 SMP
31, 34	
C26	68 pF T.C.C. 101 SMP
C40	8 μ F 15V electrolytic, T.C.C. CE67B
C41	3.3 pF Erie NPO/AD
C43, 44, 45	120 pF T.C.C. 101 SMP
C46, 47	27 pF
C49*	0.01 μ F
C50, 57, 60	1000 μ F 25V electrolytic
C51	100 μ F 6V electrolytic

C52	8 μ F 15V electrolytic
C53, 56	1000 μ F 6V electrolytic
C54	4 μ V 12V electrolytic
C55	820 pF mica
C58	0.25 μ F paper
C59	500 μ F 12V electrolytic

* The value (0.003 μ F) given for C49 in Fig. 1 (August issue) gives a de-emphasis time constant of about 15 μ sec (not 30 μ sec as stated) for treble boost. For 50 μ sec de-emphasis (flat electrical response) C49 should be 0.01 μ F. References to 1,200pF for C49 in both the caption to Fig. 1 and p. 369 should be deleted.

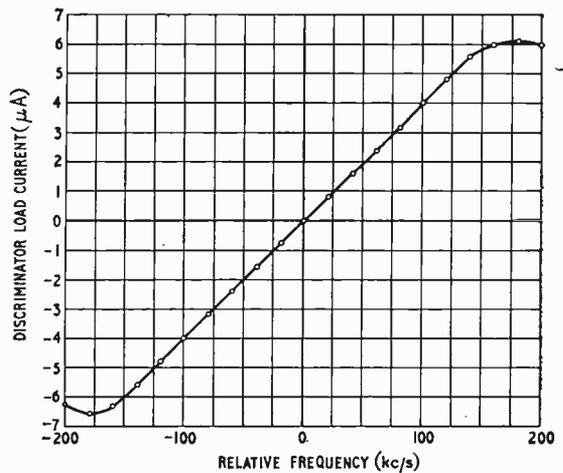


Fig. 7. Discriminator response for a signal giving a constant voltage at the limiter.

important characteristics are the same as those of the specified component.

Variable Capacitors

As with some of the fixed capacitors, special characteristics may have influenced the choice of the variable capacitors specified.

- C4, 13 Tuning capacitor. Wingrove and Rogers, Type C28-142, 9/0.045in. 7 to 18 pF per section. Restricted to 150° swing by stops on drum.
- C22, 33 I.F. coupling. Wingrove and Rogers Type C32-01, 10/0.0075in. 2 to 11 pF.
- C42 Discriminator coupling. Wingrove and Rogers Type S50-01/2. 0.7 to 4 pF.

Coil Data

Unless otherwise stated, the wire used for winding is enamel insulated. Numbers in brackets indicate the connections shown on the circuit diagram given last month (Fig. 1) and correspond with the numbers given on the coil formers. Where capacitors are mentioned, they should be fitted inside the screening can.

R.F. and Oscillator Former: Neosid 3500, Bakelite, 7 mm outside diameter (o.d.)
Core: Neosid 901, 6 × 12 mm.

R.F.: T1 6 turns 20 s.w.g. tinned-copper (t.c.) wire spaced to occupy 0.4in.
Coupling coil; 2 turns 36 s.w.g. interwound with last turn at earthy end.

Oscillator: T2 8 turns 20 s.w.g. t.c. spaced to occupy 0.6in.
Coupling coil; 2 turns bifilar 36 s.w.g. connected as 4 turns with centre tap and interwound with last turn at earthy end. Base tapping one turn from emitter end of winding.

Bias Choke: L1 110 turns 40 s.w.g. close wound on $\frac{3}{16}$ in o.d. paxolin tube or rod, with 20 s.w.g. t.c. end wires $\frac{1}{8}$ in apart.

Mixer Choke (optional) L2 40 turns 38 s.w.g. centre-tapped (c.t.) on Neosid CH2 dust core.

I.F. Amplifier Former: Neosid 5000 B/6E (7.6 mm o.d.)
Top: Neosid 5001/6E.
Can: Neosid DTV/1.
Core: Neosid 900, 6 × 1 × 12 mm.

Input: T3 Primary; 5 turns bifilar 22 s.w.g. close wound, connected as 10 turns (1, 3) with c.t. (2).
Insulation; 2 turns cellulose tape.
Secondary; 7 turns (4, 5) 22 s.w.g. close wound centrally over primary.

Second i.f.: L3 Primary at top, 12 turns 22 s.w.g. (1, 3) tapped (2) at 3 turns from (1).
Coil spaced to occupy $\frac{1}{2}$ in. Capacitor, C19, across coil, 330 pF silvered mica.
Spacing between coils $\frac{1}{8}$ in.

L4 Secondary 12 turns 22 s.w.g. (4, 6) tapped (5) at 3 turns from (4).
Coil spaced to occupy $\frac{1}{2}$ in. C21 across coil, 330 pF silvered mica.

Third i.f.: L5 24 turns 28 s.w.g. (1, 3) close wound tapped (2) at 6 turns from (1).
C26 across coil, 68 pF silvered mica.

Fourth i.f.: L6, L7 As second i.f. L3, L4 respectively, (capacitor numbers C31 C34).

Limiters: T4 Primary at top starting (1) $\frac{1}{8}$ in below top plate, 32 turns 38 s.w.g. (1, 3) tapped (2) at 8 turns from (1).
Secondary; 72 turns 38 s.w.g. (4, 6)
Wound as single layer solenoid with 24 turns of primary (2, 3) interwound with first 24 turns of secondary starting at (4).

Third-harmonic filter: L8 25 turns 38 s.w.g. close wound (5, 6) finishing (5) $\frac{1}{4}$ in from base of same former as limiter T4. C41 across coil, 3.3 pF.

Discriminator: L9 Primary at top, starting at (3) wound on one layer of cellulose tape, sticky side out, to allow adjustment, 15 turns 30 s.w.g. spaced 1 : 1 (1, 3). C43 across coil, 120 pF silvered mica.
Spacing between coils about $\frac{1}{8}$ in.

L10 Secondary 20 turns 30 s.w.g. close wound (4, 6).
Two capacitors, C44, C45 (3, 4) and (3, 6) 120 pF silvered mica.

A.F. Driver Transformer

Core: T5 $\frac{3}{4}$ in stack of 0.015in. Type 158 Mumetal* laminations. Fully interleaved, butt joint in centre limb.

Primary: 1200 turns 38 s.w.g. in two sections of 600 turns each side of secondary winding (7, 9).

Secondary: 2 windings, 300 turns 34 s.w.g., wound bifilar (1 and 4, 2 and 5).

Satisfactory results can be obtained with a Gilson Type WO929/6 transformer, but there may be a 1 to 2 dB loss in feedback and power output.

Transistors and Diodes

V1, 2	GEX66	G.E.C.
V3	2N247	R.C.A.
V4, 5, 6, 7	OC170	Mullard
V8	OA86	Mullard
V9, 10	OA81	Mullard
V11	OC75	Mullard
V12	OC71	Mullard
V13	V10/30A	Newmarket
V14	Z2A110	S.T.C.
V15, 16	GET115	G.E.C.

Batteries

Two Ever-Ready Type AD39 or equivalent (7.5V each, series connected).

To be concluded. (Part 1, dealing with design considerations and giving the theoretical circuit diagram, was published in the August issue of *Wireless World*).

*Telcon Metals Ltd., Manor Royal, Crawley, Sussex.

Aluminium in Telecommunications

TWENTY of the thirty pages in the latest edition of the *Aluminium Courier* (No. 49), published quarterly by the Aluminium Development Association, are devoted to a review of the "ever-widening range of applications" of aluminium in telecommunication engineering. The review covers cables, waveguides, aerials and towers, radar scanners, components and the aluminizing of c.r. tubes. The *Aluminium Courier* is obtainable from the A.D.A., 33, Grosvenor Street, London, W.1, price 2s 6d.

Medical Electronics at Olympia

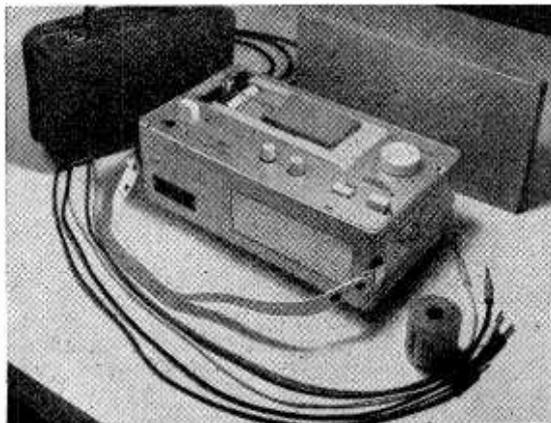
THIRD INTERNATIONAL CONFERENCE AND ASSOCIATED EXHIBITION

ONE of the main objects of organizing conferences, exhibitions and other media of communication in medical electronics has been to bring together medical men and electronics engineers into a partnership from which both sides could benefit by an exchange of ideas. So far this cosy situation has not materialized. In spite of three conferences, two exhibitions and the formation of an international body, the medical profession has failed to co-operate and the communication is still all one way.

Whether this is because of conservatism, fear of being "blinded by science," or just professional snobbery on the part of the doctors, the tactics of the electronics people have clearly not been very successful. The Third International Conference and associated exhibition, held at Olympia in July, was, therefore, like the two previous events, largely a means of preaching to the converted. It served a useful purpose in bringing together the limited number of specialists in medical electronics—whether engineers or doctors—but did not reach the larger audience that was hoped for.

A noticeable technical trend in the medical electronics apparatus on view was, as might be expected, the wide use of transistors. In hospitals it is particularly important that instruments like electrocardiographs and stimulators should be as small and light as possible, for they have to be moved from department to department very quickly, and in operating theatres in particular there is a limit on the space available for them. A transistorized electrocardiograph which was particularly noticeable for its small size, clean lines and elegant appearance was shown by the Tokyo Sibaura Electric Company of Japan, where medical electronics is a highly-organized sphere of activity.

Apart from reducing the size of existing types of apparatus, transistors have made possible new instruments which could not have been developed before.



Compact transistorized electrocardiograph (Tokyo Sibaura Electric)

One example was the implantable pacemaker for the heart shown by Sierex Ltd. This device, originally developed by Elmgrist of Sweden, is a tiny transistor stimulator, encased in plastic which is implanted inside the body with its output electrode, on the end of a flexible lead, sewn on to the heart. The transistor circuit supplies pulses of 2msec duration and 2V amplitude at the normal heart rate of about 70 per minute. It is energized by a sealed nickel-cadmium battery which is charged at intervals by an electromagnetic induction system using a coil



Electronic pacemaker for the heart (Sierex)

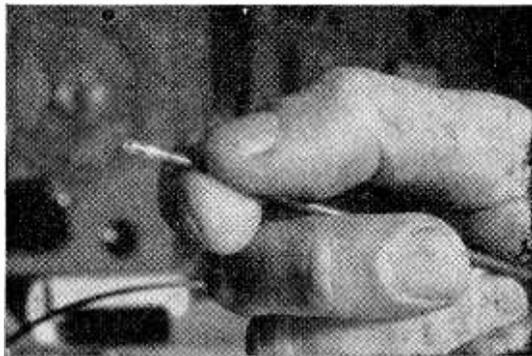
carrying 10kc/s a.c., outside the body and a small coil and rectifier inside the pacemaker.

Another small transistor device for internal operation, is, of course, the "radio pill" or telemetry transmitter which has now been widely reported. Production models of these tiny transmitters were on view. They are used mostly for measuring pressures in the gastro-intestinal tract (in the range 0-3lb/sq. in.) but later models are being developed to measure temperature and pH values. An experimental "pill" for measuring pH, shown by the Medical Research Council, is designed so that the whole case acts as a voltaic cell when immersed in the fluid inside the alimentary canal. The varying voltage derived from this is applied to a back-biased silicon junction diode so that its capacitance is varied, and the alterations in capacitance are then used to modulate the frequency of the transistor oscillator.

In a paper by Farrar, Zworykin and Berkley a new type of radio pill was described in which the size was reduced and the limitation on operating life (due to the battery) was eliminated by using a system of energization from outside the body. As with the implantable pacemaker, electromagnetic induction is used but there is no battery to be charged in the "pill." Short bursts of 400kc/s energy are sent into the "pill" at 3,000 per second. These cause a tuned circuit to ring, and it does so in the intervals between bursts, not at 400kc/s, but

at its own resonant frequency, which is determined by a capacitance transducer measuring pressure in the alimentary canal. The energizing coil is also used for picking up these responses, and in the f.m. receiver used for detection an electronic gating system separates them from the energizing bursts.

Another tiny device for measuring pressures internally was really a probe—a micromanometer, shown by Telco of France, mounted on a catheter



Micromanometer probe transducer (Telco)

for passing along a blood vessel into the heart. Measuring only 2.7mm in diameter and 7mm long, the micromanometer has a transducer consisting of a magnetic core fixed between two thin diaphragms. This moves axially with pressure changes and produces corresponding inductance changes in a coil. These changes are measured by a frequency modulation system. The pressure range of the device is ± 300 mm of mercury and as the frequency response extends to 5kc/s, the manometer can also be used as an intracardiac phonocardiograph for making a record of the sounds associated with heart action.

The use of an intracardiac phonocardiograph for locating precisely the source of murmurs and other defects of the heart was described in a paper by Wallace, Lewis, Dietz and Brown. In this case, however, the instrument was based on a barium titanate transducer and had a response up to 10kc/s.

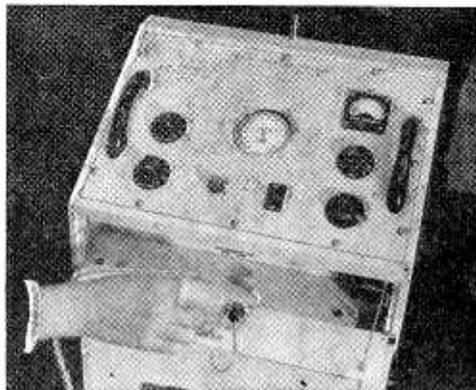
Another paper concerned with cardiac instrumentation by L. J. Ryan described a miniature, self-contained cardiometer for recording the heartbeats of patients while they move about. Looking rather like a hearing-aid, it contains a four-stage transistor amplifier for amplifying the electrical potentials from the heart and the counting is done by a wristwatch movement through electromagnetic actuation of the escapement mechanism. Incidentally this device was developed on a voluntary spare-time basis by a group of American engineers called S.A.V.E. (Service Activities of Volunteer Engineers).

Turning to the circulation system itself, Winston Electronics showed an equipment for continuously recording a patient's blood pressure over long periods of time. In this follower system, the arterial pulsation from a finger or toe is picked up by a piezoelectrical crystal. The pulsation signal is used to open an air-valve which inflates a cuff from a small pump. This cuff starts to occlude the artery and when the occlusion is complete the air valve closes. A leak then allows the cuff to deflate until arterial pulsations reappear and once again the pump starts to inflate the cuff. The cuff pressure needed to

occlude the finger artery is only a few millimetres of mercury above the arterial pressure. Indication of the measured pressure is given on a dial and on a pen recorder.

For measuring the rate of flow of blood in the circulatory system it is normally necessary to puncture the blood vessels in some way. In the electromagnetic flowmeter, for example, the blood moving through a magnetic field generates a small voltage across a section of the artery, and this has to be picked up by inserting electrodes. A technique which requires no such connections to the patient was described in a paper by J. R. Singer. It is based on nuclear magnetic resonance and makes the measurements through the agency of radio frequency and steady magnetic fields. The application of the r.f. field in a short burst, locally through a coil, causes the magnetic movements of the nuclei of the blood atoms to change their orientation rapidly back and forth with respect to the steady magnetic field. This produces a kind of "tracer" condition in the bloodstream which persists for about 0.4 second. At a known distance along the blood vessel from the point of application of the r.f. field the arrival of the "tracer" is detected, and from the measured time between these two events the blood flow can be determined. The detection is based on the fact that the nuclei in the "tracer" condition do not absorb as much r.f. energy as they do in their normal condition, and this is shown up by an auxiliary r.f. oscillator and a receiver. Time interval measurement is done on the time base of a c.r.o.

In the field of ultrasonics, great interest was shown in C. N. Smyth's ultrasonic camera for internal examination. This device, which was described fully in our August 1958 issue* converts a pattern of 4Mc/s ultrasonic energy (produced by the absorption pattern of the object under examination) into a television-type picture by means of a piezoelectric quartz disc acting as the target in a television pick-up



Automatic blood-pressure follower for continuous recording (Winston Electronics)

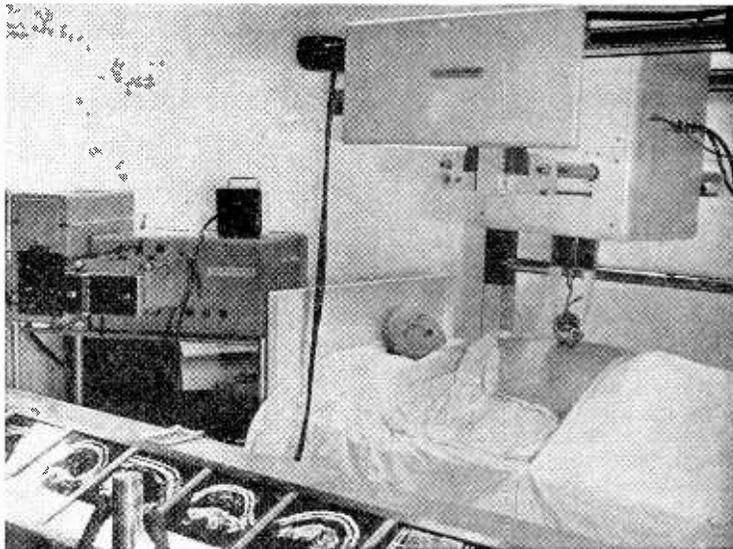
tube. Another ultrasonic examination system shown by the Western Infirmary, Glasgow, used echosounding principles and slow-mechanical scanning to build up a picture from responses displayed on a cathode-ray tube.

Ultrasonic reflections were also used in a simple apparatus, described in a paper by two Japanese

* "Medical Electronics Conference." *Wireless World*, August 1958, p. 361.

authors, S. Satomura and Z. Kaneko, for examining the condition of the blood vessels and the patterns of flow in them. It consisted of an ultrasonic transducer energized for transmitting by a 5Mc/s oscillator and with a receiver and recorder for detecting and displaying the echoes. In the blood vessel, turbulences or fluctuations in the flow produce a kind of noise in the reflected ultrasonic signal due to complex interactions of waves on the Doppler principle. Since the turbulences are proportional to the rate of blood flow, the intensity of the noise in the reflected ultrasonic signal gives an indication of this rate of flow. So do the frequencies in the noise, which get higher with increasing rates of flow.

Summing up the conference which was organized by the I.E.E. in association with the International Federation for Medical Electronics, it could certainly be put down as a success. It drew about 150 contributions and about 800 delegates from all parts of the world. The exhibition, too, was very international in character, as a good 50 per cent of the exhibitors came from overseas. Although the commercial section of the exhibition was very well laid out, it was a pity that the stands devoted to research and hospitals were crammed into an inadequate area



Ultrasonic scanning system (Western Infirmary, Glasgow)

with narrow alleyways, hidden behind the escalators, like the slum quarters of a town. However, the scene here was greatly enlivened by the general air of informality, and the notice which said "Both of these demonstrations are pretty crude, but we only thought of the circuit last week" revived the pioneering spirit and cocked a healthy and corrective snook at the rather bland atmosphere of salesmanship that hung over the rest of the exhibition.

BOOKS RECEIVED

Basic Electronics, by Bernard Grob. Vol. 1 follows the order of topics presented in the first term's work of the technicians' training course at RCA Institutes, starting with elementary electricity and magnetism and ending with a brief insight into valves, transistors and radio frequency losses. It is to be followed by a second volume on Applied Electronics. Pp. 524; Figs. 383. Price 50s 6d. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4.

Proceedings of the National Electronics Conference, 1958 (Vol. 4). Illustrated record (99 papers) of the annual conference held at Hotel Sherman, Chicago, Illinois, covering all aspects of radio and electronics from antennas to automatic navigation and from audio to computers. Pp. 1074, profusely illustrated. Price £7.50. National Electronics Conference, Inc. 228, N. La Salle Street, Chicago 1, Illinois, U.S.A.

A Quality-Checking Receiver for V.H.F./F.M. Sound Broadcasting, by C. G. Mayo, M.A., B.Sc., M.I.E.E., B.B.C. Engineering Division Monograph No. 25, gives circuit diagrams and performance details of two alternative prototype receivers, designed, without compromise to give a high standard of performance. Pp. 15; Figs. 13. Price 5s. B.B.C. Publications, 35, Marylebone High Street, London, W.1.

Testing of Screened Enclosures, by J. Miedzinski, B.Sc., A.M.I.E.E. Methods of measuring insertion loss and its dependence on the details of experimental arrangements as well as on frequency and the construction of the enclosure. Pp. 27; Figs. 19. Price 24s.

The British Electrical and Allied Industries Research Association, Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

Insulation for Small Transformers, by J. H. Mason and C. G. Garton. Handbook for designers reviewing the factors influencing electric strength and life of insulation, methods of non-destructive testing and data on new materials. Pp. 93; Figs. 33. Price 37s 6d. The British Electrical and Allied Industries Research Association, Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

OCTOBER ISSUE

In addition to a varied selection of technical articles and the usual coverage of news from all quarters, our next issue, on sale on September 26th, will include the following special features.

Radio Show Review.—An assessment of trends in the design of sound and television receivers, as portrayed at the Earls Court Show.

S.B.A.C.—Developments in the field of aeronautical radio and electronics exemplified by manufacturers' displays at the static exhibition at the Farnborough Air Show (September 5th-11th).

Converting to Stereo

JOINING TWO MONO AMPLIFIERS

SUPERFICIALLY there would seem to be little more in setting up a stereo amplifier system than is implied in the sub-title above. But there can be snags and it may be worth while to consider the minor troubles which can arise, their cause and cure.

The usual general methods of layout should, of course, still be followed, with the addition that considerable care must be taken to avoid coupling between the two amplifiers. This care is necessary since, for a given degree of coupling, the crosstalk produced in the stereo case is much more serious than the level change produced in the corresponding mono case—3dB crosstalk is much more serious than 3dB level change. Such coupling can arise via stray capacities or common earth or h.t. wiring. As in the corresponding mono case with level changes, common earth or h.t. wiring is likely to be a much less serious source of crosstalk than stray capacities. To reduce stray-capacity crosstalk it may well be worth separating the two amplifiers by an earthed metal screen. The effects of any stray capacities can, of course, be reduced by decreasing the circuit impedances connected to these capacities.

Additional Layout Problems

Earth wiring can also, of course, form hum loops. Working out an arrangement of earth connections which avoids hum loops is likely to be more difficult in stereo since one is often committed in advance to a number of earth points which are common to both amplifiers. Examples of such earth points are the common terminal of the stereo pick-up when this is a three- rather than a four-terminal device, on the balance control when this consists of a single potentiometer with its slider earthed and one arm in each amplifier, and in a common power supply.

The desirability of mechanically ganging certain of the controls, for example, the volume, bass and steep-cut controls, also imposes some restrictions on possible layouts for the two amplifiers. It may be advantageous not to gang the treble controls so that one can still make some allowance for any difference between the two loudspeakers or their acoustic surroundings—such differences are likely to be most pronounced at high frequencies.

It will naturally often be convenient to use a single common power supply. The current ratings required for the rectifier and smoothing choke are then, of course, the sum of those for the two amplifiers, and for this reason a larger rectifier than is required for each separate amplifier will often be needed. Where the voltages required by the two amplifiers are different, a single power supply would obviously have to deliver the greater of these voltages, suitable arrangements being made to drop this voltage for the low-voltage amplifier. As we have already seen, crosstalk due to signal currents coupling in common h.t. wiring will be more serious in stereo than the corresponding level changes in mono. Thus it may occasionally be necessary to increase the value of any smoothing capacitor common to both amplifiers.

Signal currents in the h.t. wiring can, of course, be very much reduced by using class-A push-pull output stages. To avoid common wiring and hum loops in earlier stages it will probably be convenient to use separate rather than common capacitors to smooth the h.t. for such stages.

Modifications to the circuits of the two amplifiers are only likely to be necessary to provide a balance control. It is desirable that, when the balance control is adjusted, the sum of the two amplifier power outputs should remain constant so that the volume level does not have to be simultaneously adjusted. If the total power output were to be allowed to vary too much, one might just as well use independently adjustable (i.e. ungangd) volume controls and dispense with a balance control. The required constant total power output can at least approximately be obtained by making the balance control in the form of a variable resistive divider gain control in each amplifier, the two gain controls being connected so that the gain of one amplifier is increased while that of the other is decreased as the balance control is adjusted. This general type of balance control is, in fact, almost universally used in practice. It is also desirable that the balance control should not produce more than about 6dB total gain variation in each channel, any greater difference between the two stereo channel sensitivities being taken up by preset adjustments. The maximum gain variations can, of course, be restricted by connecting a fixed resistor in series with the variable balance resistor in each circuit; a fixed resistance equal to the maximum variable resistor value gives a maximum variation of 6dB. Any loss in average gain due to the provision of a balance control must, of course, be allowed for.

Practical Balance Controls

Most of the balance controls in use fall into one of two general types: the two variable resistors are either two separate but ganged potentiometers or, alternatively, the two arms of a single potentiometer with its slider earthed. The latter type is perhaps not so suitable for the experimenter, since he is then committed to a common earth point, and hum loops may be more difficult to avoid. Stray-capacity coupling between the two ends of the single potentiometer is also perhaps more likely.

Where two separate but ganged potentiometers are used, the sum of the two amplifier outputs normally varies by only 0.5dB when fixed series resistors are used to restrict the maximum gain variation in each channel to 6dB: the variation in total output increases to 3dB if the fixed resistors are decreased to zero so that the maximum gain variation is increased to infinity. The first value of 0.5dB variation in the total output is certainly quite acceptable, being below what can easily be heard.

When the two amplifiers have equal gains, they are obviously balanced when the variable balance resistances and consequently also the gain losses due

S.B.A.C. EXHIBITORS

ABOUT a third of the exhibitors in the static exhibition at the Farnborough Air Show (September 5-11) are in, or closely associated with, the radio and electronics industry. The following list of manufacturers and research establishments has been selected from the list of nearly 300 exhibitors. A review of the developments in aeronautical radio and electronic equipment as seen at the exhibition, which is organized by the Society of British Aircraft Constructors at the Royal Aircraft Establishment, will be included in our next issue.

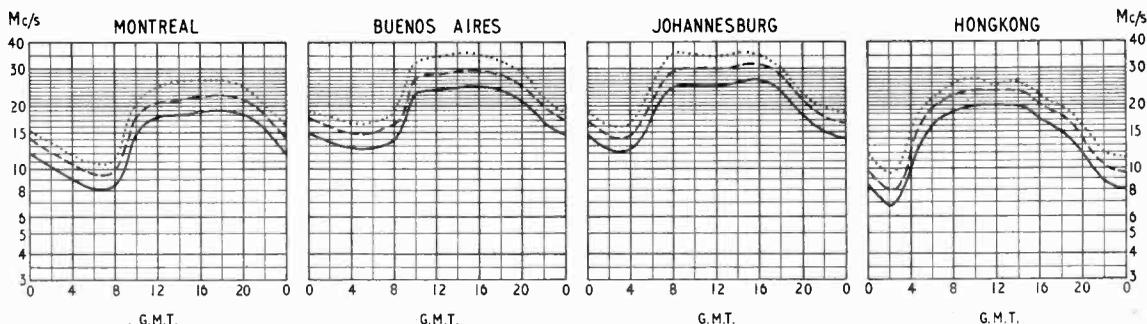
<p>A.E.I. Airmed Albright & Wilson Amalgamated Wireless (Aust.) Amplivox Bakelite Bell Precision Engineering Belling & Lea B.I. Callender's Cables Boulton Paul Aircraft Bristol Aircraft British Communications Corp. Brown, S. G. Bryans Aeroequipment Burgess Products Burndept Canadian Marconi Co. Cementation (Muffelite) Chelton (Electrostatics) Chloride Ciba (A.R.L.) Cole, E. K. Cossor, A. C. Cossor Radar & Electronics Curran, John Decca Navigator Decca Radar de Havilland Propellers Ecco Electronics Elliott Brothers English Electric Ferranti Fibreglass Formica G.E.C. General Precision Systems Godfrey, Sir George Goodmans Graseby Instruments Grundy & Partners Hawker Siddeley Hellermann Hendrey Relays Honeywell Controls Imhof Integral</p>	<p>K.L.G. Sparking Plugs Kelvin & Hughes Lucas, Joseph M.L. Aviation Co. McMichael Marconi Instruments Marconi's W/T Marston Excelsior Microcell Ministry of Aviation Murphy Napier, D., & Son Newmark, Louis Optical Measuring Tools Plannair Plessey Pullin Pye Redifon Rotax Royston Industries S.T.C. Salford Electrical Insts. Sanders, W. H. (Electronics) Sangamo Weston Savage, W. Bryan Short Brothers & Harland Simmonds Aerocessories Smiths Aircraft Instruments Solartron Solus-Schall Southern Instruments Soerry Tealemit Technograph Electronic Prods. Thermionic Products Thorn Trix Ultra Electronics Vactric Venner W.S. Electronics Waymouth Gauges Western Manufacturing Westinghouse Whiteley Electrical Wireless Telephone Co.</p>
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to the provision of a balance control are the same in each channel. It is convenient to assume this condition of equal amplifier sensitivities when quoting the gain loss due to the provision of a balance control. Usually the two variable balance resistors are equal when each is half its maximum value. In this case, the loss in gain due to the provision of a balance control is a factor of 1.3:1 when in addition series fixed resistors are used to restrict the maximum gain variation in each channel to 6dB, this loss increasing to 2:1 if the fixed resistors are decreased to zero so that the maximum gain variation is increased to infinity. As pointed out by Mullard, if one potentiometer is given an antilogarithmic law and the other a logarithmic law and is also wired in reverse, then the two variable balance resistors are equal in value when each is 0.9 of its maximum value. With such potentiometers then, the gain loss due to the provision of a balance control is reduced to a factor of 1.05:1 when series fixed resistors are used to restrict the maximum gain variation in each channel to 6dB, this loss increasing to 1.1:1 if the series fixed resistors are decreased to zero so that the maximum gain variation is increased to infinity. When such potentiometers are used the variation in the sum of the two amplifier outputs is somewhat different, being within 0.2dB of 1.9dB for any value of fixed series resistance from zero up to the maximum potentiometer value. Apart from this possibility there seems little to choose between linear and logarithmic potentiometers for the balance control.

Switches for reversing the phase of one channel or interchanging the two amplifiers relative to the loudspeakers are also sometimes provided for correcting errors in the connections between various units. However, since after any such correction the switches need never be further used, it would seem preferable to correct any connection errors directly, and thus avoid the capacity-coupling problems which are likely to arise on a switch connected to both amplifiers. Capacity coupling in such cases can be reduced by arranging for any stray capacities to occur in pairs whose junctions are connected via a relatively larger capacity to earth. Coupling either way is then attenuated by the capacitive dividers so formed.

SHORT-WAVE CONDITIONS

Prediction for September



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 September.

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

WORLD OF WIRELESS

West German "I.T.A."?

THE introduction of a second television network in West Germany has developed into a major political issue which may effect the introduction of a u.h.f. television service. There have been prolonged negotiations as to who should operate the second network, initially to consist of 29 u.h.f. transmitters due to be completed by the end of this year. At the end of July the German Chancellor announced the setting-up of a commercial television company—Deutschland Fernsehen—in which the Länder broadcasting organizations would be invited to join. For some time now, of course, there has been a limited number of commercial television programmes broadcast by the Länder organizations.

The Länder organizations have now asked the Government for permission to build a network of u.h.f. stations—some are already in operation experimentally. Our West German correspondent reports that no decision on the proposed u.h.f. networks is likely for some months, especially in view of next year's Government election.

Space Research

MOST of the sixteen grants, totalling £184,540, recently made by the D.S.I.R. to universities for space research, are for projects associated with radio and electronics. The grants, made on the recommendation of the British National Committee on Space Research set up by the Royal Society, are for salaries of staff, travel and subsistence and development or purchase of special equipment.

The biggest award goes to Dr. R. L. F. Boyd, of the physics department of University College, London, who during the next three years is to receive £35,450 for rocket research in the upper atmosphere and a further £8,880 for the development and use of photoelectric satellite tracking equipment.

Dr. R. C. Jennison, of the Nuffield Radio Astronomy Laboratories, Jodrell Bank, is to have £30,297 over the next three-and-a-half years for low-frequency radio astronomy from an earth satellite and for microwave meteorite investigations from an earth satellite. Professor A. C. B. Lovell is to have £2,500 this year for the tracking of satellites and space probes. To enable Professor J. Sayers, of Birmingham University, to undertake electron and ion propulsion studies in the upper atmosphere and interplanetary space he is to receive £26,000.

Professor W. J. G. Beynon, University College of Wales, is granted £16,530 for a three-year study on the measurement of electron density/height profile with rockets using the Doppler method and the pulse method.

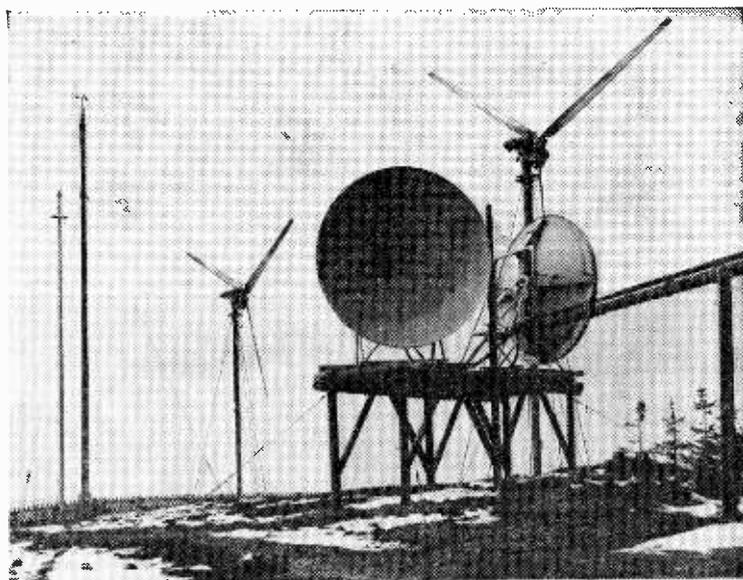
Three workers at Cavendish Laboratory have received grants: Dr. F. G. Smith is awarded £11,230 for a two-year research programme on the measurement of cosmic radio noise by receivers mounted on rockets and satellites; Professor M. Ryle, £2,678 for recording and interpretation of Doppler and Faraday effects in the radiations from artificial satellites; and Dr. K. G. Budden, £1,694 for studying the theory of propagation of radiations from artificial satellites.

Other awards include £13,006 to Professor E. A. Stewardson, physics department, Leicester University; £15,005 to Professor D. R. Bates, applied mathematics department, Queen's University, Belfast, £8,775 to Dr. H. E. Elliot and £7,935 to Dr. S. H. Hall, both of Imperial College, London and £4,560 to Dr. J. T. Houghton, of Clarendon Laboratory, Oxford.

Jubilee Lectures.—A limited number of free tickets are available for the first of the series of lectures being organized by Ultra to mark their 25th anniversary. It is being given at the Royal Festival Hall, London, at 6.30 on September 14th, when Professor Arthur Porter, of the University of Saskatchewan, will speak on the evolution of instrumentation. Applications for tickets should be sent to the Public Relations Officer, Ultra Electric, Western Avenue, London, W.3.

Anglo-Japanese Trade.—An increased quota of transistor sets is permitted to be imported from Japan during the 12 months ending 31st March next year under a new Anglo-Japanese trade agreement. The new figure is £200,000. The quota for sound radio and television sets (other than transistorized) is £100,000 and for radiograms and gramophones it is also £100,000.

Wind-Powered Relay Station.—Two wind generators with 30-ft diameter air screws are used to provide power for this microwave relay station on the Schöneberg in the Eifel mountains. The station forms part of the Frankfurt-Cologne radio link installed by the German Post Office originally for television but now used for a 60-channel pulse-modulated multiplex telephone service. The two generators together provide an overall output of 40kWhr/day. Photo. courtesy "NTZ," Brunswick.



Radio Industry Council.—Lord Brabazon of Tara, who has been president of the R.I.C. since 1957, has agreed to serve for another year. In consequence of the sudden death of Air Marshal Sir Raymond Hart who had been full-time director of the R.I.C. since last year, R. Kelf-Cohen, C.B., has been appointed acting director until such time as a permanent appointment is made. He was under-secretary, Ministry of Fuel and Power, from 1946 to 1955. The 1960/61 representatives of the three constituent bodies forming the council are:—B.R.E.M.A., G. Darnley-Smith (Bush), F. W. Perks (British Radio Corp.), E. E. Rosen (Ultra), and A. L. Sutherland (Philips); B.V.A., S. S. Eriks (Mullard), F. V. Green (S.T.C.), G. A. Marriott (G.E.C.), and J. W. Ridgeway (A.E.I. Woolwich); and R.E.C.M.F., P. D. Canning (Plessey), Hector V. Slade (Garrard), K. G. Smith (N.S.F.) and Dr. G. A. V. Sowter (Telcon). E. E. Rosen is chairman and H. V. Slade vice-chairman.

Goldup Memorial.—An annual award, which will be known as the Goldup Prize, has been established by the I.E.E. for the best Higher National Certificate student who takes electronics or telecommunications subjects in his final examination. The prize has been endowed by Mullard Ltd., as a memorial to the life and work of the late T. E. Goldup, a director of the company and a past president of the Institution, who took a keen and extremely active interest in education.

I.E.E. Council.—The following have been elected to fill the vacancies which will occur on the council of the I.E.E. on September 30th:—Sir Hamish D. MacLaren (president); C. T. Melling and B. Donkin (vice-presidents); C. E. Strong (hon. treasurer); and D. A. Barron, F. H. S. Brown, Professor J. M. Meek, Dr. R. L. Smith-Rose, Dr. H. G. Taylor, J. C. Arkless and J. S. McCulloch ordinary members of the council.

Electronics and Communications Section, I.E.E.—The new chairman of the section is T. B. D. Terroni (A. T. & E.) and R. J. Halsey (G.P.O.) is a vice-chairman. The six vacancies among ordinary members of the committee have been filled by:—W. H. Aldous (G.E.C. Research Labs.), W. J. Perkins (National Institute for Medical Research), Dr. K. F. Sander (Cambridge University), Dr. J. A. Saxton (D.S.I.R.), T. R. Scott (Standard Telecommunications Laboratories) and F. J. D. Taylor (G.P.O.).

B.E.A.M.A. has set up a Semi-conductor Devices Section to "foster standardization of semi-conductor devices both on a national and international basis." The initial membership of the section, which it is stated "will co-operate closely with the Electronic Valve and Semi-conductor Manufacturers' Association" (V.A.S.C.A.) comprises:—A.E.I. (Rugby), A.E.I. (Woolwich), Electric Construction, English Electric, Ferranti, G.E.C., Hackbridge & Hewitt Electric, International Rectifier, Philips, S.T.C. and Westinghouse.

Pye Show.—The Pye group of companies are holding their own radio, television and electronics exhibition in the Royal Festival Hall, London, from August 22nd to 24th. The exhibition will cover not only the domestic sound radio and television side of the group's business but also industrial electronics, instruments, marine radio and also telephone equipment from "Temco" the newest member of the group. It will be open to the public from 11.0 to 9.0 on the first two days and from 3.0 to 9.0 on the last day.

Cabinet Styling.—B.R.E.M.A. is to hold its fourth "cabinet styling" exhibition in the Victoria Halls, Bloomsbury Square, London, W.C.1, on October 4th, 5th and 6th from 2.0 to 6.0. It is a trade show of embellishments, cabinet materials, fabrics, ornamental controls, "in-the-room" aerials, etc., and admission is by trade card.

P. P. Eckersley is giving a talk entitled "Radio from the beginning" at a meeting in the Ilford Town Hall, Essex, at 3.0 on October 9th. The meeting has been arranged by the East London Group of the R.S.G.B.

Jodrell Bank.—Manchester University's radio astronomy laboratories at Jodrell Bank have been renamed the Nuffield Radio Astronomy Laboratories. The Nuffield Foundation originally donated £200,000 towards the cost of the radio telescope at Jodrell Bank and has recently given a further £25,000 and Lord Nuffield personally another £25,000 in order to clear the deficit on the project.

Sound propagation in the atmosphere is the theme of a symposium to be held in the new physics building of Imperial College, South Kensington, on September 8th. It is being organized by the Acoustics Group of the Physical Society. Full details are available from Drs. G. G. Parfitt and R. W. B. Stephens, Imperial College, South Kensington, London, S.W.7.

Amateur Television Convention.—The fifth convention of the British Amateur Television Club is being held on September 10th in the Conway Hall, Red Lion Square, London, W.C.1. Further particulars and tickets (5s all day, 2s 6d after 2) are obtainable from D. W. E. Wheele, 56 Burlington Gardens, Chadwell Heath, Romford, Essex.

Autumn Audio Fair Cancelled.—Audio Fairs Ltd. have announced that the Audio Fair planned for October at Southport, Lancs, has been cancelled.

MATTERS EDUCATIONAL

Logical Circuits.—A course of 12 lectures on the design of logical circuits, followed by an 11-week laboratory course, is being held on Friday afternoons from September 30th at the Borough Polytechnic, London, S.E.1. The fees are 25s and 20s respectively.

Pulse Techniques.—The Borough Polytechnic is also providing a 20-lecture course on pulse techniques on Monday evenings from October 3rd (fee £2 10s). Supplementary to this course is a 12-week laboratory course which runs concurrently with it on Monday afternoons or Thursday evenings (fee £1).

Servicing Electronics.—A course in preparation for the C. & G./R.T.E.B. new certificate in electronics servicing is offered by the Matthew Boulton Technical College, Suffolk Street, Birmingham, during the coming session. The college is also providing a new course for the C. & G. certificate in supplementary studies in telecommunications.

Norwood T.C.—Full-time technical courses listed in the 1960-61 prospectus from the Norwood Technical College, Knight's Hill, London, S.E.27, cover telecommunications engineering, marine radio operating and radar maintenance. There are also part-time day and evening courses in preparation for the C. & G. telecommunications engineering certificate, the C. & G./R.T.E.B. servicing certificate and a 2-year evening course on television technology.

Radio Amateur Exam.—We have been notified of the following classes of instruction (both radio theory and Morse) being held during the coming session in preparation for the Radio Amateur Examination:—

Battersea Men's Institute, Latchmere Road, Lavender Hill, London, S.W.11; Wednesdays.

Holloway Evening Institute, Montem School, Hornsey Road, London, N.7; Mondays, repeated on Tuesdays and Wednesdays.

Ilford Luterary Institute, High School for Girls, Cranbrook Road, Ilford; an eight-month course on Wednesdays with more on Mondays.

Wembley Evening Institute, Copland School, High Road, Wembley; Mondays.

Bognor Regis Technical Institute, Southway, Bognor Regis; Wednesdays and Fridays.

Bradford Technical College, Central Hall, Bradford, 5; Wednesdays.

Glasgow—Allan Glens School, Montrose Street; Tuesdays and Thursdays.

Openshaw Technical College, Whitworth Street, Manchester 11, classes for first and second year students.

Personalities

Sir Willis Jackson, F.R.S., director of research and education of Associated Electrical Industries (Manchester) Ltd., is to return to academic life as professor of electrical engineering at Imperial College, University of London. Sir Willis resigned his chair at Imperial College some seven years ago to become director of research and education of Metropolitan-Vickers Electrical Co., now A.E.I. (Manchester).



Sir Willis Jackson.

Sir Leslie Gamage, chairman and managing director of the General Electric Co. since 1957, is to retire at the end of this year. He is relinquishing his executive duties as managing director immediately but will continue as chairman until December 31st. He joined the company in 1919 and was appointed vice-chairman and joint managing director in 1943.

Two British women engineers, Miss Lesley S. Souter, B.Sc., A.R.T.C., F.Phys. Soc., A.M.I.E.E., and Miss Rosina Winslade, M.S.I.T., have been awarded by the Caroline Haslett Memorial Trust "travelling exhibitions" to enable them to study the training, employment and prospects of women engineers in the U.S.S.R. Miss Souter, who studied electrical engineering at the Royal Technical College, Glasgow, obtained her B.Sc. degree from Glasgow University in 1940. She was in the research laboratories of the G.E.C. and Mullard before joining the A.E.I. Research Laboratory at Harlow, Essex, where she now leads the magnetic materials section. Miss Souter is vice-president of the Women's Engineering Society. Miss Winslade is senior sales engineer with Research and Control Instruments Ltd., where she is in charge of the industrial measuring and recording apparatus in the instrument group. She was for ten years with the Plessey Co., first as junior laboratory assistant and later working on the design and development of electronic test equipment. Miss Winslade was the first woman member of the Society of Instrument Technology.

P. E. F. A. West, M.A., A.M.I.E.E., has been appointed Regional Engineer, B.B.C. West Region, in succession to G. H. Daly, M.B.E., who joined the British Broadcasting Company in 1925 as a transmitter engineer at Savoy Hill, London. He has been regional engineer since 1955. Mr. West joined the Corporation in 1936. During the war he served in the Royal Navy, where he attained the rank of Lieutenant Commander. He returned to the B.B.C. Design and Installation Department in 1946 and two years later was transferred to the Overseas and Engineering Information Department. In 1951 he was appointed assistant to the Chief Engineer and since 1956 has been on the staff of the Senior Superintendent Engineer, External Broadcasting.

Air Vice-Marshal H. B. Wrigley, C.B.E., until recently Director of Guided Weapons Research and Development (Air) in the Ministry of Aviation, has been appointed senior technical staff officer at Fighter Command Headquarters. He was at one time Chief Signals Officer of the 2nd Tactical Air Force in Germany, and in 1954 was appointed Director of Signals in the Air Ministry.

F. A. Vick, O.B.E., Ph.D., becomes director of the Atomic Energy Research Establishment, Harwell, in succession to Sir Basil Schonland, C.B.E., F.R.S., on September 1st. Sir Basil, who was knighted in this year's Birthday Honours List, is to continue as director of the Atomic Energy Research Group of which A.E.R.E., Harwell, is a part. Born in South Africa in 1896 he became exhibitioner at Gonville and Caius College, Cambridge, and carried out research at the Cavendish Laboratory. He joined the staff at Capetown University in 1922 and in 1937 founded and took charge of the Bernard Price Institute for Geophysical Research at the University of Witwatersrand, Johannesburg. He was a brigadier in the South African Corps of Signals in the early days of the last war but from 1941 to 1944 was Superintendent of the Army Operational Research Group, Ministry of Supply. After the war he returned to South Africa but came back to the U.K. in 1954 as deputy director of Harwell. Dr. Vick, who is 49 and was educated at Birmingham University, was a lecturer in physics at University College, London, before he joined the Ministry of Supply in 1939 as assistant director of scientific research. In 1945 he returned to his academic work as lecturer in physics at Manchester University. From 1950 until his appointment last year as deputy director of Harwell, he was professor of physics at the University College of North Staffordshire. Dr. Vick was vice-president of the Institute of Physics from 1953 to 1956.



Dr. F. A. Vick.



Dr. R. L. Smith-Rose.

Dr. R. L. Smith-Rose, C.B.E., has been appointed by the Postmaster General as chairman of the Post Office Frequency Advisory Committee in succession to Sir Lawrence Bragg, O.B.E., F.R.S., who has resigned owing to his many other commitments. Dr. Smith-Rose retires in September from the directorship of the Radio Research Station of the D.S.I.R., which he has held since 1948. He has been a member of the Frequency Advisory Committee since it was set up under the chairmanship of Sir Lawrence Bragg in 1958. The other members of the committee are:— Granville Berry (city engineer and surveyor, Coventry); Sir Harold Bishop (B.B.C.); Capt. C. F. Booth (Post Office); J. R. Brinkley (Pye Telecommunications, nominated by the Electronic Engineering Association); J. Clarricoats (R.S.G.B.); Major General E. S. Cole (War Office); N. H. Elgood (Home Office); Sir Robert Fraser (I.T.A.); Supt. F. Gee (Lancashire Constabulary); H. Gillender (Ministry of Transport); H. van Hasselt (S.T.C., nominated by the

Telecommunication Engineering and Manufacturing Association); G. P. Jefferies (Ministry of Aviation); K. I. Jones (Ferguson, nominated by B.R.E.M.A.); R. J. Kemp (Marconi's, nominated by E.E.A.); Air Commodore C. C. Morton (British Joint Communications Electronics Board); Capt. W. J. Parker (Admiralty); G. F. Peirson (Midlands Electricity Board); C. G. Phillips (Ministry of Aviation); D. J. A. Stevenson (Automobile Association, nominated by the Mobile Radio Users' Association); H. E. F. Taylor (E.E.A.); Air Commodore F. E. Tyndall (Air Ministry); A. Wolstencroft (Post Office); Capt. F. J. Wylie (Radio Advisory Service of the Chamber of Shipping and Liverpool Steamship Owners' Association); and J. E. Golothan (Post Office), secretary.

H. G. Whiting, A.M.I.E.E., has been appointed Regional Engineer, B.B.C. Midland Region, in succession to **W. A. Roberts**, M.I.E.E., who becomes Administrative Officer in the Region. Mr. Roberts, who joined the Engineering Division of the B.B.C. in 1937, became assistant to the Chief Engineer in 1949. He was a member of the Broadcasting Commission appointed by the Gold Coast (now Ghana) Government in 1953 to advise on the development of broadcasting in that country, and later of the Commission which was appointed to study broadcasting development in Kenya. During 1954 and 1955 he was seconded to the Colonial Office as technical adviser on broadcasting development in the Colonies. Mr. Whiting joined the Corporation in 1932 as an engineer in the Transmitter Department. He transferred to the Television Service in 1936, and since 1952 has been Engineer-in-Charge, Television, Birmingham.

T. H. Cook, B.Sc.(Eng.), M.I.E.E., has been appointed chief applications engineer of the Morgan Crucible Co. He was previously technical sales manager of the company's carbon department. He will be attending the New Delhi meeting of the International Electrotechnical Commission in November.

G. D. Speake, M.A., has been appointed deputy chief of research of Marconi's research and development laboratories, Great Baddow, Essex. He joined the company in 1950 at the age of 31 and was engaged in radar systems research until 1954, when he was appointed chief of the vacuum physics division. Two years later he took charge of the microwave physics section. Educated at St. Catharine's College, Cambridge, where he graduated with first-class honours in physics, he served in the Technical Branch of the R.A.F. as a flight-lieutenant, and was for four years with Imperial Chemical Industries as instrument manager of the plastics division before joining Marconi's.



G. D. Speake.

OBITUARY

Air Marshal Sir Raymund Hart, who died as a result of an accident on July 16th at the age of 61, had been director of the Radio Industry Council since his retirement from the R.A.F. in January, last year. His Service career began in the Royal Flying Corps in 1917. In 1936 he was attached to the Bawdsey experimental station as "Commandant of R.D.F. Training" and so began his long and close association with radar development. It was Sir Raymund who introduced the "filter room" principle into the radar reporting system. In 1942 he became Command Signals Officer of Fighter Command and was at one time Deputy Director of Radar in the Air Ministry and from 1951 to 1955 Director General of Engineering.

News from Industry

Pye Ltd. and its subsidiaries increased their "total available profit" for the year ended 1959/60 by nearly 75% compared with the previous year. The figures are £1,464,274 and £842,762. The year's trading profit was £3,927,041 compared with £2,834,841 for 1958/59. The annual general meeting is being held on August 24th to coincide with the group's exhibition being held at the Royal Festival Hall, London.

Temco.—By the purchase of shares on the London Stock Exchange Pye have acquired a controlling interest in the Telephone Manufacturing Co. in face of a bid for the whole of the company's shares by a consortium of seven companies—A.E.I., A.T. & E., Ericsson, G.E.C., Marconi's, Plessey and S.T.C. It is Pye's intention to continue the business of Temco as a separate entity.

Thorn Electrical Industries group trading profit for the year ended last March was £3,916,990 compared with £2,953,536 the previous year. Deducting all charges, including taxation of £949,069, the net profit is £1,525,988 against £979,371 last year.

Firth Cleveland Group reports a turnover of £21.5M with a profit before taxation of £2,144,806 in 1959 compared with £1.8M and £1,455,000 the previous year. The group, which comprises about 30 companies in this country and some 20 abroad, includes Solartron, Simmonds Aeroaccessories, and four chains of retail radio stores totalling in all some 450 shops.

Brimar valve and cathode-ray tube division of Standard Telephones and Cables has been acquired by Thorn Electrical Industries Ltd. A new company is being formed under the name Brimar Electronics Ltd. The "special" valve division of S.T.C. is not included in the agreement signed by the two companies.

Anglo-Swedish Agreement.—Technical and commercial co-operation between E.M.I. Electronics Ltd. and the Swedish SAAB Aircraft Co. is provided for under a recently signed agreement. SAAB will sell E.M.I.'s equipment in the industrial, automation, broadcast, instrument and special tube fields throughout Sweden, Norway and Denmark, through its sales organization, SAAB Electronics. E.M.I. will market SAAB products in the British Commonwealth and other countries.

Associated Electrical Industries Ltd. and Davy-United Ltd. have formed a jointly financed Steelworks Automation Unit to apply new automatic control techniques to the processing both of steel and of non-ferrous metals. The A.E.I./Davy-United Steelworks Automation Unit has its headquarters at Mill Road, Rugby.

Hughes International (U.K.) Ltd., set up in Glenrothes, Fife, by the Hughes Aircraft Co. of the U.S.A. for the manufacture of a wide range of semiconductor components for the European market, plans to open its factory this month. David Simpson is general manager of the Scottish company.

A trade exhibition is being held by Thompson, Diamond & Butcher at the Trocadero Restaurant, Piccadilly Circus, London, W.1, from August 23rd to September 1st. T.D.B. are both wholesalers and manufacturers; they make the range of "Top Rank" record players. Invitation tickets are obtainable by writing to the Sales Manager, 1/9 University Street, London, W.C.1.

McCarthy Radio and Electronics Ltd., of Studland Street, London, W.6 (Tel.: Riverside 1633) is the new name of what was previously Radio Mailing Ltd. The company, of which A. S. Williams is managing director, manufactures McCarthy radio-grams, record players and tape recorders, and Felgate inverters.

Elstone Electronics Ltd., of Hereford House, North Court, Vicar Lane, Leeds, 2 (Tel.: Leeds 35111), of which A. C. Farnell and A. Woffenden are directors, have been appointed British distributors for Weller Elektro-Werkzeuge, of West Germany. The company manufactures soldering guns and heat-controlled soldering irons.

Stretch, the IBM computer capable of performing well over a million logical operations per second, has been ordered by the U.K. Atomic Energy Authority. The system, to be installed towards the end of 1961, will have random access disc storage units capable of transferring one word every 8 microseconds, 6 magnetic core storage units with retrieval time of 2.18 microseconds, and a vast magnetic tape backing store.

Films & Equipments Ltd., of 138 Wardour Street, London, W.1 (Tel.: Gerrard 7711), of which D. Forrester and G. M. Forrester are directors, have disposed of their recording division to Aviation and Electronic Equipment Ltd., of the same address. The company's connector division has been taken over by Cannon Electric (Great Britain) Ltd., also of the same address.

Decca has obtained from Thermionic Products the sole manufacturing rights of their micro-lift for pickups.

Solartron Electronic Group is to provide the instrumentation and control apparatus for the next major experiment for controlled thermo-nuclear research to be undertaken by the Atomic Energy Authority. The intermediate current stability experiment (I.C.S.E., pronounced "ice") will be undertaken at the new laboratory which the A.E.A. is establishing at Culham, near Oxford.

G.E.C. is to supply and install for the Post Office a dual radio link between Carlisle and Kirk o' Shotts for the relaying of television transmissions. There will be two intermediate repeater stations along the 90-mile route. The broadband equipment, which operates around 6,000Mc/s can provide a television link or 960 speech circuits.

The **printed circuits division** of Mills & Rockleys (Production) Ltd. has been formed into a separate subsidiary company called Mills & Rockleys (Electronics) Ltd., of Swan Lane, Coventry (Tel.: Coventry 26222). The general manager is D. L. Phillips.

Teleng Ltd. are to design and supply the distribution equipment and cabling for the television relay system to be installed by Marconi's on the new luxury liners, *Oriana* and *Canberra*.

EXPORT NEWS

British manufacturers who are participating in the exhibition being held in Stockholm from September 10th to 17th in conjunction with the Fifth International Instruments and Measurements Conference include: Ether Langham Thompson, G.E.C., General Radiological, Hobson, Plessey, Solartron, 20th Century, Ultra, A.E.I., Cannon Electric, Colvern, Erie, Hunt and Texas Instruments. The last six companies are combining as the "English Component Group" through an agent.

Sub-miniature automatic direction-finders made by Bharat Electronics, of Bangalore, under a general manufacturing agreement made between the Government of India and Marconi's W/T Co., are to be fitted in AVRO-748 twin turbo prop aircraft being built in India. The radio compass is Type AD722.

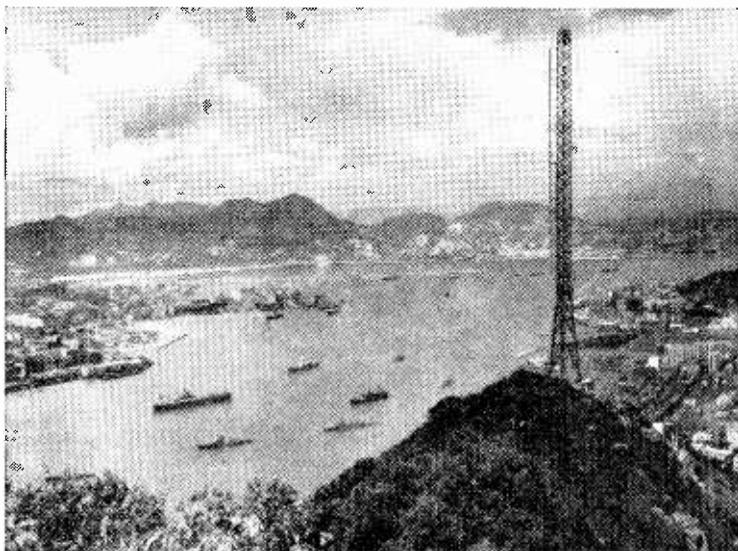
Airfield control radar is being supplied by Cossor Radar and Electronics to the East African Directorate of Civil Aviation for installation at the recently opened Nairobi Airport.

Closed-circuit television equipment was recently installed by Marconi's on a locomotive of Rhodesian Railways so that the action of the wheels could be studied while in motion because abnormal wear had been noticed on sharp curves of the track.

An O.B. television unit has been supplied to the Hungarian broadcasting authority by E.M.I. Electronics. The unit, mounted on a 7-ton chassis, is equipped with four image orthicon cameras.

Colour TV.—The colour television unit commissioned by Smith Kline & French Laboratories from Marconi's two years ago, which has been placed by the owners at the free disposal of medical authorities in this country, is now on a three-month tour of Australia. It will visit hospitals in Adelaide, Melbourne, Brisbane and Sydney. Marconi's have provided the engineering team accompanying the vehicle.

Hong Kong.—The mast of the Colony's new v.h.f./f.m. broadcasting station. Four Marconi 5-kW transmitters in two parallel pairs are used to radiate two programmes—English on 91Mc/s and Chinese on 94Mc/s.



LETTERS TO THE EDITOR

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

Negative Resistance

HAVING studied "Cathode Ray's" article "Ohm's Law and Negative Resistance" in the July issue I can now see how our differences of opinion as to whether or not a battery is equivalent to a negative resistance can be resolved.

But first, since it is hard to find a text-book which even hints that Ohm did not create Ohm's Law, "Cathode Ray's" main point in his 1953 article, that there are two distinct Ohm's Laws, should be brought to the attention of all text-book writers.

Very briefly, the first Law is based on Ohm's work and might be called Ohm's Linearity Law $R=K$; the second is what has become to be called Ohm's Law, $R=E/I$, which defines the ohm and in which R need not be constant, and is replaced by Z , the impedance, for a.c. working.

B.S. definition No. 1276 quoted by "Cathode Ray," expresses my point that for a device to be a resistance the voltage and current must be related. When shortened, the second paragraph of the definition reads, "The resistance is equal to the applied p.d. divided by the current which it produces when the body has no e.m.f. acting therein."

Hence a battery cannot be a resistance and Ohm's Law cannot be applied to it, which was the basis of my original objection. But Ohm's Law can be applied (without any modification) to a resistance having the same p.d. and current as the battery at any particular instant, and the battery can be said to be equivalent to the resistance in certain respects.

If the current through the battery is reversed, the battery absorbs energy and becomes equivalent to a positive resistance. If the battery is an accumulator on charge or even a dry cell (see, for instance, R. W. Hallows, "Reactivating the Dry Cell" *W.W.* August, 1953) some of the energy may be stored chemically, whereas in a resistor it is all dissipated. But inductances and capacitances, both positive and negative, can absorb or give out energy; the battery actually behaves much more like a large charged positive capacitance than a resistance if any changes are made to the circuit.

An engineer might ask, "Does it work?" "Cathode Ray" has shown that the battery and resistance in the circuit are equivalent to two resistances, one of which is equal to the negative of the other, and these are equivalent to a short-circuit. This simplifies the circuit but makes it impossible to find the current.

A similar thing happens when solving simultaneous equations if one substitutes twice in the same equation.

One proves that $0=0$, which does not help in finding x .

As regards "Kirchhoff's" Third Law, in a simple loop where all components pass the same current, the Law is reduced to Ohm's Law to Kirchhoff's Second Law, while if the mesh is part of a network and the current is different in different parts of the mesh, the Third Law does not hold.

Binley, nr. Coventry.

D. L. CLAY.

Analogue Computer Techniques

THE simple analogue computer as described by G. B. Clayton (May and June issues) can be used to demonstrate many problems.

A familiar example is that of the simple projectile which moves with initial velocity V ft/sec, included at an angle θ to the horizontal, with downward acceleration g ft/sec² due to gravity.

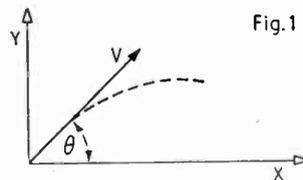


Fig. 1

With the notation of Fig. 1, the displacements in the X and Y directions after time t , are given by the equations.

$$Y = Vt \sin \theta - \frac{1}{2}gt^2$$

$$X = Vt \cos \theta$$

By assigning fixed voltages to represent the constants V and g , it is possible to generate voltages representing these displacements using a computer arrangements as in Fig. 2.

The outputs obtained can be fed into the X and Y plates of a cathode ray tube, and a trace will be produced representing the path of the projectile. It is quite easy to demonstrate the effect of varying either V , g , or θ , the latter set by the potentiometers representing $\sin \theta$ and $\cos \theta$, both of which must be adjusted for any change of θ .

The more complex case of the catenary can be illustrated in this way, this being the curve in which a uniform chain or "perfectly flexible" string hangs when freely suspended from two fixed points.

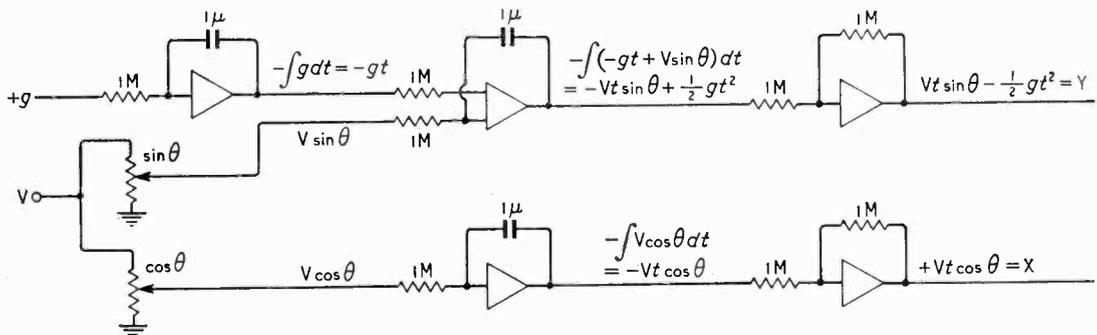


Fig. 2

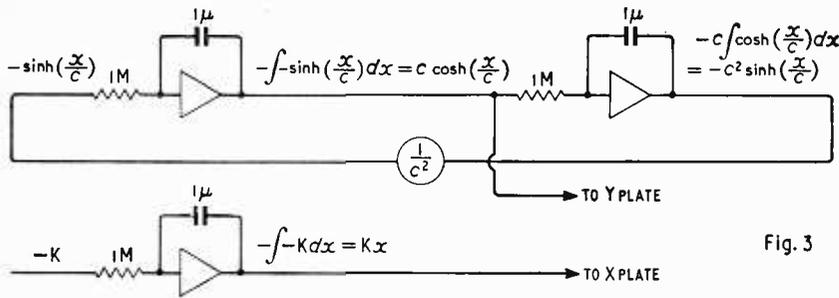


Fig. 3

The equation for the curve is

$$y = c \cosh(x/c)$$

The computer can be used to obtain such a function, by first assuming a signal for $-\sinh(x/c)$ and integrating twice with respect to x (x here being represented by time).

The output of the second integrator is $-c^2 \sinh(x/c)$ which can be modified to $-\sinh(x/c)$ by use of a potentiometer set to $1/c^2$. Thus by assuming $-\sinh(x/c)$ we have obtained $-\sinh(x/c)$, and hence if the output is fed back into the input, the circuit will produce functions as indicated in Fig. 3, the output of the first integrator $c \cosh(x/c)$ being fed to the Y plate

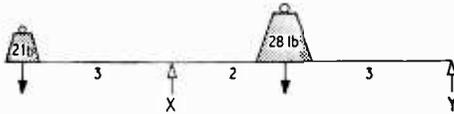


Fig. 4

of an oscilloscope. The X Plate is fed with voltage Kx , which increases linearly with x . Such a voltage is readily obtained by integrating a constant voltage $-K$ as indicated.

The effect of changing c can be seen by observing the different oscilloscope traces for various settings of the $1/c^2$ potentiometer.

A further technique worthy of mention, is that of a method of solution of simultaneous equations, such as those arising from simple beam problems. For instance if we have a light uniform beam simply supported as in Fig. 4, and with weights of 2 lb and 28 lb as shown, it may be required to find the reactions at the supports X and Y.

By resolving vertically and taking moments, the following equations for X and Y are obtained.

$$X + Y = 30 \quad \therefore Y = 30 - X$$

$$2X - 3Y = 10 \quad \therefore X = \frac{10 + 3Y}{2}$$

Using these relationships and assuming a signal for $-3Y$, summing amplifiers can be used to develop signals for X and thence $-3Y$, and by feeding the output back to the input the above equations can be satisfied (see Fig. 5).

If the appropriate fixed voltages of -10 and -30 are applied as shown, using a scaling of 1 volt \equiv 1 unit, then the values of X and Y can be read as the output voltages of amplifiers 1 and 2 respectively.

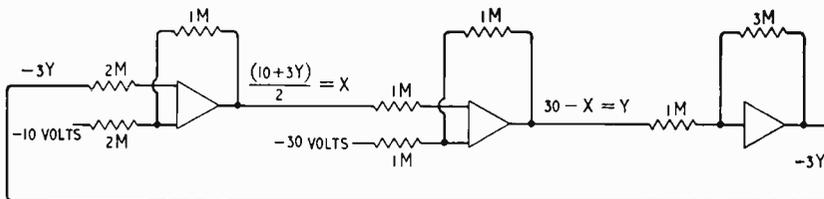


Fig. 5

This technique cannot always be used, since certain types of equations will require a computer arrangement which may be unstable. In these cases more advanced methods of solution are used.

A demonstration of these uses of the analogue computer has been made by Louis Newmark Ltd., to the sixth form students of Orpington Grammar School, where the interest aroused is now building its own

was such that the school computer. New Addington, Surrey.

M. A. COLLINS,
Louis Newmark Ltd.

Line Standards

YOUR leading article on number of lines is a refreshing change in that an authoritative opinion favours retention of 405 lines in this small island of ours, with its attendant co-channel problems.

The writer sees little to recommend a change except perhaps exchange of programmes with the Continent and the advent of colour. For the former it would be cheaper to arrange a separate camera chain from the studio on 625 lines when an exchange with Europe was necessary. 625 lines would not help a great deal with picture degradation when changing to French 819 lines.

Regarding colour, the writer recently saw the latest adaptation of the N.T.S.C. system on 405 lines at the laboratory of a leading manufacturers and the results would have satisfied even the most artistic viewer, the compatibility being excellent.

Living near the Continent the writer often has the chance to view television in the average home on 625 and 819 lines. On 625 there is no significant improvement, but with 819, provided that the television is in reasonable alignment, and the aerial system covers the bandwidth required, the picture quality is a marked improvement; but the writer has noticed when the bandwidth is restricted for any reason, the result is a very unpleasant comparison of good vertical definition with poor horizontal detail.

At present in this country, towns served by i.f. wired systems do not enjoy in most cases more than 2 Mc/s bandwidth on the whole network, so any overall improvement would be lost to these viewers.

Dover.

B. A. A. SMYE-RUMSBY

"Things Great and Small"

IN reference to "Random Radiations" in the June 1960 *Wireless World*, I would call to your attention a fund of information on prefixes in "The Greeks Had a Word for It," by A. P. G. Peterson, in the *IRE Transactions on Engineering Writing and Speech*, December, 1959.

Of passing interest is the fact that the Greeks did indeed have words for quantities above 1,000. Herodotus in his history, Book VII, Polymnia section 60, counts Xerxes' Army in terms of myriads (literally, $\mu\beta\rho\iota\omicron\varsigma$, his word for 10,000). Also, Archimedes devised a set of names for numbers greater than 10,000, using as a base the octad (10^8).

But of major significance in the article is the set of metric prefixes Dr. Peterson proposes. Here is a simple method of prefixes that takes us from 10^{-30} to 10^{30}

with logic not found in the likes of nano, giga, tera, and pico.

Basically, a Peterson prefix is, for positive powers of 10, a Greek prefix and an "ilo." The "ilo" comes from the prefix for 10³, kilo, a serves to identify the prefix immediately as being positive. For negative prefixes, Peterson combines standard Latin prefixes with "illi" (from milli, the prefix for 10⁻³). The following table shows how ingeniously simple this system is.

Value	Prefix	Symbol	Value	Prefix	Symbol
10 ³	kilo	K	10 ⁻³	milli	m
10 ⁶	dilo	D	10 ⁻⁶	billi	b
10 ⁹	trilo	TR	10 ⁻⁹	trilli	t
10 ¹²	tetrilo	TT	10 ⁻¹²	quadrilli	qd
10 ¹⁵	pentilo	PN	10 ⁻¹⁵	quintilli	qn
10 ¹⁸	hextilo	HX	10 ⁻¹⁸	sextilli	sx
10 ²¹	heptilo	HP	10 ⁻²¹	septilli	sp
10 ²⁴	oktilo	OK	10 ⁻²⁴	octilli	oc
10 ²⁷	enneilo	EN	10 ⁻²⁷	nonilli	nn
10 ³⁰	dekilo	DK	10 ⁻³⁰	decilli	dc

It is a pity that Peterson's article wasn't published 10 years ago, before such allogical absurdities as giga won their acceptance through default. But it is only a matter of time before man is again bogged down for lack of additional prefixes, and then perhaps logic will have its day.

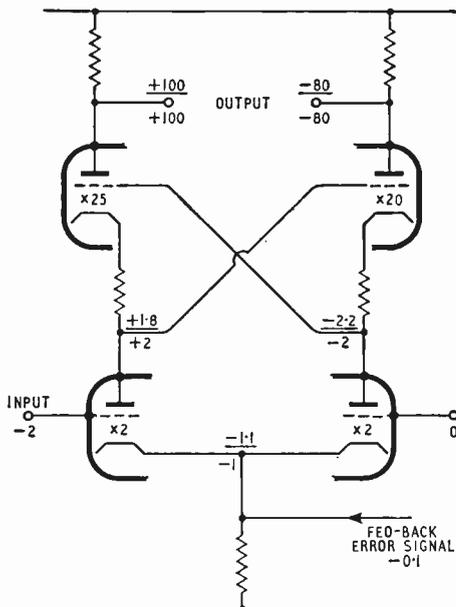
Meanwhile, several publications have reprinted the Peterson article, and I recommend it to those who crave logic in language.

Lexington, MASSACHUSETTS, FREDERICK T. VAN VEEN
U.S.A.

Self-balancing Push-pull Circuits

MR. BIRT'S reply to the first part of my letter in the August issue is quite acceptable. In fact, by showing how the magnetic coupling in the output transformer ensures no error-signal at the junction of R₁-R₂ in my two-stage amplifier (Fig. 1, p. 397), Mr. Birt makes "a fair cop". Apparently, in this case, to take the error-signal from a resistor at the primary tap is the only way. Even so, this could be coupled to the first stage common bias resistor without the intervention of a "gainless" valve stage; the gain over two stages—especially if the first is a pair of pentodes or cascodes (not cross-coupled)—ensures very close balance.

The diagram herewith shows a "Croscode" with



lower triodes having a gain of $\times 2$, the right upper triode $\times 20$, and the left upper triode $\times 25$. Tracing through (plain figures) an a.c. signal with an instantaneous input of -2 shows an unbalanced output of -80 and $+100$ at the anodes. Now adding a fraction of the error-signal in reversed phase of -0.1 at the cathodes (*relatively* positive feedback to the right side and negative to the left), the signal thus modified is traced through afresh (underlined figures). It is seen that the grid-cathode signal to both upper triodes is still 4, as before, and the output balance *not improved*. Thus, the "Croscode" does not lend itself to self-balancing by the methods under discussion. (Easy figures, rather than practical, are used for illustrating the principle.)

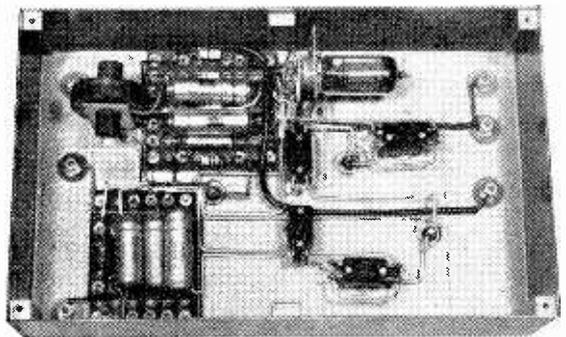
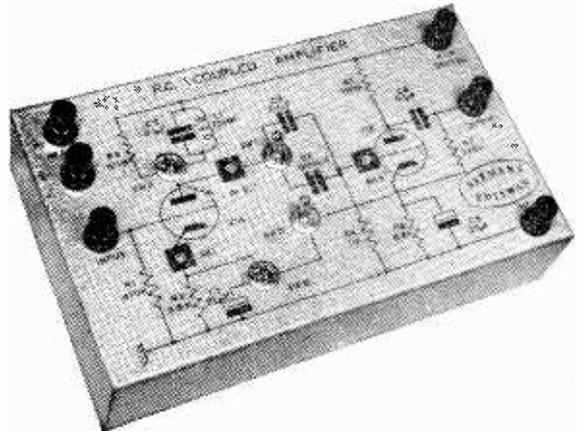
To save the Editor's precious space I leave the reader to re-draw the diagram *without* cross-coupling (i.e. with earthed upper grids), not forgetting that the gain of the lower triodes is now $\times 4$ as explained by Mr. Birt (p. 283, June issue). Tracing through the same signal, it will be found now that adding a -0.1 error-signal improves the balance to -88 and $+90$.

Walsall, Staffs.

STANLEY MAY

EDUCATIONAL AIDS

THE photographs show top and bottom views of the Associated Electrical Industries Type R2330 amplifier, one of a new range of educational aids. Also in-



cluded in this range are a power output stage, R-C coupled and tuned-anode oscillators, and high- and low-pass filters. Each unit is fitted with a Perspex base so that the wiring and construction can be seen and compared with the circuit diagram printed on the cover: this circuit diagram is also connected to the actual terminals where appropriate. Each unit is supplied with instructional sheets giving theoretical and practical details of a number of suggested experiments.

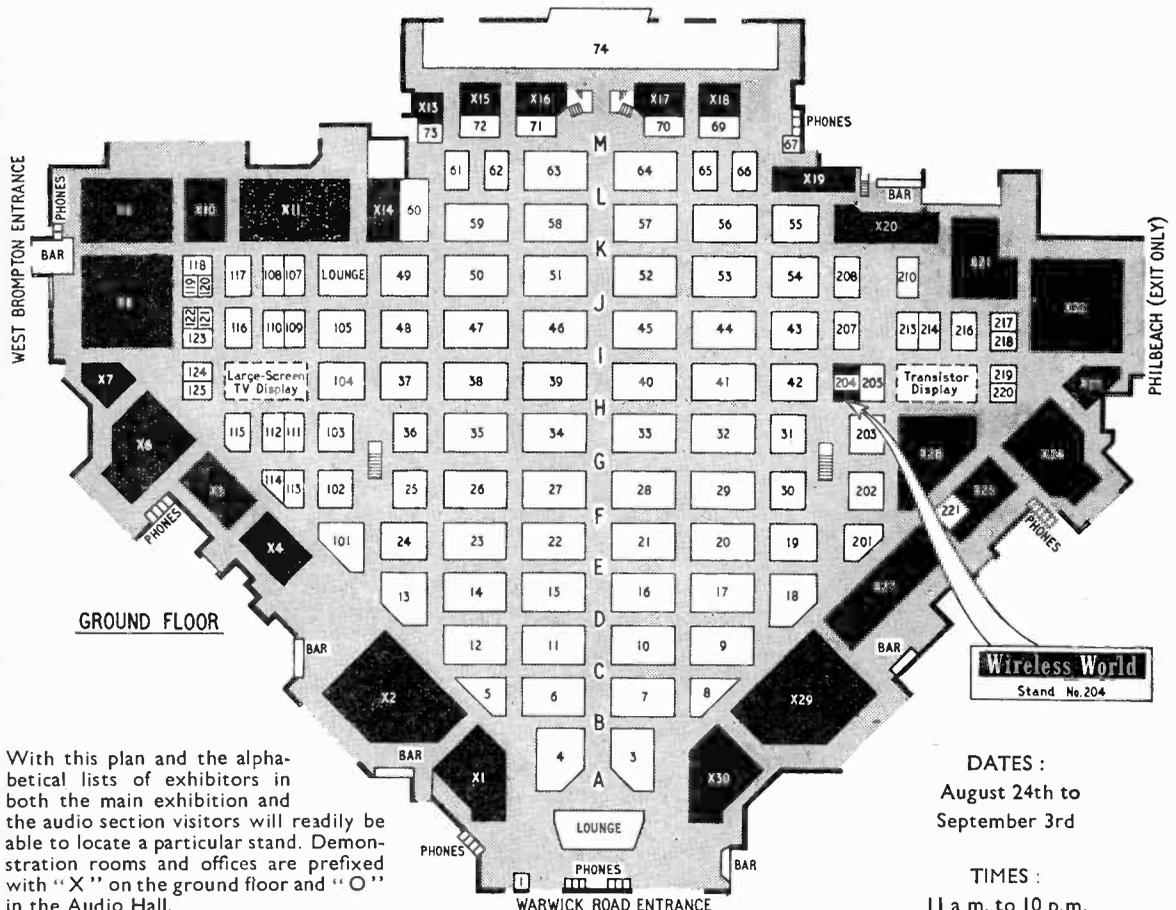
National Radio Show Guide

THE 27th British National Radio and Television Show at Earls Court opens to the public on August 24th with a preview for overseas visitors and invited guests the day before. Organized by Radio Industry Exhibitions on behalf of the British Radio Equipment Manufacturers' Association it is essentially a domestic sound and television equipment show, although the Services,

B.B.C. and I.T.A., provide interesting background. We give in the following pages a preview of the technical exhibits compiled from information available at the time of going to press. The stands in the Audio Hall are covered in a separate section at the end. In the October issue we shall give an assessment of trends in the design of equipment as portrayed at the Show.

ALPHABETICAL LIST OF EXHIBITORS

A.E.I.	21 (X27)	Casian	219	Ever Ready	34 (X10)
Admiralty	407	Charterhouse Credit Co.	8	Ferguson	39 (X5)
Aerialite	13	Chorlton & Co.	217	Ferranti Radio & TV	20 (X30)
Air Ministry	406	Collaro	38	Fidelity Radio	48
Alan-Markovits	115	Cossor Radio & TV	57	Fountain Press	124
Alba	16	Dansette	44	Fund for the Blind	414
<i>Amateur Tape Recording</i>	412	Decca Records	35 (X6 & X7)	G.E.C.	32 (X24)
Amnion	54	Defiant	7	G.P.O.	403
Antiference	17	Design Furniture	103	Gala Records	202
Argosy Radiovision	61	Domain Products	214	Garrard	56
Associated Television	74	Dublier	62	Goodmans	220
B.B.C.	408, 409 & 410	Dynatron	52	Gramophone Co.	46 (X11)
Barclays Bank	203	E.M.I. Records	65	Hacker Radio	113
Belling & Lee	63	E.M.I. Sales & Service	24	Heathkit	112
Bernards (Publishers)	125	Econasign	121	"His Master's Voice"	33 (X9)
Bowmaker	216	Ekco	58 (X8)	Hobday, Christopher	221 (X25)
Brimar Electronics	104	<i>Electrical & Radio Trading</i>	111	Home Maintenance	118
Bulgin	66	<i>Electronic Technology</i>	204	Hunts Capacitors	49
Bush	51 & 60 (X14)	Elizabethan	26	I.T.A.	74
"Careers"	405	Emerson Electronics	50		



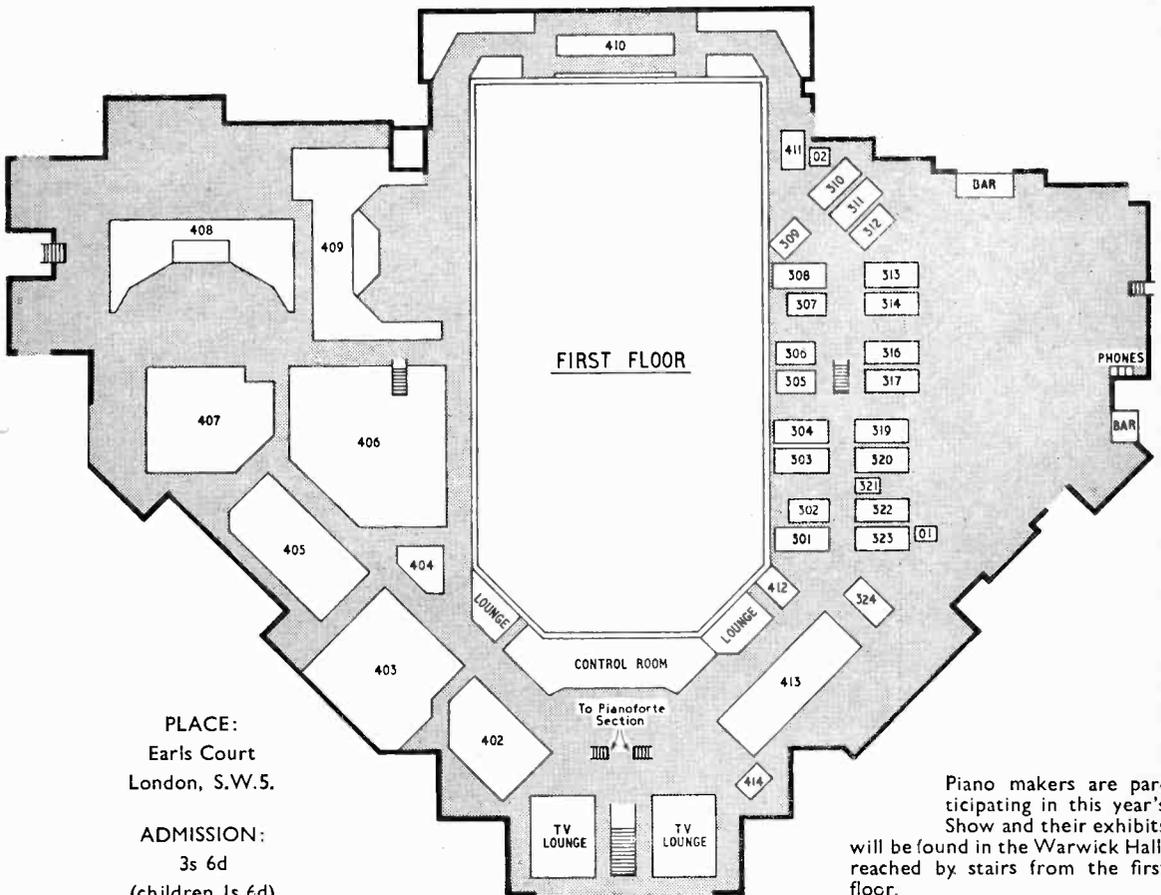
With this plan and the alphabetical lists of exhibitors in both the main exhibition and the audio section visitors will readily be able to locate a particular stand. Demonstration rooms and offices are prefixed with "X" on the ground floor and "O" in the Audio Hall.

DATES :
August 24th to
September 3rd

TIMES :
11 a.m. to 10 p.m.

J-Beam	5	<i>Radio Retailing</i>	124	<i>Teleng</i>	107
Keith Prowse	1	<i>Record Housing</i>	116	<i>Telection</i>	28
Kerry's	19	<i>Redicord</i>	123	<i>Telesurance</i>	9
Kolster-Brandes	22 (X4)	<i>Regentone</i>	59	<i>Territorial Army</i>	413
Labgear	25	<i>Roberts</i>	70 (X17)	<i>Tricity Finance Corp.</i>	36
Lee Products	55	<i>Rola Celestion</i>	213	<i>Trix</i>	37
Le Grest	122	<i>Rose Projects</i>	119	Ultra	15 (X2)
Lifeguard	30	S.T.C.	14	Valradio	114
Linguaphone Institute	109	<i>Slingsby</i>	31	Vulcan Finance	207
Lloyds Bank	4	<i>Sloss, Andrew</i>	102	Walter Instruments	72 (X15)
Marconiphone	47	<i>Sobell</i>	64 (X21)	Westminster Bank	18
Markovits	120	<i>Southern Television</i>	74	Whiteley	69 (X18)
Martins Bank	105	<i>Southgate Tubular Products</i>	210	Wireless for the Bedridden	67
McMichael Radio	53	<i>Star</i>	404	<i>Wireless & Electrical Trader</i>	110
Mercantile Credit Co.	208	<i>Stella</i>	6	<i>Wireless World</i>	204
Midland Bank	12	T.C.C.	42	<i>Wolsey</i>	43
Metropolitan Police	402	<i>Tape Recorders</i>	3		
Mullard	40 (X19, X20 & X22)				
Multicore	71 (X16)				
Murphy	23 (X1)				
National Provincial Bank	101	A.E.I. Sound Equipment	308	Gramdeck	314
NEV	218	<i>Acos</i>	310 (O2)	Gramophone Co.	323 (O1)
Perdio	41	<i>Alba</i>	306	Lustraphone	309
Perth Radios	205	Brenell	311	Philips	320
Peto Scott	27	Decca	303	REPS	305
Philco (Overseas)	45 (X23)	Dynatron	313	<i>Rola Celestion</i>	312
Philips	10 (X29)	E.A.R.	319	Symphony Amplifiers	302
Pilot Radio & TV	11	<i>Expert Gramophones</i>	307	<i>Tape Recording Hi-Fi Magazine</i>	321
Pitrie	108	Ferguson	324	Truvox	317
Plessey	73 (X13)	G.E.C.	322	Whiteley	304
<i>Practical Wireless</i>	117	<i>Gainsborough Tape Recorders</i>	301		
R.G.D.	29 (X26)	Goodmans	316		
R.S.G.B.	411				
R.T.R.A.	201				

AUDIO HALL (First Floor)



PLACE:
Earls Court
London, S.W.5.

ADMISSION:
3s 6d
(children 1s 6d)

Piano makers are participating in this year's Show and their exhibits will be found in the Warwick Hall, reached by stairs from the first floor.

NATIONAL RADIO SHOW

Guide to the Stands

A.E.I. (21)

Prominent among the exhibits on this stand is the Type CME2104, short-neck, 21-in television tube. It has a tri-potential electron-gun assembly and the overall length is only 13½ in. It has a 12.6V heater and forms a companion for the CME1705, 110°, 17in model introduced last year.

Semiconductor devices include the new Mazda XA161 and XA162 high-speed switching transistors of "mesa" construction and a 100-Mc/s amplifier transistor, the XA131. Also included are three n.p.n. switching transistors and a comprehensive range of transistor packages for the entertainment industry.

There is a representative group of Siemens-Ediswan dry batteries and among other items a range of Solon electric soldering irons.

Associated Electrical Industries Ltd., 155 Charing Cross Road, London, W.C.2.

ADMIRALTY (407)

"Navigation and charting the seas" is the theme of the Navy's display which is centred around a mock-up of a ship's bridge and plotting room. Amongst the equipment to be seen in this mock-up is the Two-range Decca Navigator, a radar display with chart comparison unit and a low-power transmitter-receiver. Airborne equipment including a u.h.f. direction finder is also on show together with a radar simulator for training purposes and a flight data system.

Admiralty, Whitehall, London, S.W.1.

AERIALITE (13)

In addition to ranges of aerials for television and radio for both overseas and home markets, cables for wired television and radio distribution will be shown. Two new cables will be introduced—one will be a "trunk" cable of low attenuation in Band III and another, utilizing an unusual construction, for which very low radiation is claimed. Also shown will be distribution amplifiers and installation accessories such as plugs and sockets and aerial filters.

Aerialite Ltd., Castle Works, Stalybridge, Cheshire.

AIR MINISTRY (406)

Many examples of electronic and radio aids used both operationally and in training by the Royal Air Force are shown on this stand. The use of the automatic landing system developed by the Blind Landing Experimental Unit of the Royal Air-

craft Establishment is illustrated, and among the training equipment shown is the trainer Type 102, which simulates the operation of airborne radar navigational and bombing aids.

Air Ministry, Adastral House, Theobalds Road, London, W.C.1.

ALAN-MARKOVITS (115)

Embellishments in the form of metal escutcheons, decorative fittings, cut-outs of various kinds and die-stamped name plates in a wide range of designs are made by this firm.

Alan-Markovits Ltd., Emblem House, Sussex Road, Hove, Sussex.

ALBA (16)

The very wide range of models displayed includes transistor and mains receivers, stereo record reproducers and radio-grams, the Duchess tape recorder and several television sets. Special features of these last are the mounting of the components on plug-in sub-chassis for ease of servicing, and provision of gated a.g.c. for more accurately reproducing picture contrasts. An unusual feature of the new Model T766 is that the brightness and contrast controls are preset. This model also uses an extra-short necked 110° tube for minimizing the cabinet depth.

Alba (Radio and Television) Ltd., Tabernacle Street, London, E.C.2.

AMPLION (54)

Shown by this company are a number of record reproducers, tape recorders and battery eliminators, as well as a stereo amplifier and transistor receiver. The "Marine" tape recorder is very unusual in that it can be operated from d.c. as well as a.c. mains.

Amplion Ltd., 175-179 Cricklewood Lane, London, N.W.2.

ANTIFERRENCE (17)

The "Cresta"—a new "in-the-room" B.B.C.-I.T.A. television aerial, which uses a full-wave Band-III dipole matched for extra gain and control over the radiation pattern, will be featured on this stand, together with new loft aerials. The remainder of the display will comprise a complete range of television and radio aerials and accessories for both home and overseas channel allocations; mounting brackets, masts, etc.; and a new "Autex" car-radio aerial.

Antiferrence Ltd., Television and Radio Aerial Division, Bicester Road, Aylesbury, Buckinghamshire.

ARGOSY (61)

The two new television receivers shown on this stand employ substantially the same circuitry, are housed in matching cabinets and differ only in the tuning systems employed. One, Model 17K12, has push-button selection of five stations, while the Model 17K14 has rotary-switch selection of all 13 channels. Both sets have 17in, 110° electrostatic focus tubes.

Sound radio sets include a transistor portable and an AM/FM table model, while for sound reproduction there is a neat and compact 2-valve, 4-speed auto-record player (Model AP11) and a single-speed (3½in/sec) tape recorder.

Argosy Radiovision Ltd., Eastern Avenue West, Romford, Essex.

B.B.C. (408, 409, 410)

Two of the three B.B.C. stands are devoted to entertainment—408 the "Gramstand" and 409 the "Teleshage." Part of stand 410 is devoted to the activities of the Corporation's engineers in research and development. Here will be seen a remotely controlled TV camera designed and produced by B.B.C. engineers. The advances made in the application of transistor techniques in various types of equipment are also illustrated in this section.

Although not strictly a technical feature, the specially constructed news studio, from which bulletins will be actually broadcast in the Light Programme, is of particular interest. Members of the Engineering Information Department are manning an information centre located between stands 408 and 409.

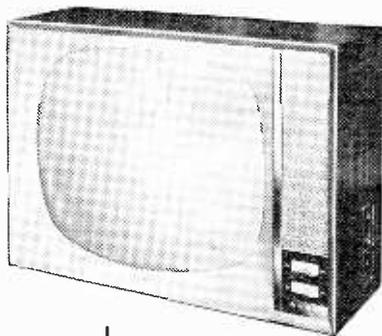
British Broadcasting Corporation, Broadcasting House, London, W.1.

BELLING-LEE (63)

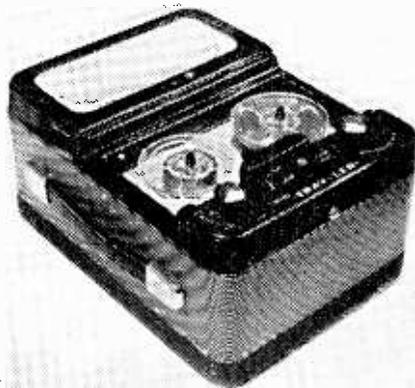
A range of set-top, or "in-the-room," aerials will form part of the display on this stand. Making its debut beside the well-established "Golden-V" and "Metropolitan" aerials is the "Vedette"—a low-priced set-top aerial.

Other aerials to be shown include attic types for Bands I, II and III, telescopic aerials which plug directly into the aerial socket of the receiver and a wide range of outdoor aerials, including types for Band V. Also featured will be complete equipments and individual units for communal-aerial and relay systems.

Belling and Lee Ltd., Great Cambridge Road, Enfield, Middlesex.



1. Alba T766 television receiver with preset brilliance and contrast controls.



2. Casian "Trav-ler" transistorized tape recorder.

3. Bush "Top Ten" battery 45-r.p.m. record player and fixed-tune Light Programme receiver.



BRIMAR ELECTRONICS (104)

A comprehensive range of valves and cathode-ray tubes for radio and television will be shown. Innovations are the 23-in 110° television tube with square corners to its screen and the ELL80 which is a double output pentode for push-pull and stereo output-stage applications.

Also shown will be the "Trustworthy" range of valves and other industrial types.

Brimar Electronics Ltd., Footscray, Sidcup, Kent.

BULGIN (66)

Many new items have been added to the Bulgin range of components recently but only a few can be mentioned here. A side-entry screened jack-plug conforming to BS666 requirements is compact, slender and has numerous applications. It is available in chrome (P535) or gold-plate (P536) finish. New side-entry plug and socket combinations are also shown.

Many additions have been made to their ranges of miniature and micro switches all of which constitute an improvement of one kind or another or to give them greater versatility. "Rocker-contact" switches of entirely new design in double- and single-pole types are now available. Some have a central "off" position and the rating is 6A to 10A at 250V a.c. Pure silver contacts are fitted and there are 8 new models in all.

A. F. Bulgin and Co. Ltd., Bye-Pass Road, Barking, Essex.

BUSH (51, 60)

On Stand 51 the complete range of television, radio, record-playing and radio-gramophone equipment produced by this company will be shown; whilst on Stand 60 working tele-

vision receivers will be massed in front of rows of seats.

New products on show will include the 21-in T.100c television receiver using the Bush push-button tuner, the TR.90 medium- and long-wave transistor portable receiver and the "Top Ten" record player. Specifically designed for the "pop" market this player is a battery-operated transistor model for 45 r.p.m. records only and it also can be switched to receive the long-wave Light Programme.

Bush Radio Ltd., Power Road, London, W.4.

CAREERS (405)

The would-be trainee will get a glimpse of the job of a serviceman from this stand, which also shows the public the standard of servicing they should expect from a dealer. There is also a display of the latest types of test equipment available to the dealer.

B.R.E.M.A., 49, Russell Square, London, W.C.1.

CASIAN (219)

Shown on this stand is the Trav-ler transistorized tape recorder. This operates at a single tape speed of 3½ in/sec and at this speed the total wow and flutter is claimed to be less than 0.4% r.m.s., the signal-to-noise ratio 30dB, and the frequency response flat within 3dB from 150 to 5,000 c/s.

Casian Ltd., 37 Grafton House, Golden Square, London, W.1.

COLLARO (38)

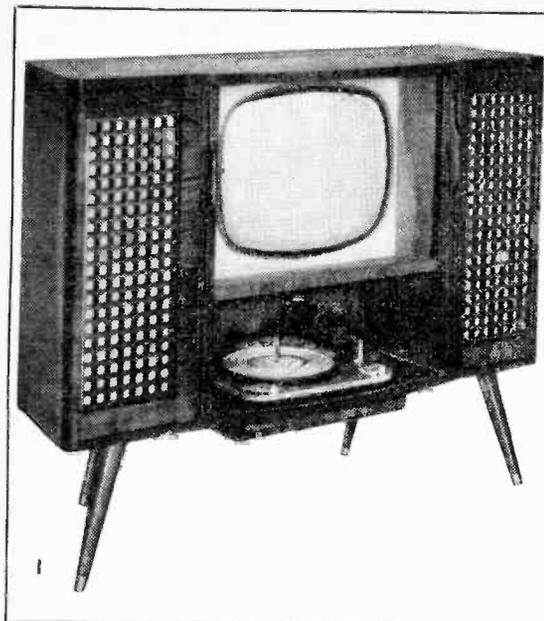
New additions to the range of tape decks, pickups and automatic and manual record turntables include the

TRP594 inexpensive transcription turntable and pickup arm, and the Studio C60 record changer. This latter incorporates a new speed-change mechanism which makes it impossible to change speed while the motor is running, thus avoiding one source of damage to the rubber driving wheels. The pickup arm is weight- rather than spring-counter-balanced so that the stylus pressure difference between the top and bottom records of a stack is kept below 1 gm. Also shown is the three-speed, three-motor "Studio" tape deck. This is normally fitted with two heads, but there is space for a third.

Collaro Ltd., Ripple Works, By-Pass Road, Barking, Essex.

COSSOR RADIO AND TV (57)

Two new television receivers are included this year, the CT1700U is a 17-in model with 110° tube and side-mounted, recessed controls. The loudspeaker while side mounted is canted forward for better sound distribution. Total depth is 15in. The other new model (CT2100U) is a



21-in version of the CT1700U and its circuitry and general features are substantially the same.

Among the new sound radio receivers is a 7-valve a.m./f.m. stereo radio-gram with two end-mounted 8-in loudspeakers. A 4-speed automatic record changer is used which is push-button operated and takes all sizes of records.

Cossor Radio and Television Ltd., 71 Endell Street, London, W.C.2.

DANSETTE (44)

A new addition to the wide range of record players and transistor receivers is the TRG45 transistor 45 r.p.m. radio-gram. This has a 600 mW push-pull output which feeds a 5-in loudspeaker. Also exhibited are a valve radio-gram, a portable stereo record reproducer, and two stereo converters.

J. & A. Margolin Ltd., Plus-a-Gram House, 112-116 Old Street, London, E.C.1.

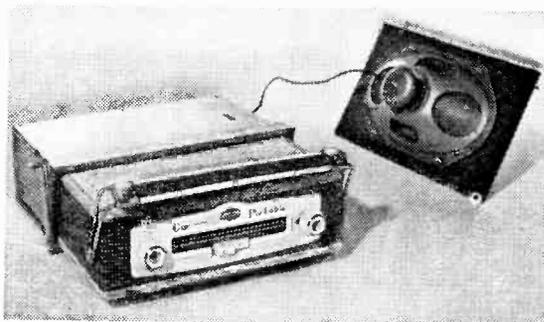
DECCA (35)

Features of the range of television sets on show are the use of two spaced loudspeakers, tripod-mounted rotatable cabinets for readily altering the viewing direction and, for ease of servicing, a specially hinged chassis. Several of these sets incorporate v.h.f./f.m. receivers. New models introduced this year include a combined television set and v.h.f./f.m. stereo radio-gram and also a transistor radio-gram. Also shown are several transistor receivers and stereo radio-grams.

The Decca Record Co., Ltd., 9 Albert Embankment, London, S.E.11.

DEFIANT (7)

Automatic brightness control is a feature of the Defiant 2A22 21-in

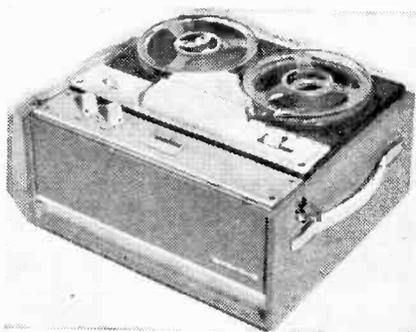


2

1. Decca combined TV receiver and v.h.f./f.m. stereo radio-gram.

2. Ever Ready dual-purpose, transistor car-radio receiver.

3. Ekco's first tape recorder.



3

television receiver on which push-buttons are provided for sound tone, on/off and picture sharpness control. 17-in models will also be shown.

For radio reception seven models of table receivers and radio gramophones are offered. A new receiver—Model A52—is described as a "cordless" receiver. In fact, this is a battery-powered transistor set, in a polished-wood table cabinet, giving a three-quarter-watt output to a large loudspeaker, thus simulating the performance of a mains-driven receiver. Also shown will be three record reproducers.

Co-operative Wholesale Society Ltd., 1 Balloon Street, Manchester, 4.

DESIGN FURNITURE (103)

Tables and trolleys of various kinds, some fitted with easy-running casters and designed especially to accommodate and harmonize with modern television receivers, are shown on this stand, together with a range of record storage and equipment cabinets.

Design Furniture Ltd., Carnwath Road, Fulham, London, S.W.6.

DOMAIN PRODUCTS (214)

To the range of showroom display shelves and floor-stands, made principally of tubular steel finished in attractive colours, has this year been added the "SL" series in 2- and 3-tier types for displaying to advan-

tage modern "slimline" television sets.

Domain Products Ltd., Domain Works, Barnby Street, London, N.W.1.

DUBILIER (62)

New developments to be shown on this stand include encapsulated paper tubular capacitors which meet the RCS131 joint services standard, sub-miniature electrolytic capacitors for transistor applications, high-stability resistors and tantalum electrolytic capacitors of both solid and foil construction.

A comprehensive range of capacitors, resistors and suppression devices for the television, radio and electronics industries will complete the display.

Dubilier Condenser Co. (1925) Ltd., Ducon Works, Victoria Road, London, W.3.

DYNATRON (52)

An unusual feature of the Autoview combined 21-in television and v.h.f./f.m. receiver is that station selection is by means of push-buttons which actuate a motor-driven turret tuner. A feature of several of the single-cabinet stereo and mono a.m./f.m. radio-grams is that bass reflex loudspeaker mounting is adopted. Several record reproducers are also on show. Transistorized units include a four-

(Continued on page 441)

speed record reproducer, a radio-gram and several receivers. Newly introduced is this company's first tape recorder—the Cordova.

Dynatron Radio Ltd., Maidenhead, Berks.

E.M.I. RECORDS (65)

H.M.V., Columbia, Parlophone, Capitol, M.G.M. and Mercury records will be displayed. Comprehensive record enquiry facilities will also be available.

E.M.I. Records Ltd., 20 Manchester Square, London, W.1.

E.M.I. SALES & SERVICE (24)

On show is the complete range of Emitape magnetic recording tape for amateur and professional users, which includes 2-in wide videotape as well as ordinary-, long-, and double-play $\frac{1}{2}$ -in tape. Also displayed is the complete range of Marconi valves.

E.M.I. Sales & Service Ltd., Blyth Road, Hayes, Middx.

EKCO (58)

Special features of several of the new television receivers on show are the use of two speakers mounted on either side of the cabinet, gated a.g.c. for more accurately reproducing picture contrasts, and the inclusion of a v.h.f./f.m. receiver.

Another new introduction is Ekco's first tape recorder which is an inexpensive, single-speed ($3\frac{1}{2}$ in/sec) model. Record reproducers include a new portable stereo record player as well as the well-known Nine-Octave RP341 which features a tuned reflex loudspeaker cabinet, an 8-watt output and bass and treble controls.

Features of a new small transistor receiver, the PT352, are provision of a push-pull output and slow-motion tuning. The wide range of valve receivers on show includes a.m., a.m./f.m. and f.m.-only models, and the well-known Radiotime combined radio, alarm clock and time mains switch.

E. K. Cole Ltd., Southend-on-Sea, Essex.

ELIZABETHAN (26)

Two four-track models are additions to the range of tape recorders. One of these, the FT1, is claimed to give a response up to 12,000 c/s at the single speed provided ($3\frac{1}{2}$ in/sec). The other new model, the FT3, can be operated at $1\frac{1}{2}$, $3\frac{1}{2}$ or $7\frac{1}{2}$ in/sec. Independent mixing of two channels is also possible with the FT3. Also on show is the two-track, three-speed Major tape recorder which features a record replay head with a gap as short as 3 microns, a meter recording-level indicator and a six-watt push-pull output.

Elizabethan (Tape Recorders) Ltd., Bridge Close, Romford, Essex.

EMERSON (50)

The Models 911 and 555 transistor portable receivers have both car-aerial and personal-listening earphone

sockets and cover medium and long wavebands, as does the personal portable Model 888. A "table" model (666) also tunes over medium and long waves.

Three gramophones will be shown, two being automatic record players, one with a "slumber switch" for turning off the mains supply after the last record has been played. The Model 502 is a stereo player with external loudspeakers.

Also shown will be two medium- and long-wave radio-grams (mono) and a 21-in television receiver.

Emerson Electronics Ltd., Brent Crescent, North Circular Road, London N.W.10.

EVER READY (34)

The "Sky Baron" and the "Car Portable" are the two newest transistor sets shown on this stand. The latter is of special interest as it includes provision for operation as a portable from its own battery or as a car radio from the 12V car battery, switching from one to the other being instantaneous. It employs 6 transistors and change from medium to long waves is effected by push-button switches.

A full range of current models in transistor and valve types are also included, as well as the Berec receivers in which series the "Musketeer" and "Auto Portable" are electrically similar to the "Sky Baron" and "Car Portable" respectively.

Ever Ready Co. (Great Britain) Ltd., Hercules Place, London, N.7.

FERGUSON (39)

A transistor v.h.f./f.m. receiver will be shown on this stand. The Model 626BT is a battery-powered receiver, using nine transistors and covering

v.h.f./f.m. and medium and long waves. One-watt a.f. output is fed to an 8×5 in elliptical l.s. and the styling is such that this set, although it has internal v.h.f. and a.m. aerials, is better regarded as a "cordless" table model than as a portable receiver. Also featured will be the Model 627 a.m./f.m. a.c./d.c. table receiver, which has a contemporary-styled case.

Several television models feature "Golden Glide" tuning—channel switching is achieved by means of a slide-bar control. Ferguson television receivers have the line and frame timebases stabilized against mains-supply variations and both horizontal and vertical retrace blanking is applied. Radio-grams and record players will also be shown: demonstrations Stand 324 (Audio Hall).

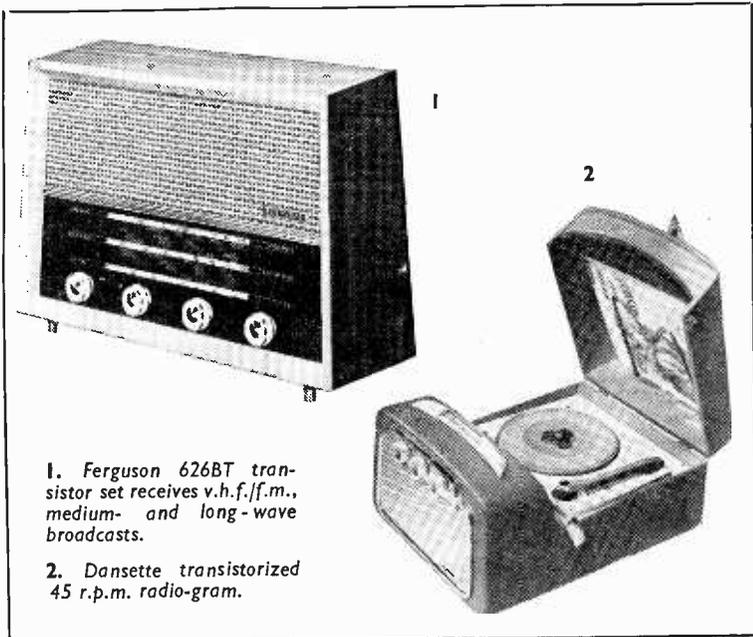
Thorn Electrical Industries Ltd., Thorn House, Upper St. Martins Lane, London, W.C.2.

FERRANTI (20)

Using the well-known B.S.R. deck, the new Ferranti Model RT1044 tape recorder has a 7×4 in internal loudspeaker and extension l.s. sockets (output power 3W).

New 21- and 17-in television receivers are designed so that access for servicing is easy and models with and without v.h.f. radio will be shown. The personal portable transistor receiver, Model PT 1031, covers the medium-wave band and provides pre-tuned reception of the long-wave Light Programme. V.h.f./f.m. and a.m. receivers will complete the display.

Ferranti Radio and Television Ltd., 41/47 Old Street, London, E.C.1.



1. Ferguson 626BT transistor set receives v.h.f./f.m., medium- and long-wave broadcasts.

2. Dansette transistorized 45 r.p.m. radio-gram.

FIDELITY (48)

To the Argyll series of tape recorders has now been added the Argyll Minor, a twin-track recorder running at 3½ in./sec. A "magic-eye" indicator provides visible check of recording amplitude. It is sturdily constructed and operates from a.c. mains.

Elegantly housed in the modern style is the RG26 radio-gram. It has ample space for record storage, the radio and gramophone compartments are side-by-side, the latter being exceptionally accessible, and the 6-valve radio unit provides for a.m. and v.h.f./f.m. broadcast reception. The gramophone is a 4-speed, auto-changer type. It is an a.c. mains model.

Fidelity Radio Ltd., 11-13 Blechyn-den Street, London, W.11.

FUND FOR THE BLIND (414)

Visitors to this stand, donated by the organizers, will be given the opportunity of seeing how the blind are able to take their place beside sighted people in industry. This organization makes a collective appeal on behalf of 14 institutions, societies and associations providing services to some 16,000 blind civilians in the Metropolitan area.

Greater London Fund for the Blind, 2 Wyndham Place, London, W.1.

G.E.C. (32)

A notable addition to this company's products is a v.h.f./f.m. nine-transistor portable receiver. A new miniature a.m. transistor receiver is also introduced. Features of a new a.m./f.m. stereo radio-gram are reflex mounting for its loudspeakers, stereo tape record/replay facilities, and an input position for a second stereo radio channel. New television receivers introduced continue G.E.C.'s slender curved styling and include several which incorporate a v.h.f./f.m. receiver. A chassis and cabinet which are hinged for ease of servicing are a feature of the new BT326 17-in portable television receiver.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

G.P.O. (403)

Radio interference and its suppression, the use of ferrite cores in telecommunications and the part played by the Post Office in linking sound and television studios to transmitters, are among the various aspects of the work of the G.P.O. illustrated on the stand. There is also a careers section where young people can obtain information on the variety of openings available to Post Office trainees.

General Post Office, Headquarters Building, St. Martin's-le-Grand, London, E.C.1.

GALA RECORDS (202)

Among the disc records shown on this stand is a new "Goldentone" series for children in 6in size (78 r.p.m.) costing 2s 9d each. Also introduced this year is a series of four language courses on 12in, 1.p. records in which is included Russian.

Selcol Products Ltd., 114-116 Charing Cross Road, London, W.C.2.

GARRARD (56)

A new model in the range of crystal and moving-coil pickups and record turntables is the Laboratory Series Auto Turntable Type A which is a combined transcription and automatic record player. The turntable in this unit has an unusual construction consisting of a sandwich made up out of an inner steel shell to provide a magnetic screen over the motor, a foam polyurethane disc, and a heavy non-magnetic outer shell. Also shown are the well-known 301 transcription turntable, TPA12 adjustable pickup arm, and SPG3 stylus pressure gauge.

Garrard Engineering & Manufacturing Co., Ltd., Newcastle Street, Swindon, Wilts.

GOODMANS (220)

A new addition to the range of compact loudspeaker systems is the inexpensive AL100. Also newly-introduced is a corner horn enclosure suitable for home construction for which working drawings but not kits are available and which is designed to be used with the Triaxette three-element coaxial loud-

speaker. Also shown are the new Axiom 110 and 112 10-in loudspeakers.

Goodmans Industries Ltd., Axiom Works, Wembley, Middx.

GRAMOPHONE COMPANY (46)

On show are three-speed tape recorders and mono portable automatic record reproducers. Also displayed is the new E.M.I. high-quality stereo pickup. Special features of the head of this are its very low effective tip mass (≈ 1 mgm) and high lateral compliance (7×10^{-6} cm/dyne). The arm is balanced both laterally and longitudinally, and the single pivot is viscous damped. The offset angle is chosen to minimize the distortion rather than—as is usual—the tracking angle. The arm incorporates a device for gently raising and lowering it so as to prevent damage to the record.

Gramophone Co., Ltd., Blyth Road, Hayes, Middx.

HACKER (113)

The main exhibit is the new Herald seven-transistor portable receiver. Interesting features of this are a specially-loaded large (8in \times 5in) loudspeaker, a one-watt push-pull output, and three-position tone control. Sockets are provided for an external aerial for use in a car and for connecting a microphone for using the receiver as a Baby Alarm. Also shown will be a portable transistor record player and radio-gram.

Hacker Radio Ltd., Norreys Drive, Cox Green, Maidenhead, Berks.

HEATHKIT (112)

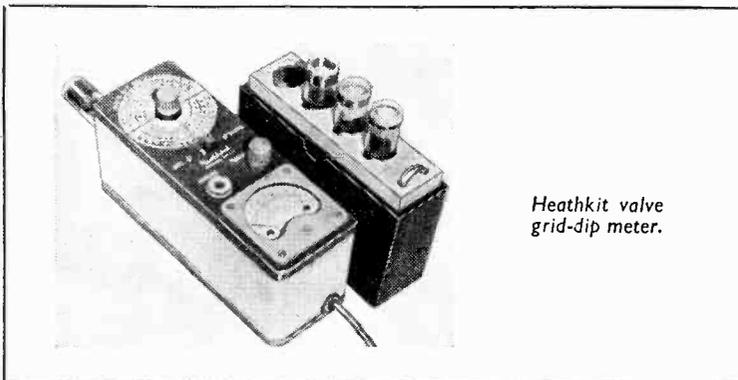
New kits on show include mono and stereo tape record/replay amplifiers as well as a transistor portable receiver. This latter covers the short and trawler as well as the usual medium and long wavebands, and has a 500mW push-pull output and relatively large (7in by 4in) speaker. The tape amplifiers can be matched to high- or low-impedance heads and feature a push-pull bias supply with a three-position level control for obtaining optimum results from any make of tape. New instrument kits include an r.f. generator covering from 100kc/s to 100Mc/s on fundamentals, as well as a valve grid-dip meter and its transistorized near equivalent.

Daystrom Ltd., Gloucester.

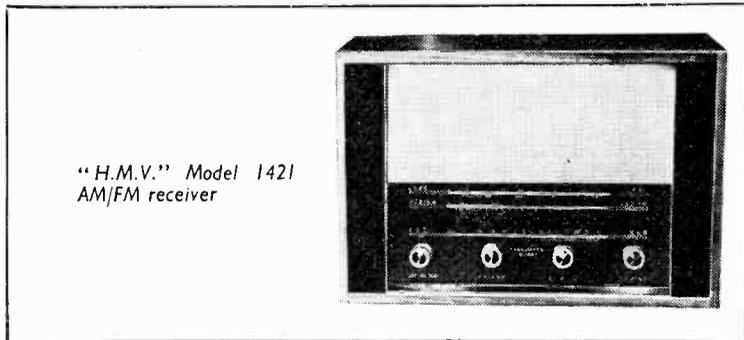
"HIS MASTER'S VOICE" (33)

The Model 1421 is a new a.m./f.m. transistor table receiver notable for employing an r.f. stage for both a.m. and f.m. broadcast reception. It has 9 transistors, 4 diodes and a 1-watt output stage feeding an 8 \times 5in elliptical loudspeaker. V.h.f. dipole and ferrite-rod aerials are included in the set.

The tuner in the Model 1910 television receiver, new this year, includes coils for all 13 channels and



Heathkit valve grid-dip meter.



"H.M.V." Model 1421
AM/FM receiver

with 4 on immediate call by means of piano-type key switches. A 17in, 110° tube, printed circuits and a 5-in front-facing loudspeaker are employed. A set of matching legs is available. There is also a 17in (110°) portable TV set with all 13 channels on call by means of an orthodox rotary switch located on one side of the very slim-looking cabinet.

British Radio Corporation Ltd., "His Master's Voice" Radio and Television Sales, 21 Cavendish Place, London, W.1.

CHRISTOPHER HOBDAY (221)

Wholesale distributors to the radio trade this firm is showing a representative range of receivers, sound reproducing equipment and associated apparatus supplied by them.

Christopher Hobday Ltd., 98-102 Broadway, Leigh-on-Sea, Essex.

HOME MAINTENANCE (118)

Servicing of radio, television and other domestic appliances for the trade is the function of this organization. On Stand 118 will be found a trade enquiry bureau.

Home Maintenance Ltd., Blyth Road, Hayes, Middlesex.

HUNTS CAPACITORS (49)

This company manufactures capacitors for all radio, television and electronic purposes. On show will be a wide range of both miniature and normal-sized units made by a variety of techniques, recent introductions being "Duolectric" metallized paper and plastics film units in metal or moulded casings and "Huntalitic" tantalum electrolytic capacitors of dry construction. Also shown will be many types of capacitors developed for use with printed wiring.

A. H. Hunt (Capacitors) Ltd., Bendon Valley, Garratt Lane, London, S.W.18.

I.T.A. (74)

This joint display by two programme contractors (Associated TeleVision and Southern Television), Independent Television News and the I.T.A., includes an O.B. unit with three cameras which are being used for closed-circuit transmissions within the exhibition. It also serves as an

information centre for independent television.

Independent Television Authority, 14 Princes Gate, London, S.W.7.

J-BEAM (5)

Well-known for their slot aerials for Band III, this company have devoted considerable research to reducing the unsightliness of television aerial arrays. Possibly the most striking examples of the outcome of this research are the combined Band I/III Double Beam 4/2, Omnibeam 4/2 and New J.One aerials; although in the New J.One the familiar slot construction has disappeared. Three more new aerials on show will be a telescopic car-radio aerial for transistor portable receivers: this is temporarily attached to the car by p.v.c. suckers, the Indoor Omnibeam—a wideband (Channels 6 to 13) Band-III slot combined with a telescopic Band-I element to cover Channels 1 to 5, and the "Marine Omnibeam" for the reception of television on ships.

J-Beam Aerials Ltd., Westonia, Weston Favell, Northampton.

KERRY'S (19)

This exhibit comprises a representative display of the various proprietary makes of radio and TV receivers, audio equipment, test gear and accessories, which, as wholesale distributors, they supply to the radio trade.

Kerry's (Great Britain) Ltd., Warton Road, Stratford, London, E.15.

KOLSTER-BRANDES (22)

The Kolsterama, Consort and Sovereign television receivers to be shown use a new 23-in c.r.t. with right-angle corners so that the complete picture as "seen" by the camera is displayed without the corner cutting inevitable when the whole screen of a more conventional c.r.t. is used. Other apparatus to be shown will include 17-in television set, radio receivers for v.h.f./f.m. and a.m., radio gramophones, record players and a tape recorder.

Kolster-Brandes Ltd., Footscray, Sidcup, Kent.

LABGEAR (25)

Television and v.h.f./f.m. aerials, accessories, amplifiers; intercom-

munication equipment and test instruments will be shown on this stand.

ECC88 valves are used in the E5053 and E5054 amplifiers, both of which are dual-channel (Band I/III) types providing gains of 15-18dB and 35-38dB respectively.

The intercommunication equipment exhibited will include instruments using the mains wiring alone for interconnection.

Labgear Ltd., Willow Place, Cambridge.

LEE PRODUCTS (55)

The wide range of products shown includes public address equipment and the Dulci and Elpico ranges of high-fidelity mono and stereo amplifiers and pre-amplifiers. Also shown are five- and fifteen-watt guitar amplifiers for which additional units for producing a tremolo effect are available. Elpico column-shaped loudspeaker enclosures as well as cabinets for housing a record turntable, pickup, pre-amplifier and amplifier are also on show.

Components exhibited include a very wide range of car aerials as well as resistors and capacitors.

Lee Products (Great Britain) Ltd., Elpico House, Longford Street, London, N.W.1.

LE GREST (122)

This firm manufacture television tables and trolleys of various kinds. There is shown a range of tables with and without lower shelves for programme journals and there are models with special non-slip tops and easy-running casters.

Le Grest and Co., 58 Fairfield Street, London, S.W.18.

LIFEGUARD (30)

On this stand C.R.T. Ltd., a newcomer to the new-tube industry, will be showing representative samples from the Lifeguard range of completely new cathode-ray tubes for television.

Cathode Ray Tubes Ltd., Factory Centre, Kings Norton, Birmingham 30.

LINGUAPHONE (109)

Language courses on gramophone records, many of them now on micro-groove discs, are available from the Institute.

Linguaphone Institute Ltd., 207-209 Regent Street, London, W.1.

MARCONIPHONE (47)

The new 17in (110°) portable television receiver (Model VP168) shown this year is housed in an attractive case giving the impression of even greater "slimness" than its modest front-to-back measurement of 12½in. Coils for all 13 channels are included and special attention has been given to achieving maximum r.f. gain with minimum noise. Printed circuits are used except for the tuner and mains wiring.

Among the valve-type receivers is a

new a.c./d.c. long, medium and v.h.f. sound receiver (Model T89DA) with provision for feeding into a tape recorder, also a 4-speed auto-radio-gram (Model RG86) which caters for v.h.f./f.m. as well as medium and long wave broadcasting.

The latest transistor portable is the Model T85B employing 6 transistors and a 400mW push-pull output stage feeding into a 5in (round) loudspeaker
*British Radio Corporation Ltd.,
Marconiphone Radio and Television
Sales, 21 Cavendish Place, London,
W.1.*

MARKOVITS (120)

This stand is devoted to a representative display of metal nameplates, receiver and equipment emblems and various kinds of metal embellishments supplied by this firm to the radio industry.

*I. Markovits, 8 Golden Square,
London, W.1.*

McMICHAEL (53)

The new television sets introduced this year are notable for at least two features of unusual interest. One is provision of remote control of brightness, volume and on/off while the other is the inclusion in the set of a light-sensitive cell (cat's eye) which automatically adjusts the contrast to compensate for changes in the room lighting. The remote control, or armchair, unit can be located up to 15ft from the set.

The new sets include a 17-in (110°), model in either a transportable (Model MP27) or "static" type cabinet (Model M75T) both similar electrically and providing for v.h.f. broadcast reception. A 21-in version is also available and it is made as a contemporary console.

To complete the range of new sets is a 17in portable, the Model MP20.

The sound radio sets include stereo auto-radio-grams and transistor portables.

*Radio and Allied Industries Ltd.,
Langley Park, Slough, Bucks.*

METROPOLITAN POLICE (402)

This is the first time for some years that the Metropolitan Police have provided a display at the Radio Show. Replicas of a radio operator's position at New Scotland Yard, a "999" operator's position and that of an Interpol operator—who by international agreement still uses a morse key—are being shown. Various mobile radio installations are also on show. An interesting feature of the 7-channel transmitter-receiver installed in the Traffic Accident Car is that it uses the r.f. output valve (a double tetrode) as a class B a.f. amplifier to feed the loudhailers.

*Metropolitan Police, New Scotland
Yard, London, S.W.1.*

MULLARD (40, X19)

The interior of Stand 40 is given over to the presentation of "Mullard

drama" on a continuous showing principle. Mullardrama is part colour film (starring Jon Pertwee), part display (starring Mullard products for the radio and television industry) and the theme is the difference between the old and the new means for providing entertainment by electronic techniques.

The Home Constructor Centre this year is at Stand X19. Here circuit diagrams and constructional details for Mullard designs will be available.

*Mullard Ltd., Mullard House,
Torrington Place, London, W.C.1.*

MULTICORE AND MULTIMUSIC (71)

This combined stand will display both the well-known Multicore solder products, such as the Savbit alloy for prolonging the life of soldering iron bits, as well as the new Reflectograph tape recorders, one of which is for two tracks and the other for four. Both of these new recorders use the same mechanical deck which provides tape speeds of 3½ or 7½in/sec and which has the unusual feature that a single potentiometer control provides variable-speed fast forward and rewind. Separate record and replay amplifiers are used.

*Multicore Solders Ltd., Maylands
Avenue, Hemel Hempstead, Herts.*

MURPHY (23)

The TR1, Murphy's first tape recorder, will be on show. Using the Garrard cassette-loading deck, to whose controls the recorder switching is ganged for simple operation, the TR1 has a "magic-eye" record-level indicator which operates before the tape can be set in motion.

Among the new radio-grams will be the portable A512R. Instead of the more usual m.w. and l.w. radio an f.m. tuner is provided. A stereophonic turnover cartridge is already fitted—for stereo reproduction the companion amplifier/loudspeaker unit is plugged-in. Another new radio-gram features a return almost to the flat baffle for its loudspeaker mounting (A592R).

The television receivers shown will include 17- and 21-in models in both "standard" and "luxury" classes, both with and without v.h.f./f.m. radio. Those receivers with f.m. facilities retain the automatic frequency control feature introduced last year so that switch programme selection, without fine-tuner fiddling, is provided.

A new transistor portable receiver, the B483, has a plastics cabinet of "Forticel", which possesses shock-resisting qualities.

*Murphy Radio Ltd., Welwyn Garden
City, Hertfordshire.*

NEV (218)

The Nottingham Electronic Valve Company claim that their cathode-ray tube reconditioning equipment is the first to be shown at a National Radio Show. The apparatus includes

semi-automatic machines suitable for the dealer who wishes to recondition up to 25 c.r.t.s per week and the plant can be expanded to deal with up to 1,000/week.

*Nottingham Electronic Valve Co.
Ltd., Kenrick Street, Netherfield,
Nottingham.*

PERDIO (41)

The wide range of transistor receivers on show includes the Continental. Special features of this are a loudspeaker as large as 8in by 5in, a one-watt push-pull output with bass boost to partially compensate for the small cabinet size, inclusion of the 70-200 metres trawler waveband, and a selectivity which automatically decreases as the station strength falls so as to minimize the signal-to-noise ratio. New transistor receivers which it is hoped to introduce include one for the v.h.f./f.m. band and another giving continuous coverage of a.m. from 11 to 570 metres as well as the long wave band.

*Perdio Ltd., Perdio House, Bonhill
Street, London, E.C.2.*

PERTH (205)

The "Home and Away" radio-gram is a combination of transistor a.m. radio receiver and, in a radio-gram cabinet, a mains-powered turntable and amplifier to which the transistor receiver can be attached as a tuner unit. The transistor receiver can, of course, be removed and used separately as a portable.

Four versions of a wholly mains-powered radio-gram will be shown: a.m., a.m./stereo, a.m./f.m. and a.m./f.m./stereo. All Perth radio-grams have polished wood backs so that they are freed from the limitation of having to be stood against a wall.

Two record players (single-channel and stereo) a tape recorder (Clarissa Mk. 3) and a transistor portable receiver will complete the display.

*Perth Radios Ltd., Marten House,
39/47 East Road, London, N.1.*

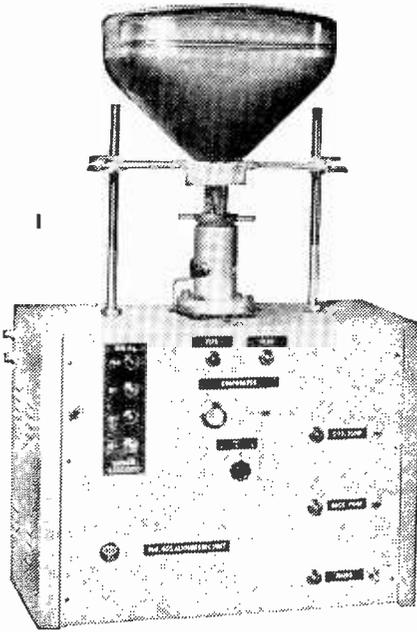
PETO SCOTT (27)

Seven types of television receiver will be shown on this stand including portable, table and table-with-f.m. models as well as the Fanfare tape recorder. Two of the television receivers will be seen for the first time at the show—a 21-in model with twin loudspeakers and side controls and a 17-in. set which is described as "extra-slim" with keyboard tuning.

*Peto Scott Electrical Instruments
Ltd., Adlestone Road, Weybridge,
Surrey.*

PHILCO (45)

Following the trend for picture-on-the-wall television, started last year with the "Telarama", Philco have introduced this year the "Picturama"—a 17-in. receiver using the short-neck 110° c.r.t.—which can be hung on the wall. This set is not



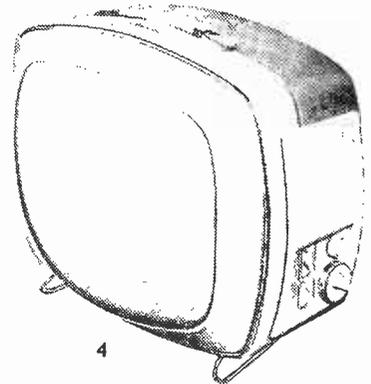
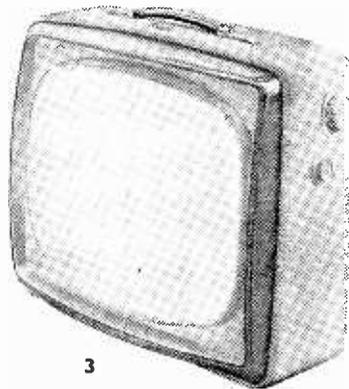
1. Aluminizing machine from Nottingham Electronic Valve Company's "400" c.r.t. reconditioning plant.



2. Picturama 17-in TV receiver by Philco hangs on the wall or uses its mounting bracket as a table stand.

3. Model VPI68 Marconiphone 17-in portable television receiver.

4. McMichael Model MP20 17-in portable television receiver.



"just a pretty face"—inside information is given to the serviceman by completely colour-coded sub-assemblies, so that, Philco claim, most servicing can be carried out without reference to a service manual.

Other new designs to be shown will be radio-grams, record players, radio receivers and, in addition to the Picturama, television receivers.

Philco (Great Britain) Ltd., 30/32 Gray's Inn Road, London, W.C.1.

PHILIPS (10)

Recent introductions by this company include an a.m./f.m. receiver, a de luxe version of the Philette transistorized receiver which has a detachable handle for converting it from a portable to a table radio, an automatic version of the Disc Jockey stereo record reproducer, and an a.m./f.m. stereo radio-gram in which the loud-speakers are mounted at the

ends of the cabinet and angled outwards. Well-known features of this company's range of television receivers are the use of a hinged chassis for ease of servicing, and side mounting but forward angling of the loud-speaker.

Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

PILOT (11)

The "Spacemaker" range of television sets introduced last year is continued with little change; this includes 17in. and 21in. models in table and portable form with and without v.h.f. radio channels.

Among the sound reproducing apparatus is a lightweight portable stereo record player with 4-speed auto record changer and embodying two detachable loudspeakers which form the lid of the player. There is

also a transistor portable which can be operated from its self-contained aerial or a car aerial. It covers medium and long wavebands.

Pilot Radio and Television Ltd., Television House, Eastcote, Ruislip, Middlesex.

PITRIE (108)

This stand will hold a display of reconditioned television cathode-ray tubes and function as a trade enquiry office.

Pitrie Ltd., 21 Noel Street, London, W.1.

PLESSEY (73)

This stand is primarily an office where design engineers, representatives of manufacturing organizations and business associates from abroad can discuss immediate and future requirements with members of the Plessey organization. Available for their

inspection are examples of this firm's current and newest products.

Plessey Co. Ltd., Vicarage Lane, Ilford, Essex.

R.G.D. (29)

Among the wide range of television and radio receivers, radio-grams, record players and a tape recorder to be shown will be five models introduced for the exhibition. Of particular interest will be the Model 612 television receiver with its press-button tuner and the 204 a.m./f.m. radio-gram which is styled in the modern long, low look.

For the connoisseur of recorded and broadcast sound the Model 418 radio-gram will be shown. This uses a Goldring variable-reluctance pick-up and is fitted with an integral 6.5W amplifier and five loudspeakers, the bass chamber using an acoustic resistance unit. For stereo a second amplifier/loudspeaker combination is added, but the controls are grouped in the original console.

Radio Gramophone Development Co. Ltd., Eastern Avenue West, Romford, Essex.

R.S.G.B. (411)

The Radio Amateur Emergency Network is featured on the Society's stand on which will be found a wide variety of amateur transmitting, receiving and test equipment. There is also a selection of the books and pamphlets issued by the Society, including the new editions of the "Amateur Radio Call Book" and "A Guide to Amateur Radio."

Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1.

R.T.R.A. (201)

A reception centre is provided for members of the Association and an information bureau for the general

public where visitors may obtain a list of R.T.R.A. members in their particular district.

Radio and Television Retailers' Association, 15/17 Goodge Street, London, W.1.

RECORD HOUSING (116)

The motto of this company is "Hi-Fi Furniture is our Business" and this puts in a nutshell what will be seen on their stand. Among the cabinets for records, equipment and loudspeakers added to their range since last year's show will be found examples of the long, low trend (Polonaise de Luxe) and the more traditional approach to cabinet design (Delius).

Record Housing, Brook Road, London, N.22.

REDICORD (123)

This firm is showing a range of stereo record players in portable form and also for mains operation at

home. One model "The Nevin" is designed with the small-flat occupier in mind as it provides, in compact form, a stereo record player, a tape recorder fitted with a Garrard magazine tape deck and integral twin loudspeakers. There is a portable tape recorder and "The Calypso" transistor 4-speed lightweight record player.

Redicord Ltd., 46 Frith Street, London, W.1.

REGENTONE (59)

The SRG15 seven-valve stereo radiogram to be shown is a one-box design in which the necessary separation between the loudspeakers is achieved by mounting them at the ends of the four-foot wide cabinet. Its companion new single-channel model, the ARG14, is wired for stereo conversion.

Among the television receivers which will include models with f.m.



1. Press-button tuning is a feature of the R.G.D. Model 612 television receiver.

2. Sobel stereophonic radio-gram, Model SG670

3. New stereo a.m./f.m. radiogramophone from Regentone has divided top covering the record changer (Model SRG15)

radio, will be two new sets, one of which, the Model 17-18, is fitted with the "Fingermatic" press-button tuner for instant selection of the desired channel.

Other products to be exhibited will include a.m. and f.m. radio receivers, record players and a tape recorder.

Regentone Radio and Television Ltd., Eastern Avenue West, Romford, Essex.

ROBERTS (70)

The R200 transistor portable is the latest addition to this firm's range of small portables. It is a two-band a.m. set, embodies a printed circuit with 6 transistors, two being a push-pull output pair, and a diode. The 5in loudspeaker is large for a portable and it has a magnet with the exceptionally high flux of 13,000 gauss. Battery economy is one of its main features, the consumption being only 20mA from the 9-V battery. Provision is made for operating the set, which has a ferrite-rod aerial, from a car aerial if required.

Roberts' Radio Co. Ltd., Creek Road, East Molesey, Surrey.

ROLA CELESTION (213)

A very comprehensive range of loudspeakers is displayed. Those for set manufacturers include several elliptical types as well as circular ones with diameters ranging from 2½ to 15in. Those for public address purposes include re-entrant horns and column units. Among the loudspeakers for special purposes are some which are flame proof.

Rola Celestion Ltd., Thames Ditton, Surrey.

ROSE PROJECTS (119)

Television tables, record storage cabinets and showroom display stands are a speciality of this firm. Included among their TV tables is a novel design known as "Long-Tom" measuring 42in x 21in and having a revolving platform at one end for the TV set which can be locked in any desired viewing position.

Rosa Projects Inc., Bourne End, Bucks.

S.T.C. (14)

Special valves for industrial applications, transistors, tunnel diodes, tantalum capacitors and many other components occupy much of the space on this stand. There is a range of quartz crystals including some triple crystal units in a single glass envelope for crystal control of the mixer oscillator in v.h.f./f.m. broadcast sets, also the FST1/4 silicon rectifier for h.t. supply in television sets. Two are required in series on 200/240V a.c. mains for half-wave rectification. The rated maximum d.c. output is 500mA.

Standard Telephones and Cables Ltd., Connaught House, Aldwych, London, W.C.2.

SLINGSBY (31)

Wheeled trucks and trolleys designed especially for handling television sets, radio-grams and the heavier kinds of audio apparatus in dealers' showrooms and warehouses, as well as loading and unloading equipment for vans, are shown on this stand.

H. C. Slingsby Ltd., 89-97 Kingsway, London, W.C.2.

SLOSS (102)

This company will be exhibiting television aeriels, accessories, and coaxial cables. The "Regal" aerial arrays are coated with a plastics film in various decorative colours to provide protection against corrosion.

Band-III aeriels have the "Ben-Nevis" diplexer built-in and are designed to be added to an existing Band-I installation. Provided with a 6ft tail of coaxial cable, the installer removes the existing cable from the Band I aerial, connects it to the Band III aerial and connects the tail to the Band I aerial.

Andrew Sloss, Belmont Works, Belmont Site, Lewis Street, Stranraer, Scotland.

SOBELL (64)

The new 21in television console, Model SC3", is fitted with two forward facing loudspeakers, a "magic eye" automatic control of contrast actuated by the degree of lighting in the room and an armchair unit on a 15ft plug-in lead giving remote control of on/off, brightness and volume. This set also provides v.h.f./f.m. reception.

There is a 17in model (110°) in transportable and table styles, TPS781 and T279 respectively, also two portables, a 21in Model T293 and a 17in, Model TP5710. Both are fitted with chassis which swing outward on a hinge for servicing when the back is removed.

Their new AM/FM stereo radiogram Model SG670 has a 4-speed auto changer and built-in twin loudspeakers. Ample space is allowed for record storage and for programme periodicals.

Radio and Allied Industries Ltd., Langley Park, Slough, Bucks.

SOUTHGATE TUBULAR PRODUCTS (210)

Manufacturers of tubular-metal stands and industrial furniture, this firm is showing a selection of its products especially suitable for window and showroom display of radio sets and accessories. Also included is a small display electric turntable claimed to run continuously for one month on two U2 batteries.

Southgate Tubular Products, 148 Chase Side, Southgate, London, N.14.

STELLA (6)

Four radio models and a record player comprise the show introductions.

Other sets on display will include

radio, radiogramophone and television receiving equipment and a record player which is adaptable for stereo.

The ST562A is the new record player. Portable, it has a stereo amplifier and twin loudspeakers, one of which can be detached for full stereophonic effect. A Philips record changer is used.

Stella Radio and Television Co. Ltd., Astra House, 121-123 Shaftesbury Avenue, London, W.C.2.

T.C.C. (42)

New developments in capacitors, printed wiring and ceramics will be featured on this stand. For instance, both dry and wet types of tantalum electrolytic capacitors will be shown, together with extensions to the range of miniature dry electrolytic capacitors for transistor applications such as hearing aids. New interference-suppression equipment will include an additional forward-scatter filter for use in the aerial lead of television receivers.

The other exhibits will be the well-established ranges of components for radio, television and electronics industries.

Telegraph Condenser Company, Ltd., North Acton, London, W.3.

TAPE RECORDERS (3)

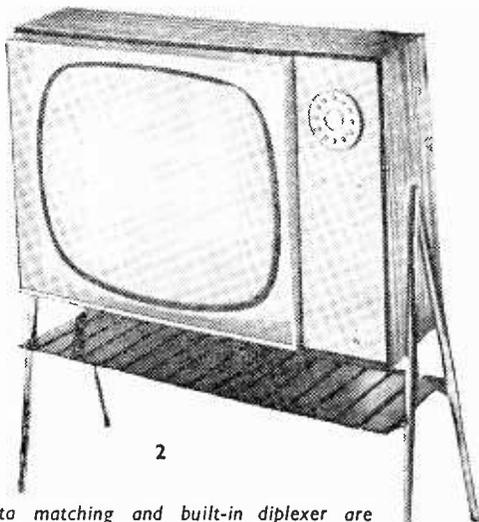
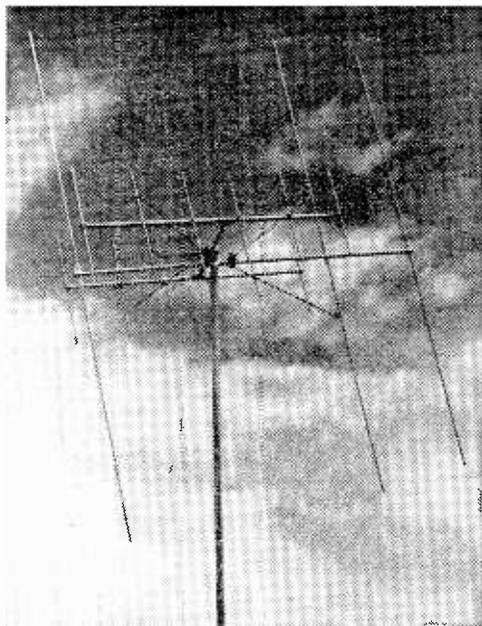
A wide range of tape recorders and accessories will be on show. This includes four-track versions of the Sound Studio and Prince recorders as well as a new dictating machine which can be completely remotely controlled. Another new four-track recorder is the Sound Master which features a 14-watt ultra-linear push-pull output, level indication by means of a meter, separate record and replay amplifiers, and facilities for mixing, monitoring and multiple superimposition. Tape accessories include splicers and the Sonocolor range of ordinary and Synchro-Ciné tapes.

Tape Recorders (Electronics) Ltd., 784-788 High Road, Tottenham, London, N.17.

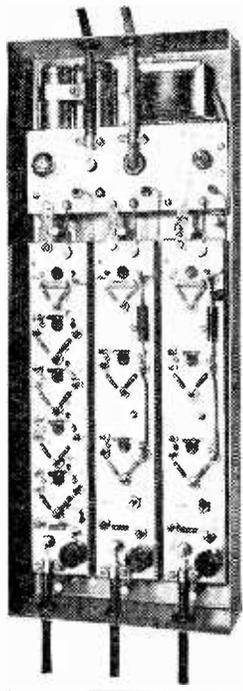
TELENG (107)

Well known in the television- and radio-relay field, this company will be exhibiting their range of equipment, cables and accessories for wired broadcast distribution, together with test equipment for networks.

One item, the Type U4000 amplifier, for communal or "extended" aerial service is unusual in that it uses transistors, even for the Band III section. This, of course, has the advantage of reducing size, maintenance and power consumption, which is 1.5W from the mains, for a Band-I, -II and -III amplifier of about 40dB gain. Thus, where line powering is used, many amplifiers can be operated from one central



1. Delta matching and built-in diplexer are features of the Telelection Maxima D6 extreme-fringe aerial.
 2. Ultra "Bermuda" 21-in television receiver with auto-tuning system.
 3. Teleng's transistor communal-aerial amplifier for Bands I, II and III.



power supply without overloading the coaxial cable.

Teleng Ltd., Church Road, Harold Wood, Romford, Essex.

TELELECTION (28)

Additions to this company's wide range of television and v.h.f./f.m. aerials include combined Band-I/III types for secondary- and fringe-area service and dual-band loft aerials. Splayed-H Band-I construction is

used in the Primax-5 and 8 Band I/III aerials and the Maxima D5 and D6 extreme-fringe arrays use delta matching for both Band-I and Band-III sections, which are connected together with a diplexer built-in at the factory. The new "Loftee" attic arrays have telescopic all-channel Band-I aerials and are suitable for both vertical, both horizontal or orthogonal polarizations of the transmitted signals.

Telelection Ltd., Antenna Works, Lynch Lane, Weymouth, Dorset.

TELESURANCE (9)

Details of the insurance-maintenance scheme operated by the organization, through dealers who are members of R.T.R.A., are available on this stand.

Telesurance Ltd., 14 Windmill Street, London, W.1.

TERRITORIAL ARMY (413)

Equipment typical of that used for training purposes by the 65th Signal Regiment T.A. (formerly No. 1 Special Communications) and the affiliated 328 W.R.A.C. Signal Squadron (for women) is displayed on this stand. Among the trades for which training is provided are radio mechanic and W/T operator.

65th Signal Regiment, T.A., 79/85 Worship Street, London, E.C.2.

TRIX (37)

This exhibit consists of record reproducers, tape recorders, public-address and sound-reproducing equipment.

The Model B100 amplifier is rated at 12W output and operates on 12V, consuming 1.5A d.c. It has eight

transistors and the pre-amplifier section has separate inputs and controls for microphone and music, the latter being suitable for tape, gramophone or radio. Provision is made for mixing the input signals; bass and treble controls are included.

Trix Electrical Co., Ltd., 1-5 Maple Place, London, W.1.

ULTRA (15)

The new "Bermuda" range of television receivers occupies a prominent place on this stand. Tuning resembles the dialling system of the G.P.O. telephone. To operate it the required television-channel, or v.h.f.-station, selector button is depressed and the whole dial then rotates automatically to the desired position. The auto tuner can also be operated manually. The range includes 17in and 21in tube models in table or console types. The cabinets are designed to accentuate the slimness of the set arising from the use of the new short-neck, 110° tubes.

The range of sound radio receivers includes an a.m./f.m. transistor portable, Model TR81.

Ultra Radio and Television Ltd., Stonefield Way, South Ruislip, Middlesex.

VALRADIO (114)

D.C.-to-a.c. and d.c.-to-d.c. converters are a speciality of this firm and examples with outputs between one watt and nearly half a kilowatt will be shown. The units for operation from supplies in the range 6 to 50V use transistors; but for conver-

(Continued on page 449)

sion of d.c. mains to a.c., valve units are available.

For the operation of apparatus using half-wave rectifiers (such as television receivers) d.c.-to-d.c. units are recommended because the unbalanced waveform on a.c. might upset operation of the converter.

Also shown will be the "Mirra-scope" projection television receiver—this produces large-screen pictures up to four feet wide.

Valradio Ltd., Browells Lane, Feltham, Middlesex.

WALTER (72)

Designed with an eye on the export market the new "Battery-Mains" transistor tape recorder while having portable applications is in all respects a "full-size" machine. It provides for twin-track recording, runs at 3½in/sec, is fitted with 5½in tape spools and is claimed to deliver an undistorted a.f. output of 2W. The recorder is completely self-contained, embodying a mains supply unit, batteries (for 9V operation) and a 7in × 4in elliptical loudspeaker. Shown also are all the current models.

Walter Instruments Ltd., Garth Road, Morden, Surrey.

WHITELEY (69)

Shown here is a selection of the wide range of audio equipment made by this firm. For stereo reproduction the WB8S amplifier, which comprises a pre-amplifier and power amplifier giving 8W per channel, has been modified for use with both crystal or low-output magnetic pickups, tape and radio. Its pre-amplifier can be used with one of several main amplifiers. Also included is a new 200mW. transistor amplifier using printed circuit technique.

Loudspeakers range in size and type from 1½in and 2½in models, some with plastic chassis and for use in personal portables, to 12in models with 16,000-gauss magnets and new cone assemblies responding to a very wide range of frequencies.

Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts.

WIRELESS FOR THE BEDRIDDEN (67)

The stand occupied by this society, which provides free radio facilities for needy bedridden, housebound and aged invalids, has been given by the exhibition organizers for the distribution of literature and the collection of donations. The society, which relies entirely on voluntary support, has supplied over 7,000 installations—either sets or relay services—which are maintained free.

"Wireless for the Bedridden" Society, 55a Welbeck Street, London, W.1.

WOLSEY (43)

A wide range of television and v.h.f./f.m. radio aerials for indoor (attic and room) and outdoor use will be shown together with a working demonstration of the Wolsey "Vision

Network System" carrier-frequency television and v.h.f./f.m. communal-aerial and relay equipment.

A range of aerials called "Collector-Combine" will be introduced: these aerials feature individual tuning and phasing by means of phasing bars on both Bands I and III.

V.N.S. apparatus can be used for

small block-of-flat systems with as few as half a dozen subscribers up to the provision of relay services for a whole town and the working demonstration will carry four television and four sound channels.

Wolsey Electronics Ltd., Cray Avenue, St. Mary Cray, Orpington, Kent.

AUDIO HALL

A.E.I. SOUND EQUIPMENT (308)

Both industrial and domestic high-fidelity loudspeakers, amplifiers and control units will be shown. An unusual feature of the domestic mono control unit is that the low-pass filter cut-off frequency is continuously variable. The loudspeakers include 12- and 18-in direct radiators as well as dual-concentric units in which the centrally-mounted tweeters are horn loaded. Also shown is the Coffee Table Console cabinet suitable for mounting a record turntable, pre-amplifier, amplifier, and radio tuner.

A.E.I. Sound Equipment Ltd., Crown House, Aldwych, London, W.C.2.

ACOS (310)

Being demonstrated is the Hi-Light pickup with its stereo head. This retains the unusual flexible cantilever arrangement of the mono head and has a needle tip mass of the order of a milligram. The arm produces a very low side thrust (0.02 gm) and is very insensitive to external displacements and vibrations.

Microphones on show include the stereo Mic44 in which two pairs of crystal inserts are used to produce a double figure-of-eight response up to about 8kc/s with the individual element responses extending still higher (up to about 12kc/s).

Cosmocord Ltd., Eleanor Cross Road, Waltham Cross, Herts.

ALBA (306)

Being demonstrated are two a.m./f.m. stereo radio-grams, a portable stereo record reproducer with the second amplifier and loudspeaker mounted in a separate matching cabinet, and the Duchess tape recorder. An unusual feature of the latter model is the use of two neons to indicate the recording level.

Alba (Radio and Television) Ltd., Tabernacle Street, London, E.C.2.

BRENELL (311)

A wide range of complete tape recorders as well as separate tape decks and amplifiers will be on show. This includes the new stereo version of the Three Star recorder which has separate modulation indicators for each channel and the very unusual facility of allowing one track to be recorded while the other is being replayed so that synchronized recordings can be made. A very versatile deck is the Mark 5 since it has four

operating speeds and room for four magnetic heads. Also shown is an inexpensive high-impedance three-channel mixer.

Brenell Engineering Co., Ltd., 1a Doughty Street, London, W.C.1.

DECCA (303)

Demonstrations will be given of the new stereo Decola record reproducer. Special features of this include a multi-directional high-frequency loudspeaker system for providing a large area of good stereo effect, incorporation of the very low ($\approx 1\text{mgm}$) effective needle-tip mass "fliss" pickup, and provision of a micro-lift for gently raising and lowering this pickup.

The Decca Record Co., Ltd., 9 Albert Embankment, London, S.E.11.

DYNATRON (313)

Stereo will be demonstrated with the aid of the well-known Berkeley 2×10 watt a.m./f.m. radio-gram as well as the new Mazurka record reproducer, in each case together with its associated separate second-channel loudspeakers. On show are valve and transistorized four-speed record reproducers as well as the Cordova—this company's first tape recorder. This is a three-speed device.

Dynatron Radio Ltd., Maidenhead, Berks.

E.A.R. (319)

Among the three new additions to the MusicMaker range of record reproducers is a stereo model in which the second loudspeaker is housed in a detachable lid. Mono and stereo versions of the 1965 and Triple-Four ranges of record reproducers are also on show. Transistorized units exhibited include a four-speed record player and radio-gram as well as a receiver. A tape recorder using the B.S.R. Monardeck is exhibited: it is also hoped to show new models incorporating the Garrard and Collaro tape decks.

Electric Audio Reproducers Ltd., The Square, Isleworth, Middlesex.

EXPERT (307)

On show are the Stereofon II and III stereo v.h.f./f.m. radio-grams. Both of these use the same 2×8 -watt amplifier, pre-amplifier and f.m. tuner, but whereas the Stereofon II uses an autochanger and inexpensive pickup arm, the Stereofon III uses

a transcription turntable and the Expert pickup arm. An unusual feature of the pre-amplifier used in these models is that the tone controls take the form of switched bass boosts and treble cuts. Also exhibited are a column-shaped loudspeaker enclosure and the Master horn-loaded loudspeaker system.

Expert Gramophones Ltd., 78 Balham High Road, London, S.W.12.

FERGUSON (324)

Demonstrations of a new high-quality radiogramophone, the 658RG, will be given in this room. For details of other Ferguson products, see Main Hall listing.

Ferguson Radio and Television Ltd., Thorn House, Upper St. Martin's Lane, London, W.C.2.

G.E.C. (322)

An interesting feature of some of the stereo demonstrations is the use of a third central loudspeaker fed with part of both the left and right signals so as to define the central image more accurately. Demonstrations will be given of the small Bookcase loudspeaker and also the Slender Periphonic acoustic "push-pull" two loudspeaker system for reducing low-frequency second harmonic distortion. On show are standard and hi-flux tweeter Presence Units as well as the well-known metal cone speaker and suitable cross-over filters.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

GAINSBOROUGH (301)

Three three-speed tape recorders will be shown on this stand. Special features of the Mark IV are the use of separate record and playback heads and amplifiers, a push-pull erase and bias oscillator, and a meter as the record level indicator.

Gainsborough Tape Recorders, 189 Northcote Road, London, S.W.11.

GOODMANS (316)

Being demonstrated are the new AL100 and the well-known AL120 compact loudspeaker systems, a new corner horn enclosure suitable for home construction which incorporates the Triaxiette three-element coaxial loudspeaker, and the new Axiom 110 and 112 10in loudspeakers in suitable cabinets.

Goodmans Industries Ltd., Axiom Works, Wembley, Middx.

GRAMDECK (314)

The Gramdeck utilises the rotation of a gramophone turntable to drive a tape deck, a turntable speed of 78 r.p.m. producing a tape speed of 7½in/sec. Also provided with the deck is a transistor record/replay amplifier and bias supply. Thus recordings can be made from a microphone or from the output transformer secondary of a radio-gram or record reproducer and replayed via the pickup input. Erasure is possible by

means of a permanent magnet. This device thus essentially converts a radio-gram or record reproducer into a tape recorder.

Andrew Merryfield Ltd., 29-31 Wright's Lane, London, W.8.

GRAMOPHONE COMPANY (323)

Being demonstrated are a range of loudspeaker systems and cabinets suitable for housing a tape deck, record turntable and associated pre-amplifiers and amplifiers. Equipment used includes the new E.M.I. high-quality stereo pickup which features a very low effective needle-tip mass (≈ 1 mgm) and a viscous damped single-pivot arm with a raising and lowering mechanism. Also demonstrated are the Models 557 2×10-watt stereo amplifier and the 556 stereo combined pre-amplifier and very comprehensive tone control unit, an unusual feature of which is the provision of a c.r.t. channel-level monitor.

Gramophone Co., Ltd., Blyth Road, Hayes, Middlesex.

LUSTRAPHONE (309)

A new addition to the wide range of microphones of all types is a relatively inexpensive stereo ribbon microphone, the VR/65NS. This is similar to the VR65 except that the phase switch and mechanism for relatively rotating the two ribbon elements have been omitted. Also available is a miniature noise-cancelling microphone.

The range of transistorized units includes pre-amplifiers and power-amplifiers as well as a four-channel microphone mixer.

Lustraphone Ltd., St. George's Works, Regent's Park Road, London, N.W.1.

PHILIPS (320)

Recent introductions by this company in the field of sound reproduction include an a.m./f.m. stereo radiogram in which the loudspeakers are placed at the ends of the cabinet and angled outwards. Also newly introduced is an automatic version of the Disc Jockey Stereo record reproducer in which one of the loudspeakers can be detached from the main cabinet for improving the stereo effect. The output of this record reproducer is 1½ watts per channel.

Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

REPS (305)

Newly introduced is the R10 three-speed tape recorder, special features of which are that the frequency response at the slowest speed of 1½in/sec. is claimed to be only 3dB down at 7kc/s and that a meter is used to indicate the recorded signal level. Both two- and four-track versions of this recorder are available. Also being shown are improved versions of the R20, R30 and R40 recorders, a special

feature of which is that each has a push-pull bias and erase oscillator.

REPS (Tape Recorders) Ltd., 118 Park Road North, London, W.3.

ROLA CELESTION (312)

An interesting unit for high-fidelity sound reproduction is the Colaudio 1550. This consists of a 15in bass unit in the centre of which are mounted two tweeters forming a short column. The high-frequency polar response of this loudspeaker can thus be altered by rotating it so as to rotate this column. Other loudspeakers on show include elliptical units as well as circular models with diameters ranging from 2½ to 15in.

Rola Celestion Ltd., Ferry Works, Thames Ditton, Surrey.

SYMPHONY (302)

Equipment on show includes two tape recorders, a bass reflex loudspeaker cabinet available in kit form or ready built, f.m. and a.m./f.m. tuners, and mono and stereo combined amplifiers, pre-amplifiers and tone control units. An unusual feature of these last is that the middle as well as the bass and treble frequencies can be boosted. Also exhibited is the Stereophoner, which is claimed to produce an effect resembling that obtained with stereophonic equipment when connected between a single-channel output transformer secondary and two spaced loudspeaker systems.

Symphony Amplifiers Ltd., 16 Kings College Road, London, N.W.3.

TRUVOX (317)

The main exhibits will be the R6 and R7 tape recorders, an unusual feature of which is that each is provided with an R.I.A.A. compensated pickup input. Other special features of the R7 recorder are that it can record or replay with the tape travelling in either direction, and that it has a ten-watt push-pull output. Both of these models can operate at tape speeds of 7½ or 3½in/sec. Also on show will be the well-known Radio Jack miniature tuners mounted on a jack plug for recording from the local B.B.C. stations.

Truvox Ltd., Neasden Lane, London, N.W.10.

WHITELEY (304)

In addition to the range of domestic-type loudspeakers there is included here a selection of various industrial type loudspeakers in a wide variety of cabinets including "line source" types for both indoor and outdoor use.

The latest technique in audio component potting in epoxy and polyester resins is exemplified by a selective range of transformers, filters and inductors encased in this form. The range of "breakdown cabinets," which includes bass reflex types, is continued this year.

Whiteley Electrical Radio Co. Ltd., Victoria Street, Mansfield, Notts.

A. D. BLUMLEIN

By M. G. SCROGGIE, B.Sc., M.I.E.E.

GENIUS was defined by Carlyle as, first of all, transcendent capacity for taking trouble. It was analysed by Edison as 1% inspiration and 99% perspiration. These both corrected popular ideas on the subject by emphasizing the part played by hard work. But that 1% is just as essential. If there have been people whose brilliant originality died with them, there were many more whose slogging failed to make up for their lack of imagination. The thinking of most of us is shaped by concepts we have received from others. When the genius comes along, with thoughts that break out into new concepts, his fellows often find him hard to understand. They may even oppose him, because he doesn't conform to their ways of thought. Matters are made worse when, like Heaviside, he is unable or unwilling to make his ideas clear to the less intelligent.

If, as I am convinced, the genius of A. D. Blumlein is not yet widely enough appreciated, that is certainly not the reason. His exposition was exceptionally lucid. The trouble is that so very little of it was published. His contribution to technical literature amounts to little more than two I.E.E. papers, the first shared with Prof. Mallett and the second with several colleagues. (Both of these papers, incidentally, were awarded I.E.E. Premiums.) He was too busy to write. So technical literature is the poorer and his name is seldom seen by his successors.

Then the last few years of his work were shrouded in wartime secrecy and his career was cut short at the early age of 38 in the service of his country. Even that fact was not published until more than three years later, and then only briefly.

Besides this, he avoided rather than encouraged publicity to such an extent that photographs of him are almost non-existent, unless one includes a back-seat view of him addressing the I.E.E. in 1938.

Some originators are commemorated in the name of a device, law or discovery—for example, the Hartley circuit, Ohm's law, and the Hall effect. Unfortunately none of Blumlein's frequently mentioned inventions bears his name. Although it appears here and there in the literature, probably very few even of the workers in the same field, and especially the younger ones, have any idea of how far ahead he was in so many important developments. How many present-day stereophony fans, for example, realize that the system of recording brought on to the market during the last year or two was invented by Blumlein in 1931?

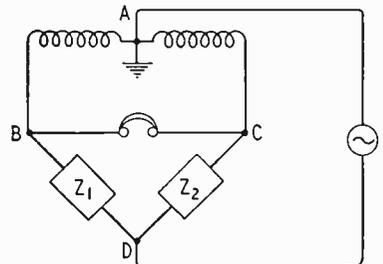
I have therefore attempted a review of the more important of his inventions, as a modest tribute to his memory. Not having had the privilege of knowing Blumlein personally, and lacking close acquaintance with some of the branches of work in which he excelled, it is a regrettably poor one, but I hope better than nothing. Lest my emphasis on technical achievements give the impression of a one-sided individual, it should be mentioned that, notwith-

standing them all, Blumlein was thoroughly human and found time for such relaxations as flying, practical astronomy, enjoyment of music and theatre. I am indebted to a number of his friends and colleagues for encouragement and information readily supplied, notably S. J. Preston and H. A. M. Clark of E.M.I., J. B. Kaye of Painton, formerly of International Standard Electric, and M. van Hasselt of Standard Telephones.

Alan Dower Blumlein was educated at Highgate School and the City and Guilds College, London. It was in January 1925, soon after he had graduated, that he and Prof. E. Mallett read their I.E.E. paper, "A New Method of High-Frequency Resistance Measurement"—a problem which was receiving much attention at the time. Their method was ingenious and potentially very accurate, but proved too complicated to achieve popularity.

At about this time Blumlein began his professional career by joining the International Western Electric

Fig. 1. Original inductively-coupled ratio-arm bridge circuit. The two coils were wound together bifilarly in two or more sections.



Corporation. His work there was mainly on problems of interference in telephone lines, and he soon provided evidence of his exceptional ability and originality in circuit engineering. At least eight patents resulted from this line communication work, the first of which (No. 291,511, in conjunction with J. P. Johns) came early in 1927 and described a method for reducing mutual interference between channels ("cross-talk") in long-distance telephone cable systems. Nowadays long-distance telephony is usually by modulated carrier, with the conversations shifted into separate frequency bands; but then they were at the original speech frequency. To equalize signal velocity over the band, the cables were inductively "loaded" by three-coil units, and these were to blame for much of the cross-talk. Having studied the problem and identified each particular source of cross-talk with great accuracy, Blumlein rearranged the windings to concentrate the unbalances at the points of connection, and then dealt with each of them independently. This method greatly reduced the trouble, and was adopted for all three-coil units from then on. It is, in fact, still used.

In order to carry out this development it was necessary to measure very small differences in impedance. Existing impedance bridges were unsatisfactory in two respects: the ratio arms were insufficiently pre-

cise, and they were too much affected by stray shunt capacitances. So in 1928 Blumlein made a major departure in a.c. bridge technique by using ratio arms consisting of two inductors with practically 100% coupling, as in Fig. 1. This looks at first glance like a conventional a.c. bridge network, so much so that it is those who are familiar with bridges in general who may have most difficulty in realizing that at balance its points B and C as well as A are effectively at earth potential, so there is no p.d. across either ratio arm, and therefore admittances across them have no effect. Blumlein obtained a very close approach to this ideal by using bifilar winding, making the two coils occupy substantially the same position on their iron core. This construction at the same time automatically achieved a 1:1 ratio with much higher precision and constancy than conventional resistance arms.

The patent, No. 323,037, is a short one—only two pages, with no Provisional Specification—yet it clearly and simply explains the principle, the construction both for 1:1 and other ratios, the application of screening, the advantages accruing, and how it can be used to measure direct capacitance between two conductors regardless of capacitances from them to earth. For good measure, it shows how the same device can be used to obtain a precise centre tap for a phantom circuit in telephony. A later specification (334,652) shows an application of the same principle to the simplifying of telephone circuits.

Unpublished Treatise

As with so many of Blumlein's inventions, his concentration on the work in hand left no time for wider publicity and exploitation, so although possibly the most important step in bridge technique since 1865, when Maxwell applied Wheatstone's circuit to a.c., it went almost unnoticed. Even when, years later (1941), Blumlein wrote an extensive fundamental treatise on the principles implicit in this apparently simple device, it was not published. The substance of it only came prominently to light in 1949, in Part I of an I.E.E. paper by H. A. M. Clark and P. B. Vanderlyn. It is a fine piece of exposition, which the authors acknowledged as being almost verbatim Blumlein. The remainder of this paper was concerned with the application of these principles in a wide-range impedance bridge produced for the Services. An accompanying paper described quite a different application—a low-reading aircraft altimeter, involving the measuring of capacitance changes of the order of one-millionth of a picofarad (10^{-18} F) in the presence of much larger capacitances to earth. All these developments were patented by Blumlein.

In the discussion of these papers, the first speaker wanted to know why such an attractive invention had been in existence for over 20 years without making more of a mark on bridge design. The explanation was lack of publicity. Since then, inductively coupled ratio arms have come into much use, notably for radio frequencies up to v.h.f. One thinks especially of the B.B.C., C. G. Mayo, and Wayne Kerr in this connection.

Another interesting Blumlein bridge patent is 338,588, which covers a mutual-inductance bridge in which the usual difficulties in varying M are overcome by means of a resistive potential divider

directly calibrated in inductance (Fig. 2). This was embodied in a valuable and widely used instrument for measurements on balanced-pair carrier cables.

Other inventions of this period concerned submarine cables.

In 1929 Blumlein moved to the research department of the Columbia Graphophone Company. Electrical recording apparatus was then at an early stage of development, having displaced acoustic recording only a few years before. It consisted of a capacitive or carbon microphone, an amplifier based

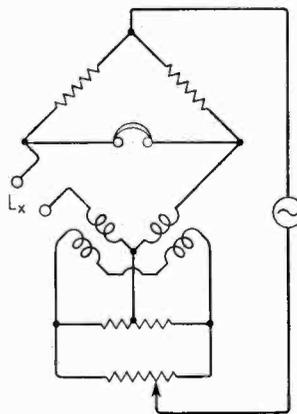


Fig. 2. Mutual-inductance bridge with fixed coils wound toroidally on an iron core. The balance of mutual inductance is shifted to either side of the bridge by a potential divider calibrated directly in inductance of the unknown L .

on public address practice, and a moving-iron cutter—satisfactory for the transition period, but far from perfect. A team was working on an improved system, and though lacking in experience of sound recording Blumlein soon grasped the principles of electromechanical transducers and made a major contribution to the effort, notably with a moving-coil microphone, an equalized amplifier and a moving-coil cutter. He showed how to match impedances by reducing the length of the cutter arm, and to eliminate the effects of mechanical resonances by electrical circuits with parameters the inverse of those of the mechanical "circuits." For this treatment to be effective, the system had to be designed for a very high electromechanical coupling factor. The first records were made with this equipment in 1930 and set a new standard of fidelity.

At the same time, with P. W. Willans, he showed how to place the needle in relation to the armature of a gramophone pickup so as to raise its resonant frequency to a maximum.

Next year the Columbia and H.M.V. companies merged to form Electric & Musical Industries Ltd.—E.M.I.—and the new recording gear was adopted as standard by the combine. Blumlein continued to work on it, and by improving the sensitivity of the cutter reduced the size of the amplifier sufficiently for portable use. He also extended the possible frequency range to 10 kc/s, but surface noise due to the record materials then available prevented full advantage being taken of this.

Two-channel Stereophony

At the same time Blumlein was thinking a lot about stereophony. Experiments in two-channel sound transmission had been made as long ago as 1881, using headphones. By the time we are considering, however, there was clearly no commercial

future for headphone listening. Loudspeakers had displaced them in the home, and the "talkies" had established themselves in the cinema. The problems of monophonic reproduction were quite enough for most people. But not for Blumlein. The multiple-speaker method is the obvious approach to practical stereophony and in the years following was adopted in America for experimental demonstrations and the public showing there of Disney's *Fantasia*. It was found that the ideally vast number of channels required for it could be reduced to three, with acceptable results. But even before this Blumlein had evidently decided that three was one too many, and so he tackled the problem of achieving satisfactory spatial reproduction with only two loudspeakers. Characteristically, he began by thoroughly working out for himself the principles involved. Now, 28 years later, with stereophony a household word, there are still people claiming to be technical who suppose that the two loudspeakers are analogous to the two earphones in the earlier experiments. But Blumlein saw clearly that both speakers communicate with both ears, thereby setting a very difficult—one might almost declare impossible—problem. His solution, based on the theory that directional hearing at low frequencies depends on time difference and at high frequencies on intensity difference, was much more subtle than it looks at first sight, and depended on the sum and difference of the outputs from the two microphones. By this means, results equivalent to cardioids pointing in opposite directions were obtained using omni-directional microphones: a remarkable achievement.

Being the first to make a serious attempt at stereophony with loudspeakers, Blumlein had the field to himself, and his patent (No. 394,325) runs to 22 pages and has 70 claims! His system was intended primarily for improving motion picture sound, but other applications, such as domestic records, were included. In almost every respect this patent was more than 20 years ahead of its time.

original 45° disk track has now been adopted throughout the world for stereophonic records, at least one make of which is produced with a cutter of a type shown in his patent.

Rather ironically, the first practical application was one *not* envisaged when the patent was drawn up; its techniques were adapted by Blumlein for better sound location of aircraft during the 1939-45 war, and some thousands of this type of equipment were produced.

Television

Even before his stereophony patent appeared in print, Blumlein's enthusiasm had been directed into another channel. Soon after the formation of E.M.I., the new company began a full-scale programme of television development. H.M.V. had already demonstrated moderately high-definition pictures (150 lines) using a mechanical system, and the first question was whether to continue along this line or venture into the unknown towards an electronic system. Although it is obvious now that the right answer was the one actually given, the number of unsolved problems that were thereby accepted must have looked pretty appalling. For one thing, the cathode-ray tubes of the period were gas-focused types that went out of focus if the beam current was varied. There was no electronic camera. Even the more familiar items such as amplifiers, transmitters and aerials had to be developed afresh to deal with signals of unprecedented bandwidth. In this connection, another bold decision, made by the E.M.I. Director of Research, I. Schoenberg, was to go far beyond the Television Advisory Committee's requirement of 240 lines—beyond anything that receivers could have been expected to handle fully for some time to come—by adopting a 405-line standard. Again, the rightness of the choice has been proved by events, for after more than quarter of a century of rapid change this same standard continues to give satisfaction and has been accepted in 10 million British homes.

There was therefore plenty of work for the development team, and no time for mistakes. The story is told by S. J. Preston in a Television Society paper, "The Birth of a High Definition Television System."[†] Blumlein's contribution displayed his characteristics—grasp of essential principles, foresight, versatility, originality, soundness of engineering and insistence on "designability." He would reckon a few extra components well spent if they enabled him to design a circuit on paper with confidence that any number of sets made up from the design would work as intended. It is significant that the E.M.I. equipment of the Alexandra Palace Station, almost every part of which owed something to Blumlein, made straight up from drawings to begin the world's first public high-definition service in 1936, was still in use in 1950.

One of his first developments was a highly original scanning system. Contemporary practice charged a capacitor slowly through a resistance and discharged it quickly through a thyatron, the capacitor voltage being applied to the deflection plates of a c.r. tube. Blumlein's patent 400,976 of April 1932 specifies a simple hard-valve circuit (Fig. 3) to produce a linear

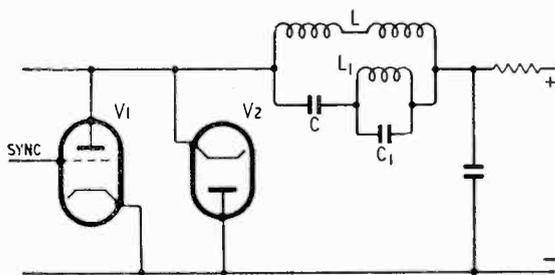


Fig. 3. Early television sawtooth current generator circuit, in which during the working stroke current flows through deflecting coils L and valve V1. The flyback is generated by a half-cycle of oscillation at the frequency of L and C, and is terminated by V2. L₁ C₁ curbs any tendency to oscillate at half working frequency.

At that date, and for years to come, shellac-loaded disks and steel needles were in use, but Blumlein advised a material of the nature of cellulose acetate, and a sapphire point as is now standard. The system as a whole was commercialized 25 years later,* at first with tape recording, but Blumlein's

* See "The 'Stereosonic' Recording and Reproducing System", by Clark, Dutton and Vanderlyn, *Proc.I.E.E.*, Sept. 1957, pp. 417-432.

[†] *Journal of the Television Society*, Vol. 7, No. 3 (1953).

sawtooth current for magnetic deflection. The valve V1 is initially conducting, and current grows linearly through the coils L, until a sync pulse cuts off V1. The circuit LC then performs a half-cycle of oscillation at a comparatively high frequency, forming the flyback. Further oscillation is prevented by conduction of V2, which limits the rate at which current through L (now negative) can decrease. L, C, was included to suppress a waveform component at half scanning frequency.

The origin of negative feedback is invariably attributed to H. S. Black in *B.S.T.J.*, January 1934. This is strange, for a number of earlier references can be found. For instance, Patent No. 425,553 of Sept. 1933, by Blumlein and H. A. M. Clark, specifies it by name for reducing the output impedance of pentodes, as in Fig. 4, and gives the now familiar formula for output impedance:

$$\frac{R_a}{1 + \mu k}$$

where k is the fraction fed back, now commonly denoted by β or B .

Considerable confusion has been caused by later writers, led by Black, who used μ in identical formulae to mean amplifier voltage gain, instead of correctly as above to mean valve amplification factor.

Negative feedback was mentioned even earlier in a patent of American origin for linearizing sawtooth

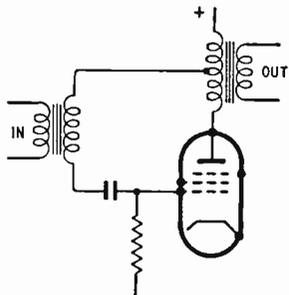


Fig. 4. A pre-Black negative - feedback circuit, designed to reduce the output impedance of pentodes.

current waveforms in frame scanning. Blumlein substantially improved on this with a circuit (Patent No. 479113 of 1936) which is the one commonly used to this day—Fig. 5.

A form of negative feedback that especially appealed to him was the cathode follower. He did not actually originate this configuration, but was the first to appreciate its great value, particularly in

Fig. 5. Blumlein circuit for linearizing frame scanning by use of frequency-selective feedback.

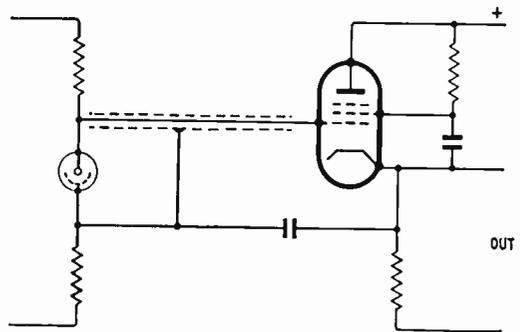
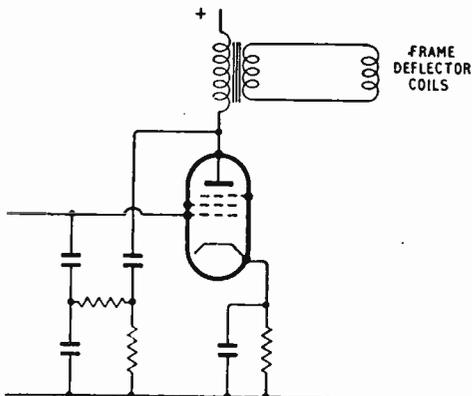


Fig. 6. Reduction of input capacitance by cathode follower (1934).

television. His specification 448,421 of 1934 sets forth with characteristic clarity how by virtue of its very low input capacitance it can be used to advantage in connecting a high-frequency high-impedance source such as a photocell to an amplifier. Furthermore, it anticipated by 15 years the discovery that it can be used as in Fig. 6 to eliminate almost entirely the shunt capacitance of the source and connecting lead. Note, too, the screened coupling; long after this, people were still saying that pentodes were unsuitable for cathode followers!

Television, with its wide signal frequency band down to zero, introduced difficult amplifier problems. It was impracticable to use d.c. couplings throughout the transmitting and receiving chain; but the trick of d.c. reinsertion or restoration, making use of the constant level of synchronizing signals, had been devised. It looks quite a simple technique, but Blumlein and his colleagues had to do considerable work to make it practical, and some of the most involved specifications relate to this development. In particular, "clamping" at an intermediate black level was due to them. The whole thing was tied up with the television waveform, which necessitated a great many irrevocable decisions. Blumlein was mainly responsible for establishing the waveform that has (with very minor adjustments) been used in Britain ever since, and was declared by L. H. Bedford to be one of the outstanding technical triumphs of television. Blumlein explained the reasons for each decision in his 1938 I.E.E. paper.*

The bearing of this waveform on an effective system of vision a.g.c. in receivers was foreseen by Blumlein, who invented several circuits for it; but a good many years passed before vision a.g.c. came into general use.

The extension of the bandwidth to zero caused troubles with power supplies, and Blumlein devised modifications to filter circuits to give them a constant resistive impedance at all frequencies. To cope with the high frequencies in amplifiers he originated the familiar series (Fig. 7) and shunt "building out" circuits. Among his many other television circuit devices were: "black spotting" to make interference less conspicuous; a method of sync pulse separation; "spot wobble"; an anti-"ghost" device; and (with E. C. L. White) the now familiar "efficiency diode."

As if this were not enough for one engineer, he was collaborating with J. D. McGee in devising the

* "The Marconi-E.M.I. Television System; Part I: The Transmitted Waveform", *Proc.I.E.E.*, March 1939, pp. 65-73.

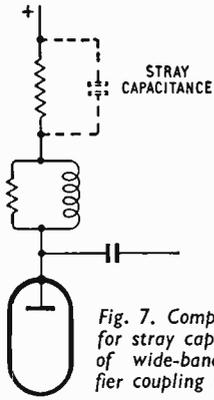
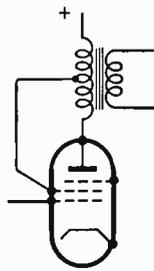


Fig. 7. Compensation for stray capacitance of wide-band-amplifier coupling resistor.

Below: Fig. 8. Essentials of "ultra-linear" or screen-feedback circuit.



very important C.P.S. Emitron, and with E. C. Cork in the r.f. cables that were used to convey the television signals between Alexandra Palace and Broadcasting House and elsewhere, and with H. E. Holman in the manufacture of very fine insulated wire. The only camera tube available for the opening of the B.B.C. television service in 1936 was the ordinary Emitron, in which relatively large spurious signals were created by secondary emission. Blumlein took a full share in providing "tilt" and "bend" signals to counteract them, and meanwhile was at work on the problem of a tube that would make this unnecessary. The McGee-Blumlein patent, No. 446,661, dated as early as 1934, describes an essential feature of the cameras introduced since the war and those now in general use throughout the world. This is cathode potential stabilization, by which secondary emission is prevented. A major improvement in the received picture was the result.

Several important inventions not particularly connected with television were contemporary with these. There was the "long-tailed pair," intended to rid push-pull signals of unwanted push-push components. Another, of great interest to *Wireless World* readers, was the so-called ultra-linear amplifier circuit, in which the screen grids of the push-pull output stage are tapped on to the output transformer. Here, again, it was a good many years before general practice caught up with Blumlein. Admittedly, he does not appear to have appreciated how effective this arrangement can be for reducing distortion; he regarded it mainly as a convenient alternative to the control-grid feedback shown in Fig. 4, for reducing the undesirably high impedance of pentodes while retaining their efficiency. One notes, by the way, how many of Blumlein's devices were concerned with impedance matching.

His freedom from convention can be illustrated by his contribution to the discussion of a paper entitled "Instruments Incorporating Thermionic Valves."* It is worth quoting:

"All the devices referred to in the paper have one point of similarity—the signals are applied at the grid and come out at the anode. It might be worth while considering where it might be advantageous to depart from this convention. One possible application of valve voltmeters is to the measurement of very high voltages. For this purpose one constructs a valve where the grid is earthed and used as a shield between anode and cathode. A

very high voltage is put on a very small anode remotely situated from the grid, and in the cathode lead is put the inevitable feedback resistance, which is given a high value.* In those circumstances the valve cathode rises to such a potential that there is practically no anode current. The valve acts as a potentiometer, the cathode voltage being about $1/(\mu + 1)$ of the anode voltage. At first sight the arrangement would seem to have no advantage over a resistance-type voltmeter, but the usual very high-voltage voltmeter resistances are cumbersome, and this arrangement will follow variations of the anode voltage quickly, so that measurements of very high voltage can be made in the comparative safety of a shielded cathode."

This contribution was ignored by the authors in their reply!

Slot aeriels are now commonplace, having come into use during the war for short-wave radar. But in 1938, when Blumlein applied for the slot-aerial patent, which in due course was numbered 515,684, it must have seemed quite revolutionary.

Another Blumlein characteristic—dislike of dependence on uncertain parameters—is exemplified by his patent No. 563,464 of 1940, which describes a simple method of stabilizing the amplitude of oscillators without relying on grid current. The mode of operation is not nearly so simple as the relevant part of the circuit, shown in Fig. 9. Valves with extra diodes being still current practice, this idea might well be about due to be discovered!

By this time Blumlein, as senior engineer in the E.M.I. research laboratories, was at work on war projects. The adaptation of his stereo ideas to the aircraft sound locator has already been mentioned. The direction of the sound source relative to the axis of the locator was indicated by a trace on a c.r. tube. His early invention of the inductively-coupled ratio-arm bridge also found novel application in an altimeter depending on the change of capacitance, induced by the ground, between two electrodes fixed to the underneath of the aircraft. This type obviously was most advantageous at low altitudes, where others fail. It was fitted to Welling-

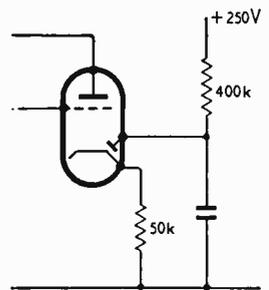


Fig. 9. Automatic amplitude control of oscillator by diode circuit. The oscillator circuit itself may be conventional.

tons and other aircraft for increasing the accuracy of torpedo laying at night. The same principles were employed in a general-purpose resistance and capacitance bridge developed for the Air Ministry. A particular merit of this type for airborne radar equipment was that measurements could be made without disconnecting the components from the circuit, which in some cases would have been impossible without damage, so tightly were they packed. The same is true of some present-day domestic sets!

* *Proc.I.E.E.*, Sept. 1939, pp. 381-410.

* British Patent No. 507,665, A. D. Blumlein and G. S. Bull.

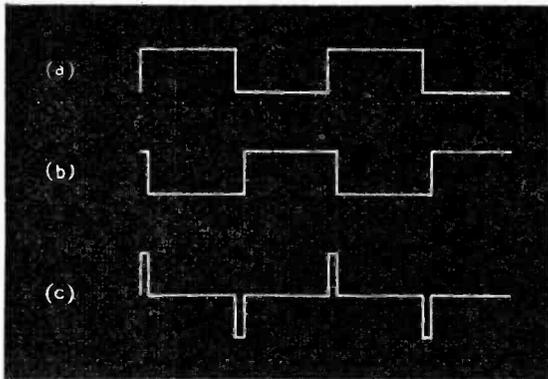


Fig. 10. Simple example of generating short pulses from longer ones by means of a reflective delay line.

One of the problems of radar is the generation of pulses of short duration, often only fractions of a microsecond, at precisely controlled instants. Such pulses are used in many low-power circuits, and also for modulating powers of hundreds of kilowatts in transmitters. In this field Blumlein made much use of the novel device of a short delay line. If a timing square wave such as Fig. 10(a) is applied to one end of such a line, and the far end is short-circuited, the step is reflected in opposite polarity. It reaches the input a short time later (b) and the resultant of the two is a pulse waveform (c). This principle was applied in many different ways for many purposes. In one particularly ingenious arrangement Blumlein used two lines end-to-end which were charged in parallel from the middle and discharged in series by a spark gap at one end, developing a high-power pulse for modulating airborne radar transmitters (Fig. 11). Delay lines are now well established as circuit elements.

One class of these airborne radars was AI, used to intercept enemy aircraft at night. The early types required an operator, which was very inconvenient in a high-performance fighter. In conjunction with E. L. C. White, Blumlein developed for production the locking strobe for AI Mark VI, which automatically performed the necessary operations of searching for an echo, locking on to it when found, and identifying it.

In these sophisticated types of radar there was need for a much more linear time base than those already available, and also for precise and adjustable time delays. To achieve these, Blumlein devised the basic circuit shown in Fig. 12, commonly known as the Miller integrator. His patent, No. 580,527, explains its principles and goes on to give a sample of each of the two applications just mentioned. These initiated a whole series of circuits,

using diodes as auxiliaries, including the celebrated "phantastron" and "sanatron." He also extended the principle to the integration of more than one voltage at a time, as used later in analogue computers.

During the war such patents were not published, and it turned out that the basic circuit was covered by a patent applied for by A. C. Cossor Ltd. and J. W. Whiteley a few months earlier. Actually Blumlein's invention was the earlier, but owing to the elaborate secrecy procedure some time elapsed before the application could be filed.

Two days after the application for Blumlein's patent was lodged, on 7th June 1942, he and two of his E.M.I. colleagues, C. O. Browne and F. Blythen, took off from Defford in a Halifax bomber to make tests on another airborne project—H.S. On the return there was engine trouble and the pilot attempted to land in a field, but on doing so the aircraft caught fire. There were no survivors.

For sheer quantity, Blumlein's inventiveness is impressive. No fewer than 132 patents were granted to him, with or without collaborators; that is to say, an average of one every 46 days during his entire

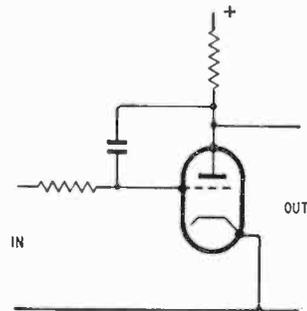


Fig. 12. Basic Blumlein integrator circuit, often wrongly attributed to Miller.

working life of 17 years! Nor is the total made up mainly of minor details or improvements, struggling for a little elbow-room of novelty among rivals.

A surprising number were so original as to carve out large new tracts and have very many claims admitted. Some were so original that years and even decades passed before their full value was appreciated. There may be some even now waiting for application.

Their most notable characteristic is that each is a practical solution arrived at by a careful study and clear understanding of the principles involved, rather than by chance or merely following the direction of current practice. How Blumlein would have enjoyed exploiting the possibilities of transistors! Is it unfair to those who have brought about such rapid developments in this field to suggest that he may have made a contribution through his influence? There can be no doubt that he set a fine example.

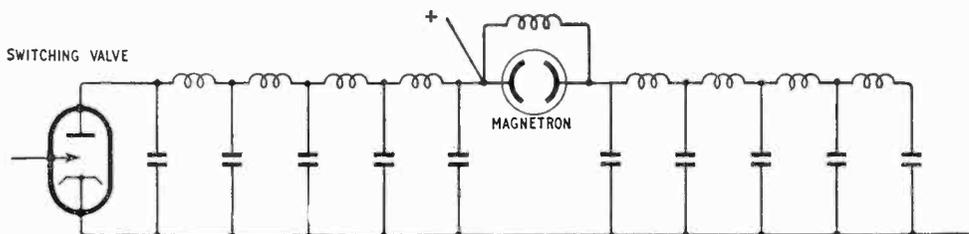


Fig. 11. Blumlein pulse modulator circuit.

Quarter-wave Transformers

SOME NEW APPLICATIONS

By "CATHODE RAY"

MY problem right at the start is to know whether it is necessary to explain what quarter-wave transformers are. After an interval for intense thought I have come to the not very helpful conclusion that for some readers it won't be and for others it will be. If my treatise on that subject had been published within the past few months I would have asked your permission to take it as read. But since it actually dates back 10 years, to the Aug. 1950 issue, I would be a little unreasonable to expect a favourable reply from young readers. So I'm going to cater for both classes by referring those whose hopes were aroused by the main title to the appendix,

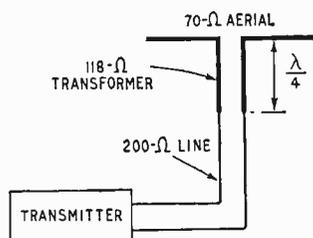


Fig. 1. Use of a quarter-wavelength line as a transformer (strikingly unlike the usual types) to match two unequal impedances.

while inviting those who were more interested in the sub-title to carry straight on.

For the reasons explained in the appendix, a piece of transmission line quarter of a wavelength long can be and often is used as a transformer to match a source of r.f. power to a load which has the wrong impedance for direct connection. Suppose for example the source was a 200-ohm line from a transmitter and the load was an aerial with an impedance of 70 ohms. If they were joined straight together there would be a mismatch at the junction, as a result of which a substantial part of the power arriving wouldn't go into the aerial but would be reflected back along the line, setting up standing waves and consequent excessive voltages and currents at certain points. The solution is to join the line to the aerial through a quarter-wave line transformer designed to have a characteristic impedance of $\sqrt{70 \times 200} = 118 \Omega$, as in Fig. 1. If the system was balanced to earth, one would make the transformer of parallel wires (or cylinders, for low impedances); if one side was earthed, a coaxial line.

That is old stuff. The April issue of our learned contemporary, *Electronic Technology*, had a contribution from a B.B.C. research engineer, Dr. G. J. Phillips, explaining quite a lot of other ways in which quarter-wave lines come in useful. They are all based ingeniously on the same principle—the way in which current and voltage change places, as it were, at opposite ends of the line. As you may have noticed, the principle of duality appeals to me, and here is an interesting example. For the benefit of those who are staring blankly, I will mention that duality is the term used to refer to the fact that for the relationships which hold for any circuit there are

analogous relationships for the "dual" of that circuit, derived from it by changing series into parallel, current into voltage, impedance into admittance, inductance into capacitance, etc., and vice versa.

We have just used the formula $Z_i = Z_0^2/Z_L$, in which Z_L is the load impedance, Z_0 the quarter-wave line impedance, and Z_i the input resistance of that line with the load at the end of it. $1/Z_L$ is the same thing as Y_L , the admittance of the load; so we have an impedance transformed into an admittance, Z_0^2 being the connecting ratio. If Z_L happened to be an inductive load, $j\omega L$, it would be transformed to $1/j\omega L$, which (because $j^2 = -1$) is $-j/\omega L$, the $-j$ showing that the load has been transformed into a capacitance. The appendix shows that $V_i = Z_0 I_L$, etc., the ratio between voltages and currents being Z_0 . And so on for other relationships.

Now consider a little problem. You have three or more items in a circuit, all of which have one terminal earthed, and you want to connect them all in series. Can you do it? Without, of course, shorting any of them! You are allowed to assume that the system works at only one frequency, in the v.h.f. region.

If I had begun with this it might have caught quite a few people out, but since the clue has been provided almost as obviously as in a give-away quiz, everyone should get the prize. The answer is to connect them in parallel through quarter-wave lines, as in Fig. 2, and these lines will transform the parallel connection to a series one.

Unless your intelligence is of a brilliance that would be wasted reading this, or your readiness to take my word for things is touching but unwise you will want

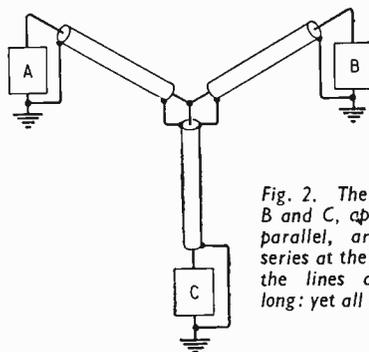


Fig. 2. The three impedances, A, B and C, apparently connected in parallel, are effectively all in series at the frequency that makes the lines a quarter-wavelength long: yet all are earthed.

a little more evidence before accepting that A, B and C are really all effectively in series. Looking at the circuit, and supposing that B and C have widely different impedances, one could be excused for not instantly seeing that a current generated in A must pass equally through B and C.

You will however grant that in a series circuit all items carry the same current, whereas in a parallel circuit all items receive the same voltage. And in a

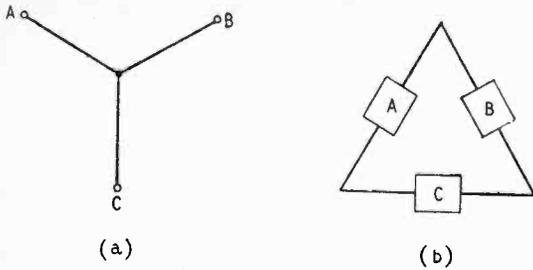


Fig. 3. Simplified version of Fig. 2, and its equivalent circuit.

series circuit the total voltage round it comes to zero (otherwise the same point would be at two different potentials at the same time), whereas in a parallel circuit the total current flowing away from the common junction is zero (otherwise some current would have to come from nowhere).

Now it cannot be denied that all the inner ends of the line in Fig. 2 are at the same voltage, seeing that they are all firmly connected in parallel. And in the appendix we have proved—I hope to everyone's satisfaction—that the currents entering the other ends are all proportional to that voltage, and are therefore equal provided that Z_0 is the same for all the lines. So the same current must pass through A, B and C, and they are as good as in series. Moreover, the currents leaving the centre junction add up to zero, so the voltages across the outer ends of the lines add up to zero; again, just as they should do if they were all in series.

Of course, this state of affairs holds good only for the frequency that makes the lines quarter of a wavelength long—or a quarter plus any number of whole wavelengths. In practice one would avoid the latter alternative, because it would introduce unnecessary losses and undermine our assumption that these are negligible.

In Fig. 3 we have Dr. Phillips' suggested simplified

representation of Fig. 2, together with the equivalent circuit. Fig. 4(a) and (b) are exactly the same diagrams laid out slightly differently so as to make it clearer that A can be regarded as being in parallel with the combination B and C in series. Connections made directly at B and C instead of through inverting quarter-wave lines of course have their normal effect, so if another "star" is connected in parallel with them as at (c) they are also in parallel in the equivalent, (d). So it is possible to apply the same earthing technique to a series-parallel circuit.

Actually it can be done more simply. The quarter-wave lines attached to impedances A and B, looked at from the junction ends, are equivalent to impedances Z_0^2/A and Z_0^2/B respectively, as at (c), where Z_0 is as usual the impedance of the line. So now we have the lines arranged in a closed ring instead of in star formation. Because Fig. 4(e) now has exactly the same formation when turned on its side, for all we know it might have been derived from an arrangement in which B and C were the impedances on stalks, in which case (f) would be its equivalent—and therefore the equivalent of (d).

Another point is that if Fig. 4(d) were a desired equivalent, in which A was say a capacitance, and operation was required over a band of frequencies, an actual circuit of form (e) would need an inductance Z_0^2/A , or alternatively A and a line as in (c).

If the quarter-wave line is doubled in length to make a half-wave line, the two quarter-wave impedance transformations cancel out. Doubting Thomases can satisfy themselves by going through the motions, thus: if Z is the impedance at one end of the half-wave line, then half-way along the line it will (owing to quarter-wave transformer action) look like Z_0^2/Z . This in turn, viewed through the remaining half of the line, looks like $Z_0^2/(Z_0^2/Z) = Z$. This is because the phase difference between a wave entering the line at one end, and the reflection of that wave arriving back, is one cycle; which is to say, in phase. And the phase difference between the

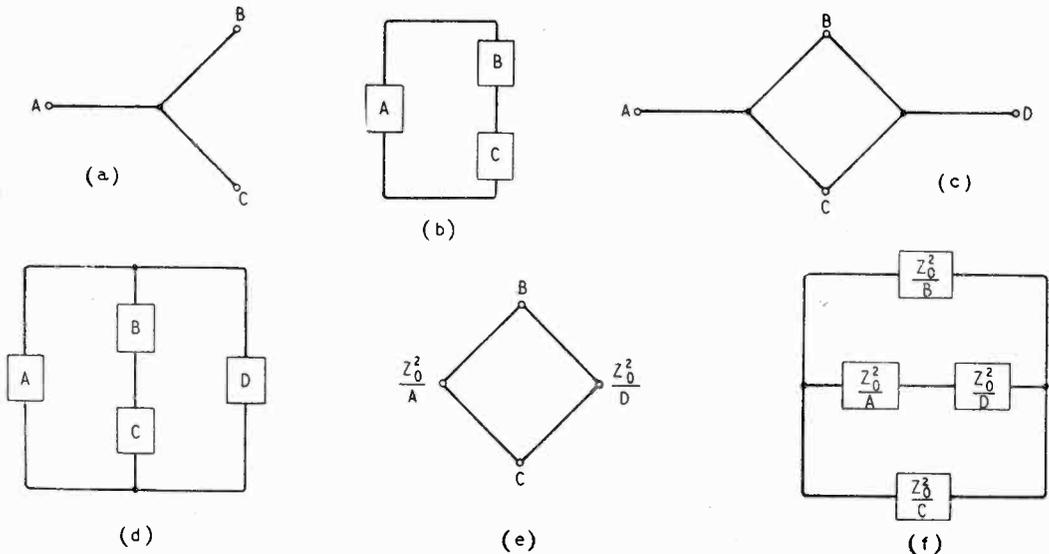


Fig. 4. (a) and (b) are identical with Fig. 3. (c) comprises two such star formations connected directly in parallel (without $\lambda/4$ lines), and (d) is its equivalent. A and D in (c), with their $\lambda/4$ lines, can be replaced by Z_0^2/A and Z_0^2/D directly connected, as at (e). This is therefore equivalent to (d), and so is (f).

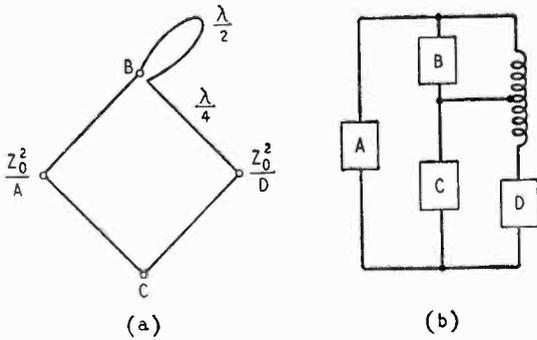


Fig. 5. A half-wave line is a 1 : 1 phase-inverting transformer, so by inserting it in one arm of Fig. 4(e) one gets the equivalent shown here at (b). This has some interesting properties.

two ends, being half a cycle, is in effect a reversal of polarity. So a half-wave line is commonly used as a reversing or 1 : -1 ratio transformer.

A useful circuit explained by Dr. Phillips is obtained from the preceding one by inserting a half-wave line in series with one of the four sides of the ring as in Fig. 5(a). (In practice a rather neater form of transformer can be used, but the principle is the same). Remember that in Fig. 4(d)—the equivalent of Fig. 4(e)—A and D are fed in phase by any voltage generated in B. The only change made in Fig. 5(a) is the introduction of a phase reversal in one of these arms, so in the equivalent circuit any B voltage feeds D in opposite phase to A. This is indicated by the 1 : -1 transformer in Fig. 5(b). The merit of this scheme is that if the impedances A and D are made equal the currents through them due to voltages in B will be equal and opposite, so they will cancel out in C. And voltages generated in C will send equal currents through A and D and the two halves of the transformer in such a way as to cancel therein and allow no appreciable voltage to be developed across B. So B and C communicate with A and D without affecting one another. Similarly, if B and C are equal, any voltages originating in A or D will affect them but not one another. This is the v.h.f. analogue of the "hybrid coil" used in telephony (and the "rat-race" used in waveguide circuitry).

The foregoing is only the beginning of what (to use an apt phrase) can be done along these lines. Anyone interested can obtain much more from Dr. Phillips' paper. But before closing down I had perhaps better do something for those who may have spotted an apparent contradiction. I have emphasized that these quarter-wave (and half-wave) lines work as described only at the frequencies corresponding to their lengths. On the other hand, except for standard-frequency transmissions all practical radio systems require a band of frequencies. At the sort of frequencies that make quarter-wave lines reasonable in length for circuit purposes, one expects to have television, f.m. broadcasting, and such things that take up quite a wide frequency band. However, it is usually only a small percentage of the nominal or carrier frequency, causing practically the same percentage departure from exact quarter wavelength, which should be tolerable in most applications. The effect of a quarter-wave line not being exactly quarter of a wavelength long for some part of the signal is

equivalent to introducing a reactance at the end of the line, and also to altering its characteristic impedance slightly. Here again, Dr. Phillips goes into the matter more deeply. He also shows how the whole idea can be applied to waveguides.

To end, here is a little problem arising from Fig. 4. Circuit (e) is entirely symmetrical in form; there is nothing to distinguish one pair of impedances from the other. (Z_0^2/A and Z_0^2/D could of course be denoted by single letters, such as E and F). It has two equivalents (d) and (f), in each of which one pair of impedances is distinguished from the other by being connected in series across them. One would expect—I would, anyway—that an entirely symmetrical equivalent existed. So far I haven't found a general equivalent; for the special case of $B + C = Z_0^2/A + Z_0^2/D$, there is a symmetrical equivalent consisting of all four connected in series. Can anyone produce an all-lumped circuit equivalent to (e) in which the impedances can have any values?

APPENDIX

There is a limit to how far back towards the beginning of the story we can go just now, and anyone who doesn't know (and isn't prepared to take my word for it) that an endless transmission line is equivalent to a resistive impedance Z_0 , called the characteristic impedance and determined by the cross-sectional geometry and materials of the line, will have to look it up in a book.

Fig. 6 shows a short length of line—parallel-wire

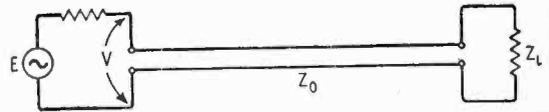


Fig. 6. A length of transmission line of characteristic impedance Z_0 , fed at one end by a v.h.f. generator of source impedance Z_G and terminated at the other by a load impedance Z_L .

or coaxial—with a generator to supply an alternating e.m.f. E at one end, and a load impedance Z_L at the other. When the generator is first connected, a current I starts to flow. By Ohm's law* I is equal to V/Z_0 , V being the voltage at the generator terminals. Because time is needed for the wave of current to travel along the line, Z_L can have no effect at this stage. But when eventually (after a small fraction of a microsecond) the current reaches the far end, what then? If Z_L is equal to Z_0 , Ohm's law continues to be satisfied and Z_L absorbs all the power that comes.

But suppose Z_L is greater than Z_0 . Then, since the ratio of V to I arriving is right for Z_0 it can't be right for Z_L . V is not enough to pass I through it. The falling off in current makes V rise, and because it is now greater than the line voltage it acts as a generator, driving the surplus current back along the line. In other words, part of the wave is reflected. The combined effect of voltage rise and partial return of current makes Ohm's law fit Z_L . Of course, no other laws must be broken in the process. The amount of power absorbed by the load, plus that sent back to the generator, must exactly equal what arrives. And the ratio of the surplus voltage and current, which we shall call v and $-i$ (minus, be-

* Meaning what is commonly but wrongly understood by this term: the relationship " $V = IR$," or " $V = IZ$." Actually Ohm's law was " V/I is a constant."

cause it is a deduction from I), must of course equal Z_0 .

Next, suppose that the length of the line is such that the time taken to travel once along it is equal to quarter of a cycle at the generator frequency. Then at any moment, if the pattern of current and voltage along it were visible, we would see quarter of one wave. We say it is a quarter-wave line.

That being so, there is half a cycle phase difference between the starting of a wave from the generator and the receiving back of the weaker reflected wave from the load. So if, as in our example, the reflected voltage at the load adds to the forward voltage, and the reflected current subtracts from the forward current, these phase relationships will be reversed at the generator. The total voltage at the generator terminals ($V-v$) is less, and the total current ($I+i$) is greater, than they were when the line fed a matched load.

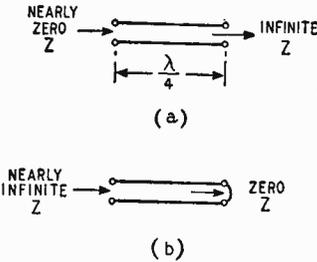


Fig. 7. The two extreme cases of quarter-wave transformation, in which an open circuit is made to look like a short circuit, and vice versa.

Their ratio $(V-v)/(I+i)$ is therefore a smaller number than Z_0 , and the quarter-wave line with its greater-than- Z_0 load presents a smaller-than- Z_0 impedance at the generator terminals. To take things to extremes, if the load end of the line were open-circuited, no power could be absorbed there, all the power would be reflected, the voltage at the generator terminals would be cancelled and the current doubled, so the input impedance of the line would be zero. This is the inverse of the infinite impedance of the load.

The same kind of argument for Z_L less than Z_0 leads to the conclusion that at the generator end of the line it looks like a correspondingly higher impedance than Z_0 . In the limit, the quarter-wave line transforms a short-circuit (zero Z_L) into an apparent infinite impedance or open-circuit (Fig. 7). In fact, it is sometimes used as an insulator at the one particular frequency that makes it quarter of a wavelength long; at other frequencies its impedance is quite low, and at zero frequency negligible.

All we need now is to be more explicit. To comply with Ohm's law:

$$V = \frac{EZ_0}{Z_0 + Z_G} \quad \dots \quad (1)$$

$$\frac{V}{I} = Z_0 \quad \dots \quad (2)$$

$$\frac{v}{i} = Z_0 \quad \dots \quad (3)$$

$$\frac{V+v}{I+i} = Z_L \quad \dots \quad (4)$$

The resistance and other losses of the line itself are neglected. Let Z_1 denote the input impedance of the quarter-wave line terminated by Z_L .

Then

$$Z_1 = \frac{V-v}{I+i} \quad \dots \quad (5)$$

Using (2) and (3) to substitute IZ_0 for V and iZ_0 for v in (4),

$$I+i = \frac{Z_L}{Z_0}(I-i) \quad \dots \quad (6)$$

$$\text{Similarly } V-v = \frac{Z_0}{Z_L}(V+v)$$

So

$$\begin{aligned} Z_1 &= \frac{\frac{Z_0}{Z_L}(V+v)}{\frac{Z_L}{Z_0}(I-i)} \\ &= \left(\frac{Z_0}{Z_L}\right)^2 \frac{V+v}{I-i} \\ &= \frac{Z_0^2}{Z_L} \quad \dots \quad (7) \end{aligned}$$

$$\text{or } Z_0 = \sqrt{Z_1 Z_L}$$

So if you want to make any impedance Z_L look like a different impedance Z_1 , interpose a quarter-wave line ("transformer") having a characteristic impedance equal to $\sqrt{Z_1 Z_L}$.

And if the input current and voltage, $I+i$ and $V-v$, are called I_1 and V_1 ; and the output current and voltage, $I-i$ and $V+v$, are called I_L and V_L :

$$\text{By "Ohm's law"} \quad V_1 = Z_1 I_1$$

$$\text{Using (6)} \quad = \frac{Z_1 Z_L}{Z_0} I_L$$

$$\text{Using (7)} \quad = Z_0 I_L \quad \dots \quad (8)$$

$$\text{Similarly} \quad V_L = Z_0 I_L \quad \dots \quad (9)$$

That is to say, for a given type of quarter-wave line, the voltage at either end is proportional to the current at the other end.

I.E.E. PREMIUMS

THE premier award of the Electronics and Communications Section of the I.E.E.—the Duddell Premium (£20)—for papers read or accepted for publication during 1959, is to be given to Dr. G. B. B. Chaplin (Plessey), A. R. Owens (University College of N. Wales) and A. J. Cole (Plessey) for their papers "A method of designing avalanche transistor trigger circuits" and "A sensitive transistor oscillograph with d.c. to 300 Mc/s response." The Ambrose Fleming Premium (£15) goes to Dr. A. E. Karbowiak and V. H. Knight, of Standard Telecommunication Laboratories, for "An experimental investigation of waveguides for long-distance transmission."

Premiums of £10 each are being awarded to A. H. W. Beck (for his paper "High-current-density thermionic emitters: a survey"), L. Lewin ("The efficiency of a ferrite as a microwave mixer," "A ferrite boundary-value problem in a rectangular waveguide" and "Phase measurements through tapered junctions"), and G. Craven and V. H. Knight ("The design and testing of integrally constructed waveguide assemblies"), all of Standard Telecommunication Laboratories, Professor A. L. Cullen ("Theory of the travelling-wave parametric amplifier") of Sheffield University, R. Beaufoy ("Transistor switching-circuit") of British Telecommunications Research, and to H. A. C. Hogg ("Periodic electro-static beam focusing") of G.E.C. Research Laboratories.

The premier award of the Measurement and Control Section (the Silvanus Thompson premium—£20), goes to Dr. L. Essen, E. G. Hope, J. V. L. Parry and J. McA. Steele for two papers on the N.P.L. caesium standard.

Transistor Inverters and Converters

2.—Basic Principles of the Push-pull Square-wave Oscillator System

By M. D. BERLOCK,* *Grad. I.E.E.*, and H. JEFFERSON,* *M.A.*

IN the first article we described the single-ended transistor oscillator which operated on what might be described as a pump basis. The energy is fed into a storage device, which is actually an inductor, on the charging stroke and then transferred to the load on a second, discharge, stroke. The limitations of a system of this kind are fairly easily seen. At best each part of the circuit is working for half the time so that the losses involved in cramming

energy stored in the system. An oscillator of this kind will also, of course, have a stored energy content large compared with the energy delivered to the load. Not surprisingly, this means that at low frequencies the tank circuit is both bulky and noisy.

The square-wave circuits with which we are concerned have, in their ideal form, no stored energy at all. The transistors act as switches, the transformer, for most of the time, purely as a transformer. Each half-cycle is an operation independent of the past. Let us examine the basic form of the circuit, which is shown in Fig. 1. It has, as you can see, the appearance of an oscillator circuit, although the tank circuit capacitance is missing and, as we shall see, the concept of inductance should not be applied to the collector winding of T. The core of T is, indeed, one of the so-called square-loop materials which have ideally infinite permeability below saturation and a very sharp knee at which the permeability falls to a very small value. How does this circuit operate?

When we first switch on let us assume that Q1 is in a higher gain condition than Q2. Current flowing into Q1 produces, through the conventional transformer action of T, a forward bias into the base of Q1 and a cut-off bias into the base of Q2. In consequence Q1 becomes a virtual short-circuit—a voltage drop of less than one volt at a current of ten amperes is normal. Across one half of the collector winding of T, we have almost the whole of the supply voltage and this, appropriately transformed, appears across the load.

The basic circuit during this phase of the operation can be simplified right down to that shown in Fig. 2, with the transistor put in even though it is a short-circuit, and the load resistance transformed back as a resistance R across the half collector winding. We could now write

$$\frac{dI_m}{dt} = \frac{V}{L}$$

But the trouble is that in a circuit of this kind the only way to define L is by the equation

$$L = \frac{V}{dI_m/dt}$$

We can avoid this difficulty by considering the

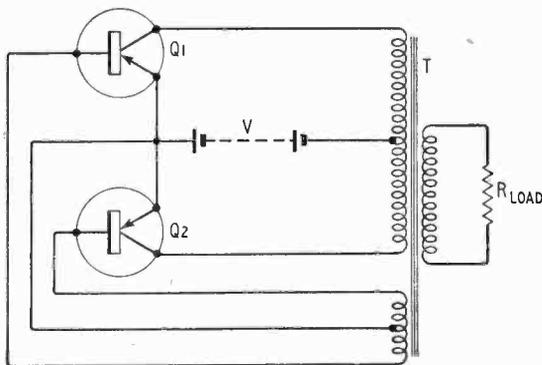


Fig. 1. Basic Uchirin-Royer circuit with a saturable collector transformer.

the energy through are doubled, while any deviation from the 50-50 ratio reveals that what you lose on the swings you do not get back on the roundabouts.

The use of a push-pull oscillator circuit operating in class-B is an obvious step forward in converting direct current to alternating. We can see, indeed, the whole family of class-B and class-C oscillators of traditional design but modified to use transistors available for this purpose. Much more interesting, however, is a family of push-pull square-wave oscillators which have come into use only with the advent of transistors. These oscillators are now quite widely used and provide efficiencies which range from perhaps 80% upwards depending on the conflict of the requirements presented to the designer: 95% is not uncommon but demands a bigger, more expensive unit than 90%. The choice is there to be made.

It is an interesting problem in semantics whether these circuits should be described as oscillators at all. The essence of an oscillatory system, one might say, is that it should have two energy storage methods with the energy being passed from one to the other and back again. In the pendulum the energy is now potential, now kinetic: in the LC oscillator the energy is now $\frac{1}{2} CV^2$, now $\frac{1}{2} LI^2$, in the tank circuit. The active element provides a make-up energy which is small compared with the

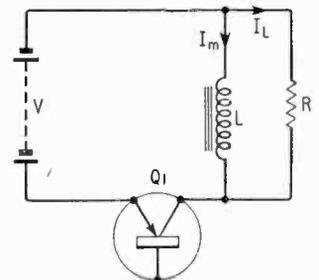


Fig. 2. Essential circuit for the switching operation of Fig. 1.

*The Phoenix Telephone and Electric Works Ltd

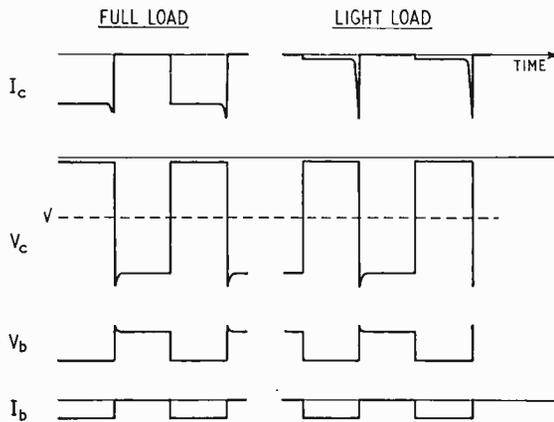


Fig. 3. Waveforms in Fig. 1 under full and light load conditions. Note the high current spike even under light load.

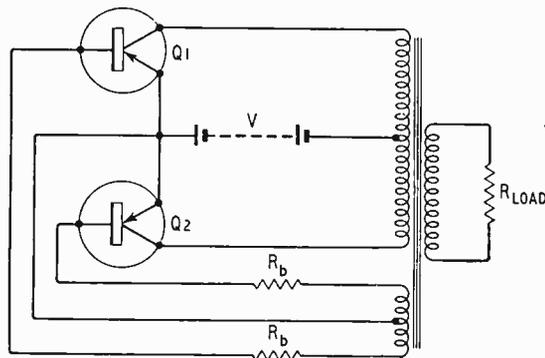


Fig. 4. Practical circuit with base current control.

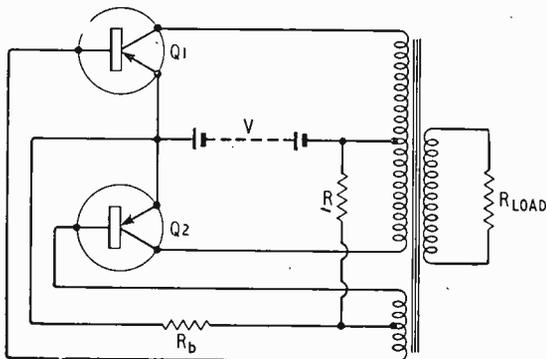


Fig. 5. Simple method of biasing the transistors.

We can make life easier by writing $t_0 = 0$ so that $B = kVt$ and we see that there is a steady growth, directly proportional to time, in the value of B . We know that B and H are connected by the equation $B = \mu H$, though μ is very large and probably not very constant.

In consequence we have

$$I_m = \frac{kVt}{\mu C}$$

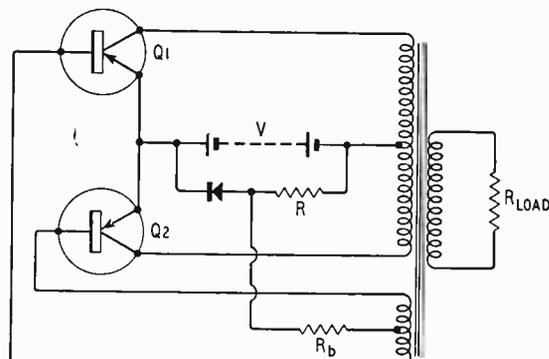
which is proportional to time and, because of the size of μ , rather small. There comes a limit to this state of affairs, however, when B reaches some value B_c . Any further increase in B then requires a very large increase in H , or if you prefer it, μ falls to a very small value. In consequence I_m attempts to rise rapidly to meet this demand.

The total available current is, however, limited by the transistor to a value βI_b , so that I_m can rise only if I_b falls. We have, however, $V = RI_L$, so the voltage across the winding collapses. The onset of this condition reduces the base drive to $Q1$ and the positive feedback loop drives $Q1$ off. The stored energy BH is small, but it is sufficient to lift $Q2$ into conduction and away we go, in the opposite direction.

The current and voltage waveforms for this circuit are shown in Fig. 3. It will be seen that the transistors are subjected to twice the supply voltage when cut-off and that the current is almost constant during the on period. In practice it is found that the voltage spikes shown, which are due to leakage reactances, may be substantial. The whole transient switch-over period is a rather dangerous one, with the very high current spike just at the end of the conduction period giving high dissipation in the transistor and also presenting a momentary heavy loading on the supply line. This current spike makes the transient behaviour very dependent on supply impedance.

The first stage in setting up a practical circuit of this kind is shown in Fig. 4. This circuit differs from the simplified circuit of Fig. 2 in the addition of the base current limiting resistors R_b . To begin the design we must, of course, choose our transistors. We assume that the supply voltage and power output are fixed: the current drawn from the supply will be something more than (power)/(voltage) and during its on period all this current flows through one transistor. Thus for a 30-W inverter operating from a 12-V supply the collector current rating must be over 2.5A. Because the efficiency will not be

Fig. 6. More economical method of biasing the transistors.



flux, B , in the core, which satisfies the equation

$$\frac{dB}{dt} = \frac{V}{nA} \times 10^8$$

where n is the number of turns and A the core area. From this we see that we have

$$B = kV(t + t_0)$$

(k and t_0 are constants)

This flux is associated with a magnetomotive force H which can be written simply as

$$H = C I_m \quad (C \text{ is another constant})$$

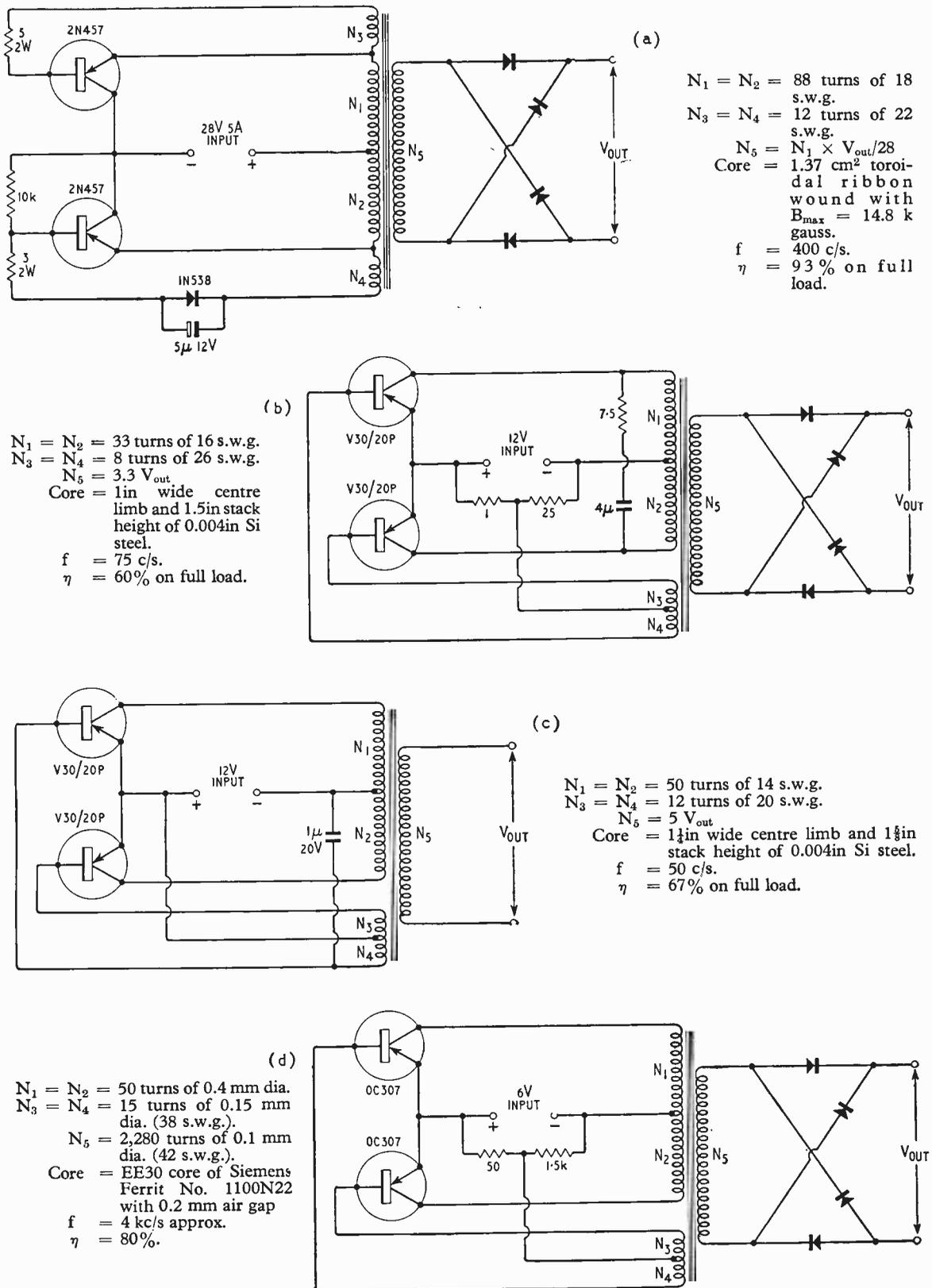


Fig. 7. Typical designs for inverters: (a) is suggested by Texas Instruments in their Bulletin No. DL-S 909, March 1958, (b) and (c) by Newmarket Transistors in their Application Notes Nos. 18 and 22 respectively, and (d) by Brush Crystal on p.21 of their Intermetall "Silizium-Germanium Halbleiter Bauelemente" (1959).

100% the current might be assumed initially as 3A. The voltage on the cut-off transistor will be twice the supply voltage, which for a charged battery means some 28-30 V.

These rather rough and ready sums are intended just to guide us in preparing a short list of possible transistors. For our example the average current is about 2.5A and the peak current will probably be about 4-5A during the spike. Prices and deliveries will now play some part in cutting down the list.

When a transistor has been selected we have the essential data for continuing the design: lack of this data is a reason why one manufacturer's products never appear in the short list. To drive the transistor fully on the data will indicate that we need some base current I_b which may be given in characteristic curves, or may be taken from the minimum value of β as simply

$$I_b = I_c / \beta$$

To get this current to flow into the base we need a base-emitter voltage V_{be} so that the ratio of the transformer must be

$$\frac{N_2}{N_1} = \frac{V_{be} + I_b R_b}{V_{cc} - V_{ce}}$$

where V_{cc} is the supply voltage and V_{ce} the transistor knee voltage. In what follows we shall write V_{ce} in place of the more exact form $V_{cc} - V_{ce}$. If R_b is such that $V_{ce} N_2 / R_b N_1$ is less than the maximum permitted value of I_b then the transistor cannot be overdriven.

The next problem is to decide the value of N_1 the collector winding. This is given by

$$N_1 = \frac{V_{cc} \times 10^8}{4 A f B_c}$$

The manufacturers of square-loop core materials, such as HCR, Mu-metal and some ferrites, give details of the saturating flux density B_c . The choice of area A and frequency f is left to the designer. He will begin by choosing a frequency based on a previous design. It will not be high, because the transient loss will become too great: it will not be too low, or N_1 becomes too large. A convenient value for the 10-100 W class of converter is 400-800 c/s. With the value of f determined a core size must be guessed, to give a value of A and thus of N_1 . We now make the first test, to see whether we can actually wind two windings of N_1 into half the window area of the core chosen (the other half is reserved for the load winding). Resistance, copper-loss and core-loss calculations follow with the usual painful reappraisal and the choice of a new core size. As this side of the design work is leading towards a satisfactory compromise between cost and efficiency, a new assessment of frequency may be made.

As the process of transformer design approaches completion it becomes necessary to examine the losses in the transistor itself. When passing its full current there will be a drop of about 0.5 to 0.8 V across the collector-emitter path and for a current of 3A this means a loss in the pair of 1.5-2.4 W. Transient distortion is more difficult to estimate even when the waveform can be displayed on an oscilloscope, and in general is small enough to be omitted from a broad study unless the frequency is abnormally high. The term we have just considered, say 2 W out of 30, suggests the order of magnitude we must allow for the transformer loss. The base circuit loss is added and we have a good idea of what

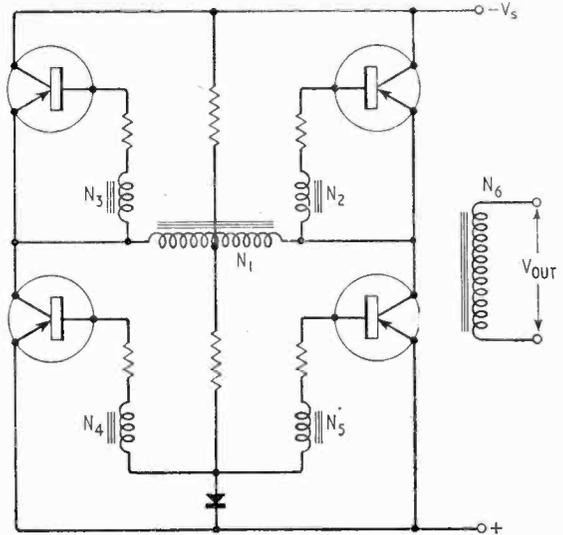


Fig. 8. For higher voltages two transistors are put in series in a design suggested by Mullard. (N_1, N_2, N_3, N_4, N_5 and N_6 are all on the same core.)

the inverter will do. For our arbitrary example with a 3A limit and an output of 30 W we cannot afford more than 6 W total loss. This means an efficiency of 83%, which is quite reasonable.

It is now necessary to elaborate the circuit slightly. The elementary circuit has the transistor bases returned directly to the emitters and the transistors may therefore be regarded as biased pretty close to cut-off. The loop gain will often, though not always, be too low to start the system oscillating and this is especially true when the load is permanently connected.

One starting mechanism used consists merely of a resistor in one base line, the base winding of the transformer being split to enable it to be put on the battery side of the winding, with a capacitor taken back to the negative centre-point of the collector winding. When the battery is suddenly applied this base is flicked sharply negative into a high-gain region and the circuit starts off. The disadvantage is that if the supply does not come on quickly enough the base does not get sufficient kick. When a large capacitor is connected across the supply terminals and the battery leads have significant impedance there may be starting trouble. Increased resistance means better starting but also, since base current flows through the resistor, lower efficiency.

Stephenson has shown in *Electronic Engineering*, Vol. 31, No. 380, October 1959, that to get this kind of oscillator to start it is necessary to provide a minimum base current of

$$25 n / (\beta R_L - n R_b) \text{ mA,}$$

where n is the (collector winding)/(base winding) turns ratio, R_L the collector load, and R_b the total resistance in the base path. For very simple applications it is sufficient to adopt the standard method of biasing the transistors to this working point. The result is the circuit shown in Fig. 5. Although this circuit is economical in components it is wasteful in power as the base current, which may be substantial, must flow through the bias resistors.

The standard bias circuit is that shown in Fig. 6.

The resistor provides the starting base current given by the expression above. It is, of course, quite calculable. The much larger base current taken once the system starts oscillating will flow through the diode. Once the diode is conducting the voltage drop across it does not vary very much with current and in a typical case of a 100-W inverter the diode current of 1 A results in a voltage drop of about 0.7 V a power loss of only 0.7 W. Allowance must be made for this additional voltage drop in determining the ratio N_2/N_1 .

Starting circuits involve the designer in a compromise which must be studied rather carefully. As we have seen, the starting condition is that a specified minimum current should flow in the transistors: this current must not be large enough to overheat the transistors if the load on the inverter is excessive and the circuit fails to oscillate.

The basic Uchirin-Royer inverter which has been described in this article is probably at the moment the most commonly used form of circuit. Most transistor manufacturers publish designs for using their transistors in this way and give details of the transformers. Some, at least, of the inverters available commercially are based on their information.

Typical designs are those illustrated in Fig. 7.

For higher supply voltages it is possible to work with two transistors in series in the circuit shown in Fig. 8. This circuit was described in *Mullard Technical Communications*, Vol. 4, No. 36, December 1958. All the transformer windings are on a common core of HCR laminations.

There are a number of disadvantages to the simple transistor inverter which we have described here. In the next article we shall discuss these and show how they are overcome in another slightly more complex circuit. We also hope to describe a new variant of this circuit which is slightly more economical and which has been found to have a number of operating advantages.

Corrections: In part I of this article (August issue): on p. 400, col. 2, line 21, C, should read C_1 ; on p. 401, col. 1, line 11 should read $I_c = \beta I_b$; on p. 402, col. 1, line 10, "to" should be deleted; line 19 of the same column should read

$$I_{pk} = \frac{4W(t_1 + t_2)}{E} \left(\frac{t_1}{t_1} \right);$$

line 27 of the same column should read $I_b = I_{pk}/\beta = E (N_2/N_1)/R_b$; on p. 402, col. 2, line 19 should read $t_1 = L_1 I_{pk}/E$.

HOW PRECISE IS YOUR ATTENUATOR?

EFFECT OF RESISTANCE TOLERANCES ON ATTENUATOR ERRORS

By H. STERN, B.Sc.

THE simple potential divider, consisting of two resistors in series (Fig. 1), is frequently used in electronic equipment to adjust the level of an incoming signal; for instance, it is used as the input attenuator in many cathode-ray oscilloscopes. In many cases the divider consists of high-stability close-tolerance resistors, the accuracy of the step-down being dependent on the accuracy of the resistors.

From comparison of circuit component values with the specifications of some instruments and from conversations with several engineers, it is obvious that it is frequently assumed that, if resistors of equal percentage tolerance are used in the divider, the maximum percentage error in the step-down ratio will be equal to that tolerance. It will be shown below that this is only true in a very limited number of cases.

If we let the desired voltage ratio V_{out}/V_{in} equal n we have, assuming precise resistor values:

$$n = \frac{R_2}{R_1 + R_2} \dots \dots \dots (1)$$

Taking partial differentials we get:

$$\frac{\partial n}{\partial R_2} = \frac{R_1}{(R_1 + R_2)^2} \text{ and } \frac{\partial n}{\partial R_1} = -\frac{R_2}{(R_1 + R_2)^2}$$

$$\text{Now } \delta n = \frac{\partial n}{\partial R_2} \cdot \delta R_2 + \frac{\partial n}{\partial R_1} \cdot \delta R_1$$

$$\therefore \delta n = \frac{R_1 \cdot \delta R_2 - R_2 \cdot \delta R_1}{(R_1 + R_2)^2}$$

$$\text{And hence } \frac{\delta n}{n} = \frac{1}{R_2} \cdot \frac{R_1 \cdot \delta R_2 - R_2 \cdot \delta R_1}{R_1 + R_2}$$

and by appropriate substitutions for R_1 and R_2 from equation (1) we get

$$\frac{\delta n}{n} = (1 - n) \left(\frac{\delta R_2}{R_2} - \frac{\delta R_1}{R_1} \right) \dots \dots \dots (2)$$

From (2) it is obvious that the maximum percentage error in the ratio n will be proportional to the sum of the percentage errors in the two resistors

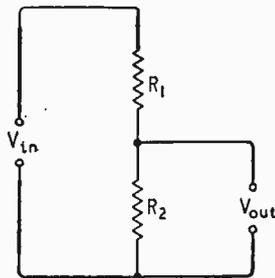


Fig. 1. Simple resistive potential divider.

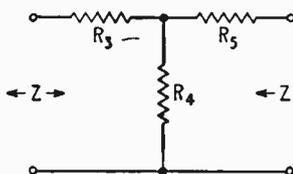


Fig. 2. T-type attenuator.

Fig. 3. Fig. 2 redrawn as two cascaded potential dividers.

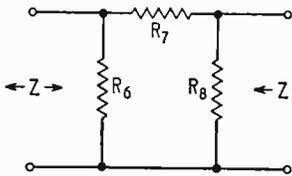
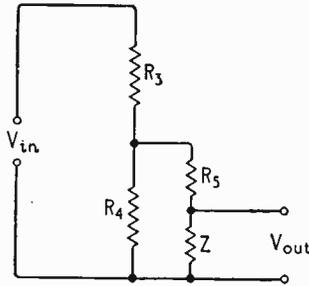


Fig. 4. π -type attenuator.

Fig. 5. Fig. 4 redrawn as a potential divider.

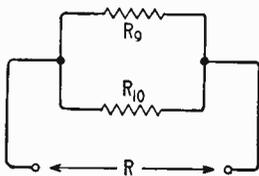
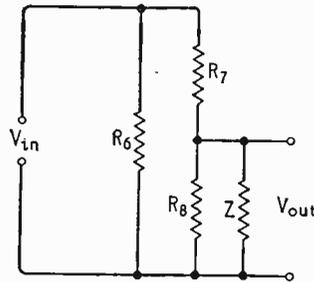
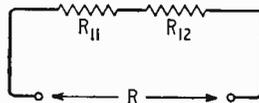


Fig. 6. Two resistors in parallel.

Fig. 7. Two resistors in series.



(i.e. $\propto (\delta R_1/R_1) + (\delta R_2/R_2)$) and will increase for a given resistance tolerance as the attenuator ratio $1:n$ ($n < 1$) increases.

If resistors of equal percentage tolerance are used we get:

$$\frac{\delta n}{n} = 2(1-n) \frac{\delta R_2}{R_2}$$

$$\text{Thus } \frac{\delta n}{n} \leq \frac{\delta R_2}{R_2}$$

Only if $(1-n) \leq \frac{1}{2}$

i.e. if $n \geq \frac{1}{2}$

i.e. if $R_2 \geq R_1$

In most cases the step-down ratio $1:n$ is greater than 2 and in consequence the maximum percentage error in the ratio is greater than the tolerance of the resistors used. In the limit, as n approaches zero we have:

$$\frac{\delta n}{n} \text{ tends to } 2 \frac{\delta R_2}{R_2}$$

In a practical example, for a $100:1$ ratio with $\pm 1\%$ resistors the error in the attenuator ratio may be as great as 1.98% .

The above considerations may easily be extended to cover more complex attenuator circuits. For instance, a T type of attenuator (Fig. 2) may (assuming purely resistive loading) be redrawn in the form of two cascaded potential dividers (Fig. 3). The first of these dividers has the combination of R_4 shunted by R_5 in series with Z as its lower arm.

In a similar way a π -type attenuator (Fig. 4) can be redrawn as a potential divider (Fig. 5).

The maximum possible error can then be calculated from the above theory if one takes into consideration the following factors:

For a parallel combination of resistors (Fig. 6):

$$\frac{\delta R}{R} = \frac{1}{R_9 + R_{10}} \left(R_9 \frac{\delta R_{10}}{R_{10}} + R_{10} \frac{\delta R_9}{R_9} \right)$$

If $\frac{\delta R_9}{R_9} = \frac{\delta R_{10}}{R_{10}}$ this simplifies to $\frac{\delta R}{R} = \frac{\delta R_9}{R_9} = \frac{\delta R_{10}}{R_{10}}$

For resistors in series (Fig. 7):

$$\frac{\delta R}{R} = \frac{\delta R_{11} + \delta R_{12}}{R_{11} + R_{12}}$$

Again, if $\frac{\delta R_{11}}{R_{11}} = \frac{\delta R_{12}}{R_{12}}$ this simplifies to

$$\frac{\delta R}{R} = \frac{\delta R_{11}}{R_{11}} = \frac{\delta R_{12}}{R_{12}}$$

Commercial Literature

Electronic Cable Gauge, for continuous measurement of diameter in cable works, based on a scanning light beam and photoelectric pick-up, with a system for measuring the time interval of the cable shadow passing across the pick-up. Said to be more accurate than light intensity methods. Leaflet from The Addison Electric Company, Ltd., 10-12 Bosworth Road, London, W.10.

Catalogue of Components made by A. F. Bulgin and Co. Ltd., Bye Pass Road, Barking, Essex. 2s 6d by post, or free to trade.

"**Electronic Measurement**" is the title of a new edition of a 23-page catalogue of Marconi test instruments. From Marconi Instruments, Ltd., (home) Marconi House, Strand, London, W.C.2, (overseas) St. Albans, Herts. (U.S.A.) 111, Cedar Lane, Englewood, New Jersey.

Television and V.H.F. Distribution systems made by Belling and Lee Ltd. are constructed on a modular basis to ensure serviceability and adaptability. The equipment is suitable for any size of installation and any television receiver or v.h.f. radio can be connected. Booklet from Belling and Lee Ltd., Great Cambridge Road, Enfield, Middlesex.

Sensitive D.C. Relay, Type K01, made by B. & R. Relays, is an alternative to the well-known P.O. 3,000 pattern, but is not affected by 25g acceleration. Vibration-resisting qualities are enhanced by replacement of the usual knife-edge armature support by a stainless steel shaft. Details of this and many other relays are given in a new catalogue from B. & R. Relays Ltd., Temple Fields, Harlow, Essex.

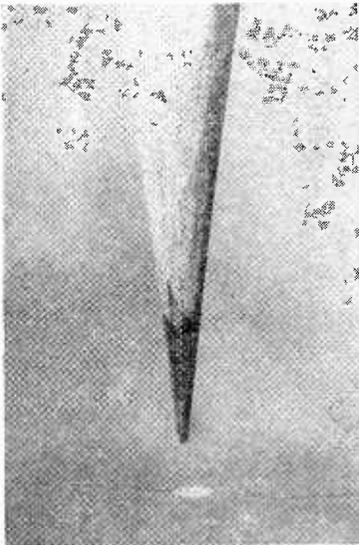
"**Resins and Glues for Industry**" is the title of a new edition of the catalogue of Lester, Lovell & Co. Ltd., North Baddesley, Southampton.

Five-valve 250-W a.f. amplifier or **150-W 30Mc/s transmitter** are two possible applications of the S.T.C. Type 828 beam-power amplifier valve. Application report giving details from Standard Telephones and Cables Ltd., Special Valve Sales Department, Footscray, Sidcup, Kent.

Valves and C.R.T.s for industrial purposes, comprising several hundred items, are listed in the 1960 edition of G.E.C.'s catalogue. From M-O Valve Co. Ltd., Brook Green, Hammersmith, London, W.6.

Automatic Stereo Phase Corrector developed by the American Columbia Broadcasting System laboratories was described at the recent New York I.R.E. Convention. In this corrector, portions of both the left and right stereo signals are amplified and then added and subtracted, the sum and difference signals so formed being then rectified. The resulting d.c. signals are applied to a mechanical flip-flop. If the relative phases of the left and right stereo signals are correct, the sum d.c. signal will be greater than the difference. If this is not so, the mechanical flip-flop automatically reverses the phase of one stereo signal to correct their relative phases.

Pinlite sub-miniature incandescent electric light shown in the photograph is claimed by its manufacturer, the American Kay Electric Company, to be at least 30% smaller than the



next smallest mass-produced bulb. Its actual dimensions are 0.062in long by 0.015in in diameter and it operates from a supply of 1.5V at 15mA. Possible uses for this bulb are in computer readouts or as a meter pointer position indicator. Because it operates at low voltages and currents it is also suitable as a transistor circuit on/off indicator.

Cleaning Flux from printed-wiring boards is necessary to avoid subsequent breakdown due to short circuiting or corrosion. In *Electronic Industries* for November 1959 (p. 110) results of a radioactive-tracer test are given. Flux containing a radio active substance was brushed on to the boards and allowed to dry. The boards then solder-dipped at 520°F for 5 seconds. Cleaning methods compared were mechanical agitation in a 100% chlorinated solvent and a water-based detergent solution, and

Technical Notebook

sonic agitation in the same two liquids. The results were, in per cent flux removed: 82%, 91.3%, 89.1% and 97.8% respectively. In the last case, the 2.2% remaining flux was found to be trapped in the solder and board or dispersed so as not to be a hazard in the future life of the board.

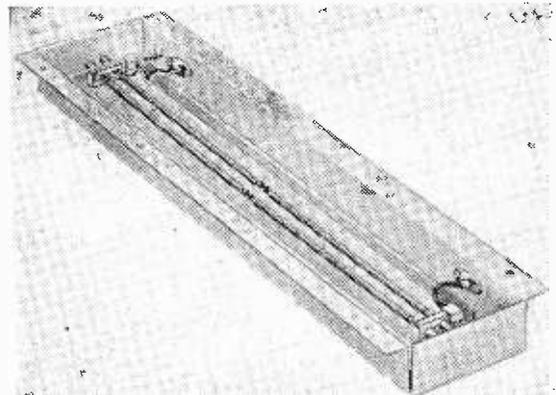
Gallium Arsenide Transistor has been developed by R.C.A. according to the May 13 issue of *Electronics*. One advantage of using GaAs as the semiconductor in a transistor is that it can be operated at a higher temperature even than Silicon—250°C compared with 175°C. The new R.C.A. transistor is a diffused-junction drift-field type with an alpha cut-off frequency of approximately 100Mc/s.

Pulse Sharpener, described by J. F. Golding and L. G. White in the September 1959 issue of *Electronic and Radio Engineer* (now *Electronic Technology*), uses a pentode switched on by the differentiated pulse leading edge to rapidly discharge the stray capacitance across which the pulse is developed and thus to provide a very fast pulse leading edge.

"Cocktail Party" Effect—i.e. one's ability to concentrate at a cocktail party on a single voice amid the surrounding babble and other party noises—has been reproduced electronically by E. E. David and J. F. Kaiser at the Bell Telephone Laboratories. This effect is due to our being able to separate sound sources according to their different directions, and in a two-eared listener can produce an apparent improvement in the signal-to-noise ratio of from 5 to 15dB. Since this improvement is greater than that theoretically possible by means of linear processes, non-linear processes were used in attempting to reproduce this effect electronically. In one experiment the outputs from two spaced microphones were compared by cross

correlation to produce a gating signal. This signal was arranged to increase the combined output of the two microphones when they each produced simultaneous identical signal outputs. (It was also, of course, arranged that such simultaneous signals were produced by the voice to be concentrated on.) Interfering signals then only had their intensities increased if they occurred at the same time as the desired signal. In this way in the combined microphone output the signal-to-noise ratio was improved by 9dB with a single interfering talker and by 5dB with two interfering talkers.

Artificial Reverberation obtained from mechanical spring delay lines (see photograph) developed by the Hammond Organ Company is being incorporated in new American Philco and Zenith stereo record reproducers. Two lines giving delays of 29 and 37msec are used. According to *Electronic News* for the 30th May, the delay is obtained from torsional motion of the springs; conversion between this torsional motion and the electrical input and output signals being carried out by means of ferrite rotors. By deliberately mismatching the delay lines, repeated reflections are produced and the delayed signal decays logarithmically as in natural reverberation. In the Philco units the sum of the left and right channels is reverberated and fed back into the left and right channels. In the Zenith units, the stereo signals are summed and differenced, and the sum channel is reverberated and fed into the difference channel.



Elements of Electronic Circuits

17.—BLOCKING-OSCILLATOR TRANSFORMER-COUPLED TIMEBASE

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

ALTHOUGH this type of relaxation oscillator is used primarily as a square-wave generator, a sawtooth waveform can be obtained from it. Fig. 1 shows a simple form of free-running blocking oscillator and Fig. 2 illustrates the waveforms.

Superficially the circuit resembles the familiar tuned-grid oscillator without its tuning capacitance, but its action is rather more complex. A single triode amplifier is used and the necessary positive feedback is obtained from the antiphase output of the tightly-coupled anode-to-grid transformer (usually having a Mumetal or ferrite core). When the valve starts to conduct, V_a falls and V_g is driven positive by the transformer action. A cumulative build-up of I_a and I_g to high values occurs, which causes V_a to drop sharply. The grid capacitor C is consequently charged by the large grid current and the tight transformer coupling ensures that the grid voltage is driven sufficiently far positive to permit this large current to flow.

The charge on C is now of such a value that it carries the grid well beyond the cut-off bias of the valve, thus stopping the flow of I_a and hence the production of the alternating grid voltage. The valve remains non-conducting while V_g rises exponentially towards earth potential with a time constant CR seconds. As soon as cut-off bias is reached, I_a flows again and the cycle repeats.

For correct operation a high negative bias voltage must be developed across C as there is a possibility of the positive-going excursion of the remaining, damped grid-voltage oscillation raising the grid above cut off again. To avoid this, damping (usually a parallel resistor) is sometimes added across the transformer. Choice of value of capacitor C is also influenced by the chance of ringing—if C is made

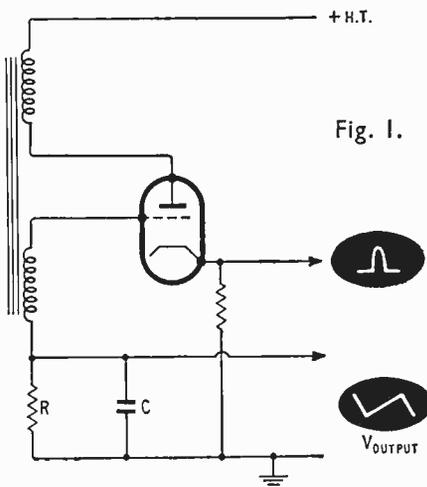


Fig. 1.

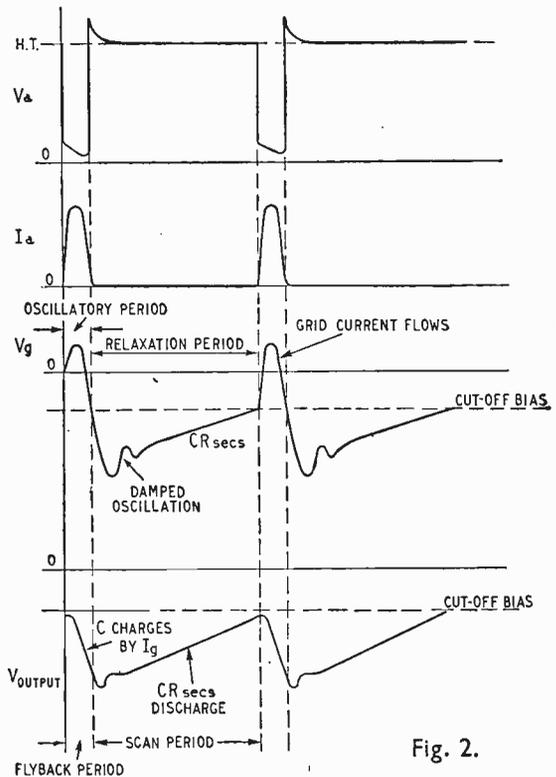


Fig. 2.

large it may not be charged sufficiently by grid current to ensure that the valve is held cut off after the half-cycle of oscillation. Thus for a slow p.r.f. a relatively small value is chosen for C with a correspondingly high value of R .

The timebase sawtooth waveform can be taken from C and, to make the rise in voltage more linear, grid-leak resistor R is sometimes connected to h.t. + instead of to earth. Positive-going pulses can be developed across the cathode resistor and applied to the c.r.t. cathode as blanking pulses, so blanking out the spot during the flyback period (i.e. the oscillatory period when I_a is flowing).

TECHNICAL WRITING

IT is announced by the Technical Publications Association that nineteen colleges have registered as providing courses in technical authorship for the 1960/61 session. Details of the technical authorship syllabus and of the colleges providing courses are obtainable from the City and Guilds of London Institute, 76, Portland Place, London, W.1.

CONFERENCES AND EXHIBITIONS

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

LONDON

- Aug. 24- Sept. 3 **National Radio and Television Show** Earls Court
(Radio Industry Exhibitions Ltd., 59 Russell Square, London, W.C.1.)
- Sept. 1 **Rocket and Satellite Instrumentation** 26 Portland Pl.
(Society of Instrument Technology, 20 Queen Anne Street, London, W.1.)
- Nov. 21-25 **Industrial Photographic and TV Exhibition** Albert Hall
(Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, W.C.2.)
- Nov. 22-24 **Electronic Telephone Exchanges (Conference)** Savoy Place
(I.E.E., Savoy Place, W.C.2.)
- Nov. 23-26 **Radio Hobbies Exhibition** R.H.S. Old Hall
(P. A. Thorogood, 35 Gibbs Green, Edgware, Middx.)
- Jan. 16-20 **Physical Society Exhibition** R.H.S. Halls
(Physical Society, 1 Lowther Gardens, S.W.7.)

BOURNEMOUTH

- Oct. 18-19 **Air Traffic Control Convention** Town Hall
(Guild of Air Traffic Control Officers, 118 Mount Street, London, W.1.)

CAMBRIDGE

- Sept. 15-17 **R.S.G.B. National Convention** Arts School
(H. Waton, 35 Metcalfe Road, Cambridge.)

CARDIFF

- Aug. 31- Sept. 7 **British Association Annual Meeting**
(British Association, 18 Adam Street, London, W.C.2.)

CHELTENHAM

- Sept. 22-24 **Theory and Practice of Ultrasonic Inspection (Conference)** Queens Hotel
(I. M. Barnes, Materials Laboratory, de Havilland Propellers Ltd., Hatfield, Herts.)

FARNBOROUGH

- Sept. 5-11 **Farnborough Air Show**
(Society of British Aircraft Constructors, 29 King Street, London, S.W.1.)

MANCHESTER

- Sept. 21- Oct. 1 **International Factory Equipment Exhibition** Belle Vue
(Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, W.C.2.)

OVERSEAS

- Aug. 29- Sept. 2 **Physics of Semiconductors Conference** Prague
(International Union of Pure and Applied Physics, 3 Boulevard Pasteur, Paris, 15.)
- Aug. 30- Sept. 6 **Firato—International Radio Show** Amsterdam
(Firato Secretariat, Emmalaan 20, Amsterdam, Z.)
- Sept. 14-15 **Military-Industrial Electronic Test Equipment Symposium** Chicago
(Armour Research Foundation, 10 West 35 St., Chicago.)
- Sept. 19-21 **Space Electronics and Telemetry** Washington
(I.R.E., 1 East 79 Street, New York.)
- Sept. 19-21 **International Symposium on Data Transmission** Delft
(B. Barrow, I.R.E., Postbus 174, The Hague.)
- Sept. 21-22 **Industrial Electronics Symposium** Cleveland
(I.R.E., 1 East 79 Street, New York.)
- Oct. 3-5 **Communications Symposium** Utica
(I.R.E., 1 East 79 Street, New York.)
- Oct. 4-6 **Radio Interference Reduction (Conference)** Chicago
(Armour Research Foundation, 10 West 35 St., Chicago.)
- Oct. 10-12 **National Electronics Conference** Chicago
(I.R.E., 1 East 79 Street, New York.)
- Oct. 19-26 **Interkama—Congress and Exhibition for Instrumentation and Automation** Dusseldorf
(Nordwestdeutsche Ausstellungen, Ehrenhof 4, Dusseldorf.)
- Oct. 24-26 **Aeronautical and Navigational Electronics (Conference)** Baltimore
(I.R.E., 1 East 79 Street, New York.)
- Nov. 14-16 **Mid-American Electronics Convention** Kansas City
(L. R. Crissman, T.W.A., 10, Richards Rd., Kansas City.)
- Nov. 14-17 **Magnetism and Magnetic Materials (Conference)** New York
(L. R. Bickford, I.B.M. Research Center, Yorktown Heights, N.Y.)
- Nov. 15-17 **Electronics Research and Engineering Meeting** Boston
(I.R.E., 73 Tremont Street, Boston, Mass.)
- Dec. 13-15 **Eastern Joint Computer Conference** New York
(P.O. Box 2580, Grand Central Station, New York, 17.)
- Jan. 9-11 **Reliability and Quality Control Symposium** Philadelphia
(R. Brewer, G.E.C. Research Labs., Wembley, Middx.)

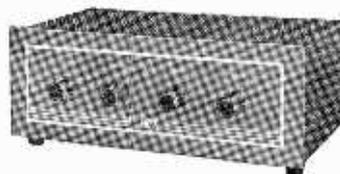


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FROM facts and figures issued by the National Council for Technological Awards one gathers that the Dip. Tech. has not only made a most promising start but has come to stay. The qualification, equal in standing to an honours degree at a university, has already been awarded to 163 students, including one woman. There are now 95 recognized courses at 23 technical colleges and nearly 4,000 students, including 84 women, have been enrolled. The demand for men and women with science qualifications is ever increasing and the universities are already so packed that there can't be room for all who would like to become students. And there's more to it than that. As its name implies, a university should deal with all branches of human knowledge. It must not specialize or it ceases to be a university, nor must it allow any faculty to become so big that it overshadows the rest. Hence it would never do to allot vacancies to all those who wish to obtain scientific qualifications. To do so would mean upsetting the balance. The Dip. Tech. provides a very satisfactory answer to the problem of coping with a far greater number of would-be science and technology students than the universities can cater for.

TV/DX in Bermuda

FROM Pembroke in Bermuda a reader writes to tell me of his experiences of long-distance TV reception. He is service manager of a firm and it occurred to him that it would be very useful if he could obtain a good picture in the showrooms at times when the local station, on Channel 10, wasn't working. He put up a 5-element aerial covering the American Channels 2-13 on a 20-foot mast on the roof of the 45-foot high building. The result was just astonishing. Havana, in Cuba, though 1,000 miles away, comes in steadily and regularly with very little background snowiness. Other distant stations giving pictures with real entertainment value are Daytona Beach in Florida on Channel 2 and Washington, D.C., on Channel 3. A glance at an atlas will show you that these are quite remarkable feats. His concluding sentence is of particular

interest: "The British receiver which my firm stocks always gives a better contrasted and more snow-free picture than the most expensive American sets of any make, even those claimed to be in the luxury class."

Telesmellevison ?

IN the U.S.A. several cine theatres are now equipped with apparatus which releases appropriate odours at the right moments. In jungle scenes, for instance, there might come whiffs of lion, tiger or elephant, or a garden scene can be accompanied by the scent of roses. The idea seems to have caught on, for a good few other theatres are ordering the apparatus. The gear has not yet reached a form suitable for domestic use but it could be developed to meet the requirements of a theatre showing big-screen television. Television has shown that it can do most if not all of the things so far achieved by the cinema. So why not? How does it work? A revolving platform carries bottles charged with the required scents, and capable of dispensing the scent in aerosol form. A foil strip pasted to the film switches on a device which brings the required bottle into position and then causes a plunger to press the knob. The scent is diffused via the air conditioning system and is said to be mopped up electrostatically when it ceases to be re-

quired. For telesmellevison the transmission of special trains of pulses would be needed, of course.

Pulse Pacemaker

WHEN Galvani made the leg of a dead frog twitch by connecting the muscles to an electric cell it is extremely unlikely that he had any idea that he had made a discovery which long after his death would lead doctors to developing methods of dealing with conditions in the human body which had hitherto been regarded as incurable. Yet this has happened, for doctors in Britain, Sweden and the U.S.A. are now using electric pulses to regulate heart beats. You couldn't very well run wires leading to the heart from a battery, but you can use the transformer principle, with the secondary, buried in the body and the primary outside it. As I wrote some time ago in these notes, the induction principle was used by a French doctor in an attempt to make a totally deaf person hear. What is being done in the case of irregular hearts is to implant a small secondary coil into the body and to connect it to the main nervous system of the heart. Outside the body is a time-base connected to the primary. By means of this, sync pulses are applied to the heart, which responds to them and begins to beat regularly. It is reported that when the device has been



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in use for some time the heart may become so trained that it continues to beat as it should when the pulses are switched off for a while.

Bigger and Bigger Screens

IN most countries which have television services there's a marked movement towards larger c.r. tubes for receivers. In France 19-, 21- and 23-in tubes have been popular for a year or two now. That's understandable, for even with such large screens an 819-line image is not liney, even if sets are used in quite small rooms. One rather wonders, though, whether the 19- and 23-in screens which are expected to be the standard size in the U.S.A. this year will be successful with 525-line images. Still the radio industry over there is predicting that the bigger (and let's hope better) sets will sell like hot cakes. So far I haven't seen a 625-line picture on a 19-in screen, but it's pretty well bound to be liny at closish quarters. There is, I fancy, bedrock truth in the suggestion made in a recent *Wireless World* editorial that many viewers don't mind liness. At any rate no British receiver using spot-wobble or spot-astigmatism has succeeded in catching on. Whenever I've seen spot-wobble sets in use in people's homes the wobble switch has always been in the off position.

Still Going Up

WITH 55,193 new combined TV/sound licences taken out in June, the total at the end of the month was 10,702,131. The summer months aren't normally responsible for big increases, though this year the cold, wet weather may be making people think more of indoor rather than of outdoor diversities. Anyhow, as the combined total of television and sound-only licences had reached 15,104,329 at the end of June there can't be an enormous number of homes now where there isn't a set of one kind or another, or sets of both kinds. Still, we're a good way yet from reaching saturation, in TV at any rate. With nearly four and a half million homes with nothing but sound only receivers there's still a bigish slice of our population to be roped into the television fold. New stations, both B.B.C. and I.T.A., are going up and satellites and boosters will be coming into action in more and more of the difficult areas. Every such station is bound to keep things moving and in some places where good pictures have seldom been obtainable the increased number of viewers should be considerable.

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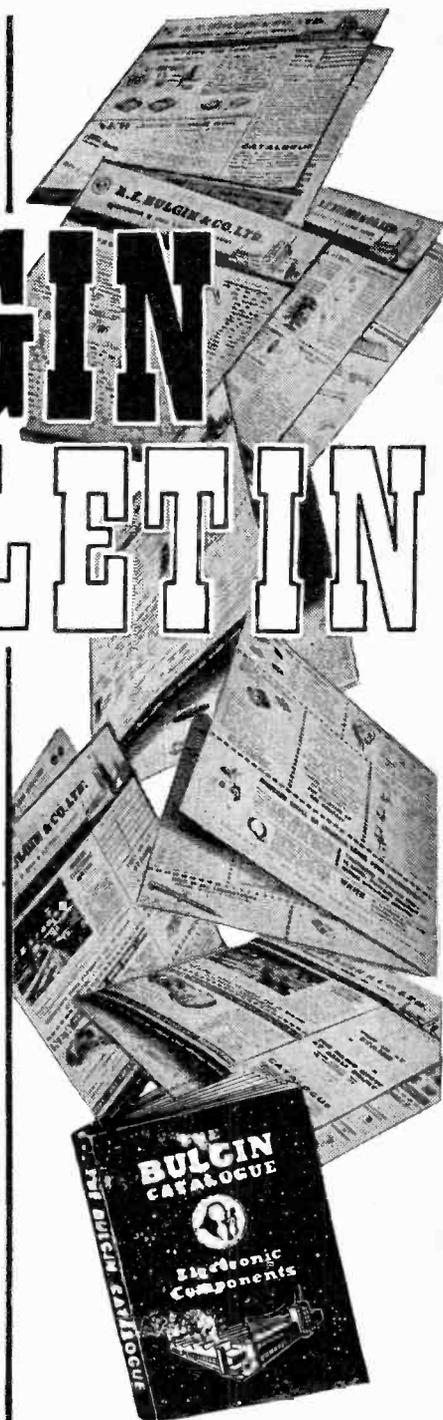
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"Line upon Line"

AS these notes are intended for the September issue, it means that it is just thirty years since I started writing in these columns by prophesying that the then largely discredited superhet showed unmistakable signs of staging a comeback (September 17th, 1930). It was then considered that good quality and the superheterodyne principle would never run together in harness. But that attitude has long since been forgotten.

Nowadays, judging by the Editor's remarks in the July issue, the question is whether a good-quality picture—or at any rate a reasonably non-liney one—can be obtained with 405-line television.

I certainly received a salutary shock when I first read in the July issue the Editor's stringent strictures on the popular idea that everything in the garden would be lovely if we changed our TV system from 405 to 625 lines. Hitherto I have not given any very serious thought to the matter but in my ignorance have just followed the herd-minded belief that the only remedy for "lines" was to have more of them.

The Editor rightly tells us there are ways of getting rid of lines other than by increasing their number, and one method which he picks out for mention is "spot wobble." At the risk of being impeached for lese-majesty I feel I must disagree, as spot-wobble to my mind is rather like the dodge of the old-time photographer who used to use what



Mrs. Free Grid also has views on lines.

he called a soft-focus lens to blur the blemishes and iron out the hard lines on the faces of some of his fair sitters who were no longer as young as they wished to appear in the photograph. Like Oliver Cromwell I prefer my picture "warts and all."

To my mind the real cause of the totally unnecessary lininess one sees on some TV screens is simply that the set is not interlacing correctly.

After all, if the odd-numbered lines do not fall squarely between the even-numbered ones, they tend to merge with them and so produce a coarse thick-lines and wide-spaces effect. I'm afraid many viewers don't know that incorrect interlacing can occur and so they wrongly blame the 405-line system.

1910 and All That

AS I sat listening to the "Scrapbook for 1910" some time ago, I could not help thinking what a wonderful year it must have been to have lived through. Life seemed to be one long round of music, dancing and theatre-going, with no clouds of war and no nuclear nightmares; and only the rollicking fun of the militant suffragettes to cause anxiety to the Government.

As I sighed and remarked on this to Mrs. Free Grid, she, with the uncompromising reason of her sex, tartly reminded me that I *had* lived through the year 1910. So indeed I had, but I suppose my memory is not what it was, otherwise I should have recognized the joyful scene.

My one criticism of the programme, however, is of a technical nature. Naturally we were regaled with the oft-told story of Dr. Crippen. We were given a touch of realism by being permitted to hear the actual message from Captain Kendall of the *Montrose* to Scotland Yard, being growled out by the ship's radio operator.

As I rather fancy myself as a morse reader, I naturally seized pencil and paper to take down the message. But I must confess I could make neither head nor tail of it. It seemed just a jumble of gibberish. Surely the radio operator of the *Montrose*, if he is still alive, could obtain substantial damages for libel, slander, defamation of professional ability and half a dozen other things?

Yet the Post Office radio operator at Land's End must have understood the message as its receipt at Scotland Yard sent Inspector Dew scurrying across the Atlantic in the *Laurentic* to overtake the *Montrose*. Could it be that the jumble of sound was sent by somebody who knew nothing of morse? Surely the B.B.C. could have borrowed a radio operator from somewhere or even invited the services of a competent amateur. As it was, the producer's attempt at realism turned to ashes in my mouth, or should I say the sounding of brass and the tinkling of cymbals in my ears.

There is another small point of criticism, which is also a technical

one but chronometrical rather than radio. It is simply that the producer did not seem familiar with the correct method of measuring the passing years. 1910 was *not* the first year of a new decade as was stated. One thing more. If, as I believe, we are to hear a scrapbook for 1911, I hope *Wireless World's* birthday in that year will not be forgotten.

Out of Synchrony

WE are often told that science is measurement, and this view was certainly confirmed in my mind when I heard of a molecular clock which does not lose or gain one second in a century. Actually I read about this in *IEA News*, a publication issued at the time of the I.E.A. exhibition by its organizers to tell us all about the wonders to be seen there.

But turning to another page of the same publication, my faith in science measurement was rudely shattered when I found that the Editor (or one of his slaves) makes it very plain that 1960 is regarded as the first year of a new decade. This sort of muddled thinking is what one might expect in lay circles, but is hardly in keeping with the split-second and split-micron accuracy that pervades the other pages of the I.E.A. publication.

In theory the present era began on January 1st in the year A.D. 1. Not until ten years had passed could our ancestors have legitimately hailed the beginning of the second decade on 1st January, A.D. 11, and it was not until six complete decades had passed that they could on 1st January, A.D. 61 hail the birth of the seventh decade. Similarly, we of the present century must wait until it has completed six decades before we start our own seventh one on 1st January, 1961.

It is true the "sixties" and the seventh decade are nearly but not quite in synchrony; just 10% out. But in scientific matters "nearly" or "10%" is not good enough; it would be useless, for instance, for an ordinary electric clock to be nearly but not quite in step with the supply mains.

Of course, I may be quite wrong in my view. It could be it is myself who is out of step, or, in other words, not quite in synchrony. If so, I hope somebody will take on the rôle of sergeant-major and devastate me with a blast of invective as so frequently happened in the days of the first world war when my faltering footsteps were so often nearly but not quite in synchrony with those of the rest of the platoon.

ask SIMA

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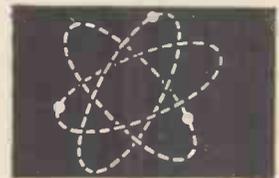
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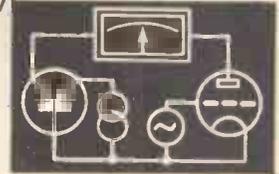
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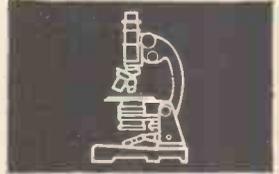
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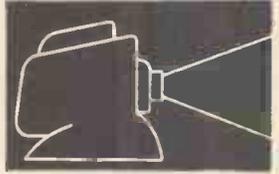
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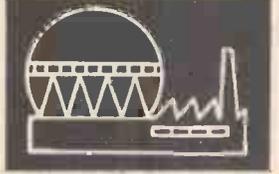
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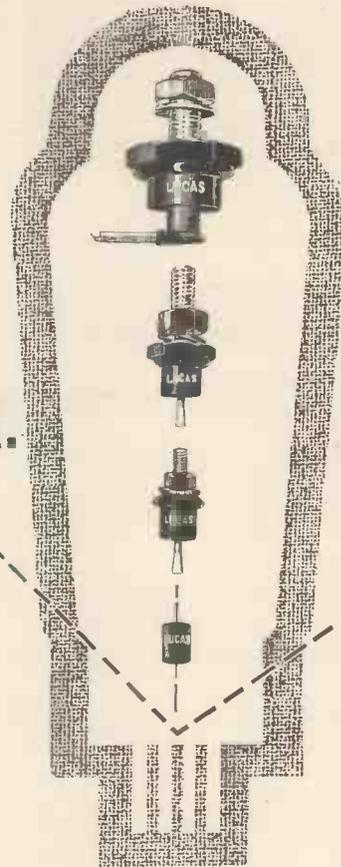
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Please contact Mullard House for full data and any other information that you may require.

Abridged Data

V_{cb} max.	— 32V
V_{ce} max. ($V_{be} > +0.5V$)	— 32V
V_{ce} max. ($I_c \leq 200mA$)	— 24V
i_c (pk) max.	500mA
I_c max.	250mA
$T_{junction}$ max.	150°C
P_{tot} max. at 25°C	310mW
P_{tot} max. at 100°C	125mW
I_{co} ($V_c = -10V, I_e = 0$)	20 μ A
V_{ce} bott. ($I_c = 125mA, I_b = 17mA$)	— 250mV
$\bar{\alpha}'$ ($V_c = -2V, I_c = 30mA$)20
$\bar{\alpha}'$ ($V_c = -1V, I_c = 150mA$)15
f_1 ($V_c = -6V, I_c = 1mA, \bar{\alpha}' = 1$)1.5Mc/s



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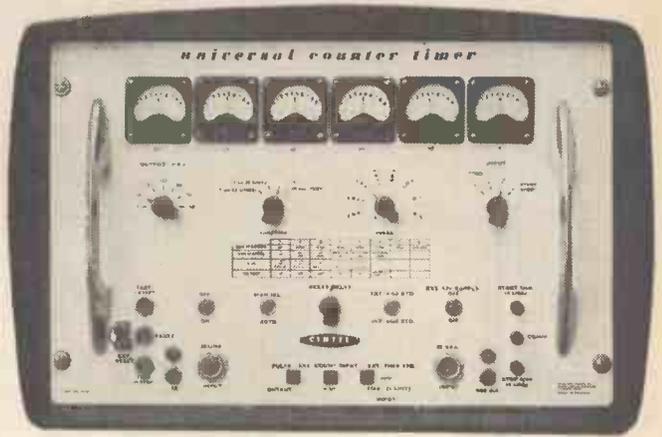


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This fully transistorized portable equipment provides for a wide range of time and frequency measurement as well as facilities for counting, frequency division and the provision of standard frequencies. The facilities available are briefly listed below:

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Full technical specification available on request.



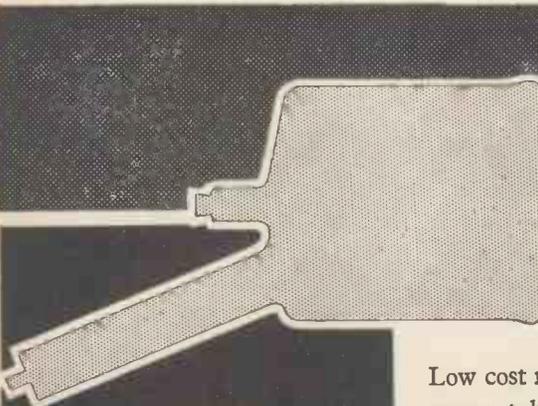
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Advanced development is now in progress on both bi-stable and half-tone storage tubes. The bi-stable tubes are electrostatically deflected and are intended for use in infinite persistence oscillograph applications. The half-tone tubes are magnetically deflected and provide a bright flicker-free display with controllable persistence characteristics. Uses for these half-tone tubes include radar displays where ambient light levels are high and equipment for the display of information received on slow-scan narrow bandwidth systems.

* Information storage tubes

Tubes are being developed which provide electronic writing and reading facilities for use in information processing systems. Of particular interest is a single-gun tube capable of storing a high resolution television picture for purposes of standards conversion, or processing for band-width compression. In the radar field it has applications in systems employing true-motion display or moving target indication.

* Solid State display devices

Among the solid state devices under active investigation is a light amplifier which utilizes a combination of electroluminescent and photoconductive principles. Other devices in this sphere of activity include solid state image converters and multi-element devices.

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* Scan Magnification

Deflection sensitivities of both magnetic and electrostatic industrial and radar tubes of conventional design can, under certain conditions, be increased by factors of 10 times by the use of magnetic and electrostatic lens systems of scan magnification. Substantial progress is being made at the Mullard Research Laboratories in the complex problems which must be resolved before this attractive system becomes a practical proposition.

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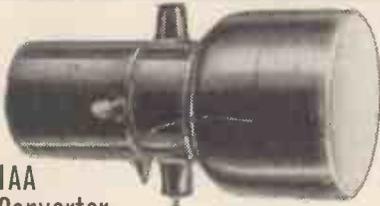
AW17-20 Television Camera Viewfinder

This high quality viewfinder and monitor tube has a 6½-inch diagonal rectangular screen. Compared with earlier 5-inch round tubes, the rectangular screen of the AW17-20 provides nearly twice the useful screen area for an increase of only 20% of the face plate area.



5820 Television Camera Tube

The 5820 is a 3-inch image orthicon tube with an exceptionally high sensitivity and a spectral response approaching that of the human eye. It is a direct equivalent of the American tube of the same type number.



ME1201AA Image Converter

One of the most important applications of the image converter is as an electronic shutter in high speed photography. With the grid controlled ME1201AA, exposures as short as a thousand-millionth of a second are possible.



AW36-48 Studio Monitor Tube

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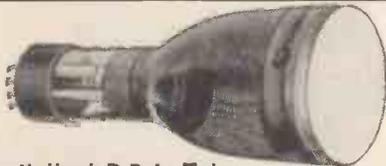
MM13-10 High Brightness Radar Tube

At high altitudes ambient light is strong, and for easy viewing, radar tubes are made with a very high brightness. The MM13-10 is a five-inch magnetic tube specially designed for such applications.



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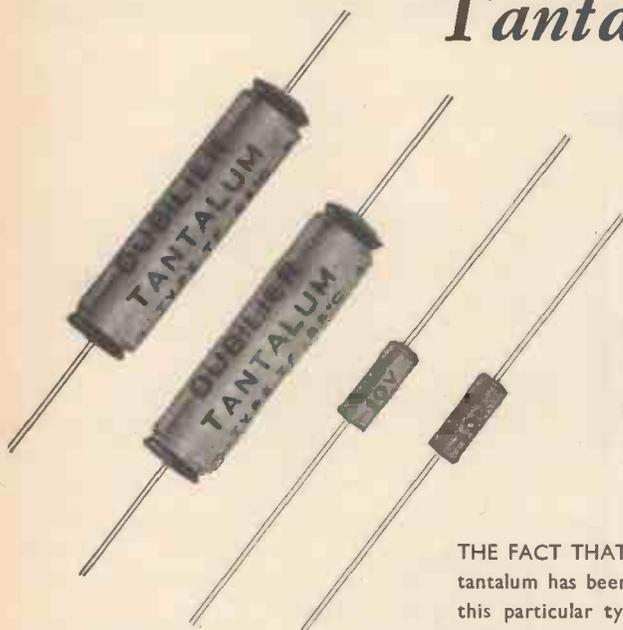
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The plain or etched foil types which are of comparable construction to the well-known dry aluminium electrolytic capacitor and known as "Foil Type Tantalum Capacitors." These foil type units are suitable for standard circuitry where a size limitation exists requiring high capacitance at up to 150V with wide temperature and/or long shelf life characteristics.

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The solid type, in which the anode is a formed tantalum wire or, more usually, a sintered pellet of compressed tantalum powder encased in a semiconductor and housed in a container fitted with wire lead terminations. This type is most suitable where it is undesirable to have any liquid component present and where exceptionally long shelf life, extremely small dimensions and operation at temperatures beyond the capacity of the foil type is essential. The peak operating voltage of the solid type is, at present, limited to 35 volts.

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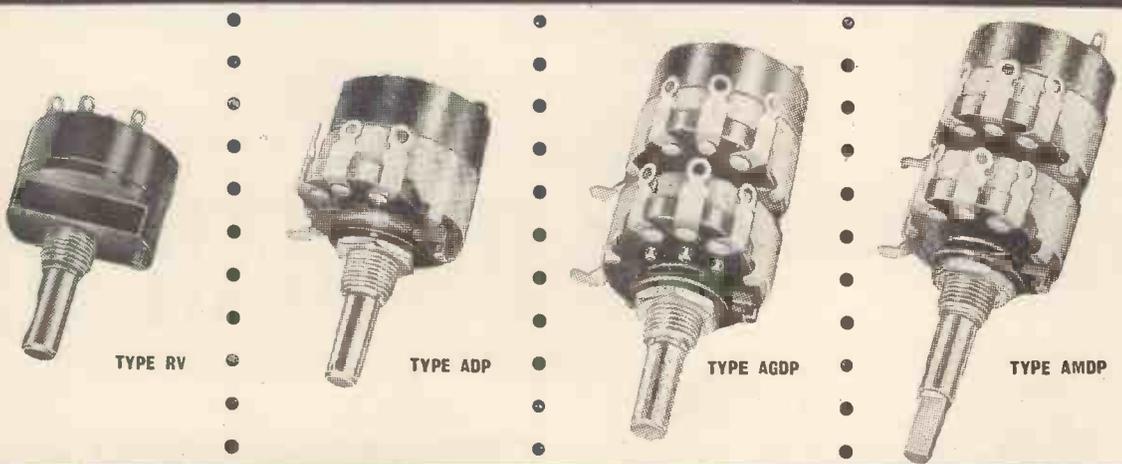
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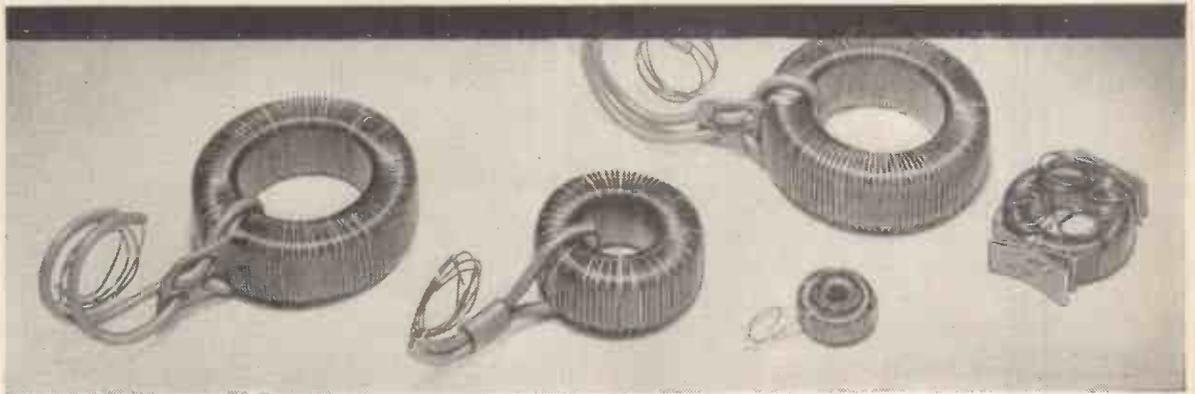
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CODE	Inductance at Cont. rated current (μ H)	Current Rating		Volt Drop at Cont. Rated Current (V)	Self Resonating Frequency (Mc/s)	D.C. Resid. (Ω)
		Cont. (A)	Peak (A)			
C1A8 300	300 \pm 10%	0.5	0.7	0.25	5.0	0.5
C2B8 500	500 ,, ,,	1.0	1.2	0.30	3.2	0.3
C3C81000	1000 ,, ,,	1.5	2.2	0.45	1.2	0.3
C4C81000	1000 ,, ,,	2.0	3.5	0.44	0.9	0.22
C5D81000	1000 ,, ,,	3.0	4.4	0.54	0.8	0.18

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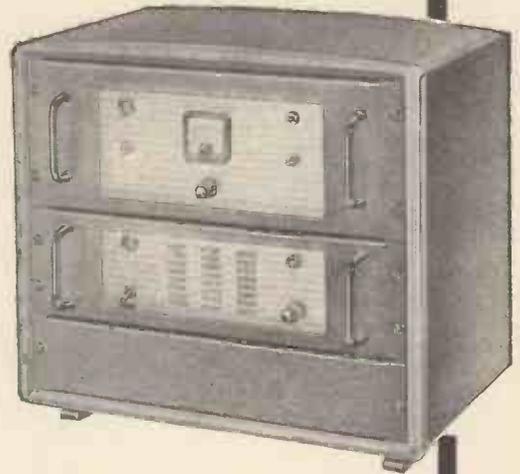
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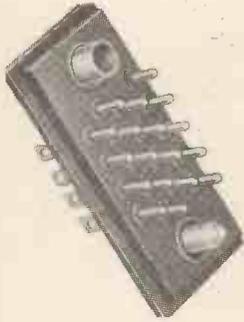


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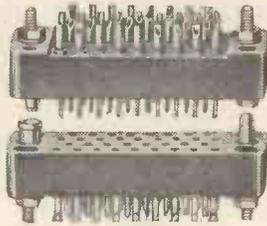
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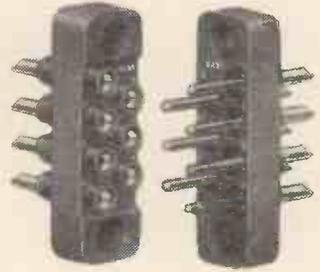
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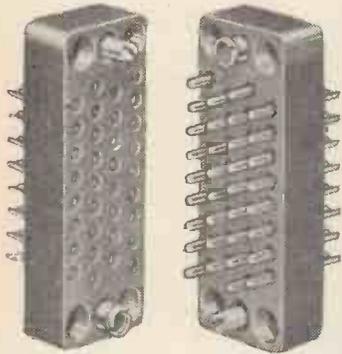
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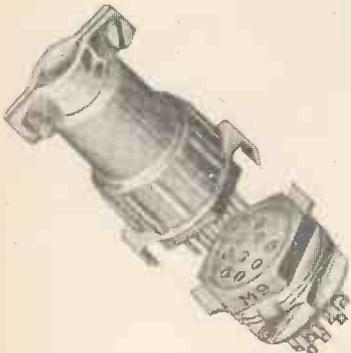


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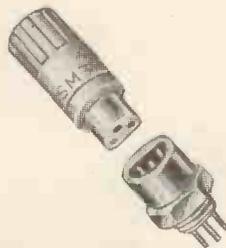
- * Precision Mouldings
- * Gold-plated Contacts



PRINTED-CIRCUIT SERIES



MINIATURE ROUND SERIES



SUB-MINIATURE ROUND SERIES



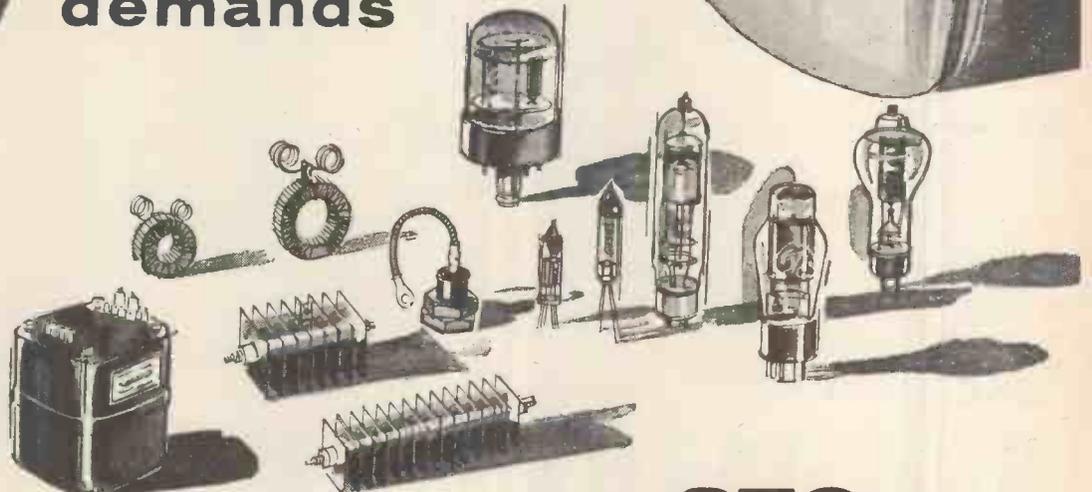
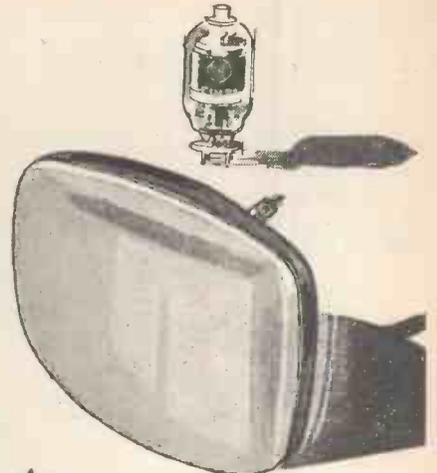
STACKABLE SERIES

Illustrated technical data sent on request :

ELECTRO METHODS LTD., Electrical Connector Division,
HITCHIN STREET, BIGGLESWADE, BEDS. : : Telephone: Biggleswade 2086 (3 lines)



**RELIABLE
PERFORMANCE
demands**



STC COMPONENTS

The standard of reliability of STC components is set by the vital roles of the navigation and communications equipments in which many of them are used. The consequent employment of top grade materials and high degrees of skill and care in manufacture ensures that all users of STC components may have the fullest confidence in them.

YOU CAN RELY ON STC COMPONENTS

- Brimar Teletubes
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- Special Valves Selenium Rectifiers
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- Suppressors Transistors Thermistors
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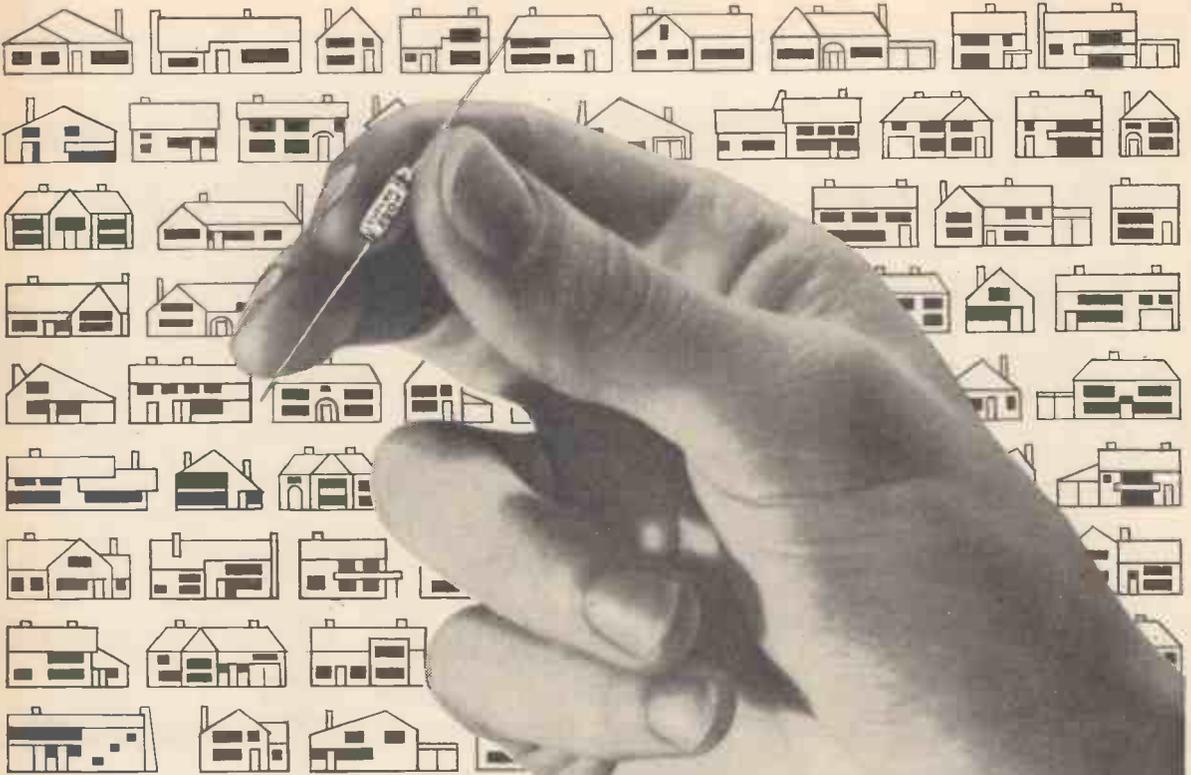
Get to know about STC Components—write for booklet M/103 which lists all components and their relevant technical literature.



Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2.

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5 MILLION HOMES

(or more, we have not made a strict count)

contain Suflex Polystyrene Capacitors

To save you looking we can tell you they are to be found in most of the various makes of T.V. and Radio, and they are used because of very small size and excellent electrical properties (good power factor, high capacitance stability, and high insulation resistance). They are also, we hope, to be found at your place of work in electrical instruments, computers, etc., doing whatever capacitors are supposed to do, and, we hope, doing it well. We suggest you telephone or write to bring yourself up-to-date with our latest developments—for example, Polyester and Polycarbonate capacitors.

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P.S. Don't forget we are one of the first names in insulating sleeving and probably have at least one range you have not heard about.



Remember Our new telephone No. **EALING 7733**

SenTerCel

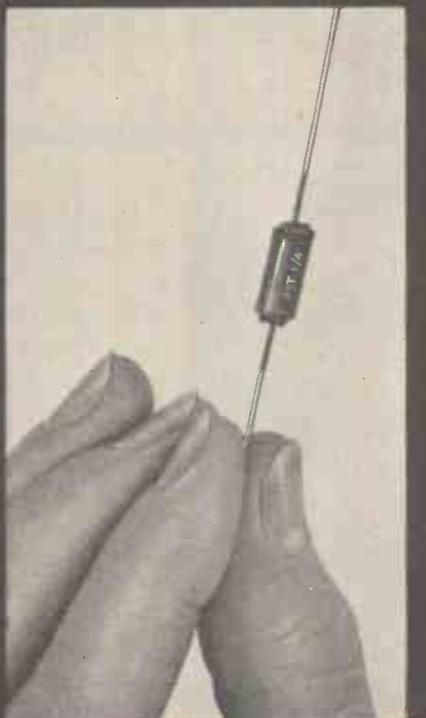
SILICON h.t. power rectifier type FST1/4 for television receivers

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.

SenTerCel FST1/4 silicon rectifiers are miniature wire ended devices which can be speedily mounted to tag panels, no heat sink being required. Typical performance curves and design procedure are included in leaflet MF/109.

Important advantages of the FST1/4 silicon rectifiers are :—

- Large Power Output
for Small Size
- .35 Amp Surge Current
Rating (5 m/secs.)
- High Ambient
Temperature Operation
- No Heat Sink Required
- High Output Voltage
- No Forward Ageing
- High Efficiency
- Low Cost

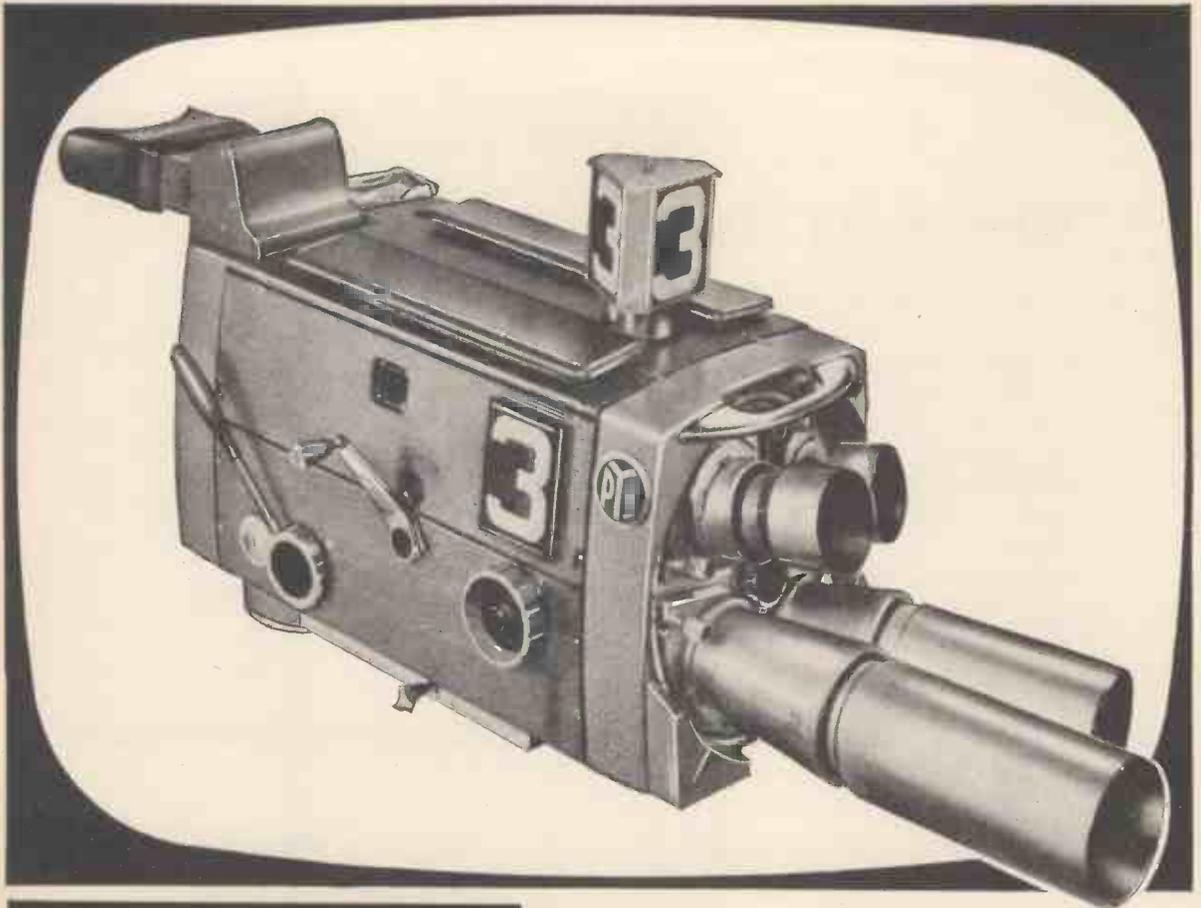


6C/6 MF

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

RECTIFIER DIVISION: EDINBURGH WAY · HARLOW · ESSEX



The New



**3" IMAGE
ORTHICON
TV CAMERA**

4½" also available

Exact standards of design have resulted in a high-grade camera capable of reproducing the fine picture quality demanded in studio use, yet, at the same time, light and strong enough for field use.

OUTSTANDING FEATURES:

- ★ Pick-up Tube can be replaced in one minute without disturbing cover or lenses.
- ★ 'Image orbiting' device reduces risk of target 'burn-in'.
- ★ Built-in hour meter records pick-up tube running hours.
- ★ Electronic viewfinder with 7" diagonal rectangular tube. It presents a picture which is perpendicular to the line of vision.
- ★ All chassls of plug-in type for easy maintenance and replacement.
- ★ Servo control of light by filter or irfs.
- ★ Thermostatic temperature control of pick-up tube.



For full technical details, please write to:

PYE LTD., SALES DEPT., TV TRANSMISSION DIVISION, CAMBRIDGE

VINKOR

Pot
Core
Assemblies
offer...

adjustment of $\pm 7\%$

with an accuracy of better than $\pm 0.02\%$

Any assembly in the Mullard Vinkor range can be easily adjusted to an accuracy of better than $\pm 0.02\%$ by using a trimming screwdriver, whilst stability is ensured by the self-locking action of the adjuster core. The range of adjustment is approximately $\pm 7\%$ about the nominal mid-position of the adjuster core. Over and above these advantages, for each size of core there is a choice of three permeabilities which are controlled to close limits so that it is possible to calculate and wind an inductance to $\pm 3\%$ of the value required before adjustment.

These are just some of the reasons why leading equipment designers acclaim Vinkor as the world's most efficient pot core. If you have not received your copy of Vinkor data, write at once to the address below.



Mullard Ltd. Component Division, Mullard House, Torrington Place, W.C.1.

THE SCALE IS INSIDE!



EDISWAN 6-in. Aluminised Indirectly Heated Cathode Ray Tube for Radio DF Compass and other applications. High Brightness Level. Internal Scale.

This Ediswan Radio DF Compass Tube ends parallax errors for the simple reason that the scale is printed on the inside face in actual contact with the phosphor screen. The scale pigment used is completely inert and unaffected by the electron beam. It is a dense black and does not fade after prolonged use.

Contrast is further improved by the aluminised screen which greatly intensifies the brilliance of the trace.

Anti-Dazzle Face All CRTs in this range have a concave face, treated on the outside with a robust process which eliminates distracting specular reflections and gives the impression of a soft matt ground glass finish.

Scale Applications The tube is available with an octantly corrected scale (31C1) or a uniformly graduated scale (31C2). Other versions can be supplied printed with selected portions of the Smith's Impedance Diagram.

Invitation We should welcome discussions with designers and manufacturers who have specific requirements involving special scales.

BRIEF SPECIFICATION

Heater voltage (volts)	V_h	4.0-6.3
Heater current (amps)	I_h	0.72-0.6
Anode voltage, rating (kV)	V_a (max)	10.0
Anode voltage, typical operation (kV)	V_a	9.5

EDISWAN

INDUSTRIAL VALVES & CATHODE RAY TUBES
Associated Electrical Industries Limited

Radio & Electronic Components Division

155 CHARING CROSS ROAD, LONDON W.C.2. TELEPHONE: GERRARD 8660

ERC 16/13

STAND
112 See these kits at



STAND
112 the RADIO SHOW

Seeing is believing

So come along to our Stand and study these instruments at close range. They will bear the keenest scrutiny and will convince you of their outstanding quality.

5in. OSCILLOSCOPE KIT

Model O-12U



Laboratory quality at utility oscilloscope price and ease of assembly make this kit of outstanding value. Vertical frequency response 3 c/s to 5 Mc/s., ± 1.5 dB. - 5 dB., sensitivity 10 mV. per cm. at 1 kc. Horizontal frequency 1 c/s. to over 400 kc/s. (± 1 dB. up to 200 kc.). The Heath patented sweep circuit functions from 10 c/s to 500 kc. in five ranges giving five times the usual sweep of other 'scopes.

In addition it has exceedingly short re-trace and rise times and electronically stabilised power supply. Included is a 48-page instructional Manual. **£34.15.0**

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



This extremely useful, low priced device will extend the use of your single-beam oscilloscope for duties otherwise only in the province of the double-beam tube.

In short, at a nominal cost, the Heathkit model S-3U will give you the advantages of a double (or other multiple) beam 'scope, while retaining all the advantages of your present single-beam instrument.

Hitherto an electronic switch of this nature, permitting the simultaneous observation of two signals on the screen of a single-beam C.R.T. oscilloscope, has cost nearly as much as the 'scope itself. **£9.18.6**

RESISTANCE-CAPACITANCE BRIDGE KIT Model C-3U



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

STEREO CONTROL UNIT KIT Model USC-1



Incorporates all worthwhile features for high fidelity stereo and mono. Push-button selection, accurately matched ganged controls to ± 1 dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape heads and any stereo or mono pick-up. **£17.19.6**

BALUN COIL UNIT KIT Model B-U

Useful transmitter accessory. Will match unbalanced co-axial lines, used on most modern transmitters, to balanced lines of either 75 or 300 Ω impedance. **£4.4.6**

POWER SUPPLY UNIT KIT Model MGP-1



Compact, general purpose unit suitable for FM Tuners, Tape Recording Amplifiers and general Laboratory use. Input 100/120V, 200/250V, 40-60 c/s. Output 6.3 V 2.5A A.C.; 200, 250, 270V. 120 mA. max D.C. **£4.9.0**

MULTIMETER KIT Model MM-1U

Provides wide voltage, current, resistance and dB ranges to cover hundreds of applications. Sensitivity 20,000 ohms/volt D.C. and 5,000 ohms/volt A.C. Ranges: 0-1.5V to 1,500V A.C. and D.C.; 150 μ A. to 15A D.C.; 0.2 Ω to 20 M Ω . 4 $\frac{1}{2}$ in. 50 μ A meter. **£11.8.6**

DECADE CAPACITOR KIT Model DC-1U

Capacity values 100 μ F to 0.11 μ F in 100 μ F steps. Precision silvermica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£5.18.6**

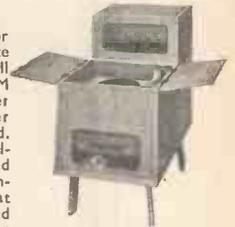
2 $\frac{1}{2}$ in. SERVICE 'SCOPE KIT Model OS-1

Light, compact, portable, for service engineers. Printed circuit board for easy construction. Wt. 10 $\frac{1}{2}$ lb. Size 5in. x 8in. x 14 $\frac{1}{2}$ in. long. **£18.19.6**

● Deferred Terms ●

available on all orders above £10

"CHEPSTOW" EQUIPMENT CABINET KIT



Specially designed for those whose floor space is at a premium. Will house Record Player, FM Tuner, Stereo Amplifier and additional power amplifiers where needed. An upper deck is available for the self-powered stereo amplifiers to ensure maximum heat dissipation. Veneered and left in white for finishing to personal taste. Overall dimensions are 35" x 18" x 33" high. **£10.10.0**

HI-FI STEREO AMPLIFIER KIT Model S-88



Gives 16 w. output (8 per channel with 0.1 per cent. distortion at 6 w. per channel). It has ganged controls; STEREO/MONAUROGRAM, radio and tape recorder inputs and push-button selection as well as many other first class features well above its price range. In two-tone grey metal cabinet with a golden surround and fittings. Also ultra-linear push-pull output. **£25.5.6** Basic sensitivity 10 mV. (2 mV. available 20/- extra).

DUAL-WAVE TRANSISTOR RADIO KIT Model UJR-1

This sensitive headphone set is a fine introduction to electronics for any youngster. Operated by a small torch battery. **£2.16.6**

TRANSISTOR PORTABLE KIT Model UXR-1



Presented in elegant real hide case with tasteful gold relief. Can be assembled in 4 to 6 hours, and you have a set in the top flight of transistor portables. Prealigned I.F. transformers, printed circuit and a 7in. x 4in. high-flux speaker. **£14.18.6**

AUDIO WATTMETER KIT

Model AW-1U. Up to 25W continuous, 50W intermittent. **£13.18.6**

VARIABLE FREQUENCY OSCILLATOR KIT Model VF-1U



For all Amateur Bands, 160-10 metres. Ideal for Heathkit DX-40U and similar transmitters. **£10.12.0**

Price less valves £8/19/6

DAYSTROM LTD.
DEPT. W.W.9, GLOUCESTER, ENGLAND

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

Technically



excellent



6 WATT STEREO AMPLIFIER KIT Model S-33

A versatile high-quality self-contained STEREO/MONAUROAL Amplifier with adequate output for a living room—or with which to convert a favourite (monaural) radiogram into a stereo-radiogram. 3 watts per channel; 0.3% distortion at 2.5 w/chnl.; 20 dB N.F.B., inputs for Radio (or Tape) and Gram., Stereo—or Monaural; Ganged controls. **£11.8.0**
Sensitivity 100 mV.



VALVE VOLTMETER KIT Model V-7A

The world's most popular valve voltmeter, with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively d.c. volts to 1,500 and a.c. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 M ohms with internal battery. D.C. input impedance is 11 Megohms and dB measurement has a centre-zero scale. Complete with test prods, leads and standardising battery... **£13.0.0**

R.F. PROBE KIT Model 309-CU

This complete probe kit will extend the frequency range of the V-7A Valve Voltmeter to 100 Mc/s. and will enable useful voltage indication to be obtained up to 300 Mc/s. **£1.5.6**



"HAM" TRANSMITTER KIT Model DX-40U

Covers all amateur bands from 80 to 10 metres. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for V.F.O. Filters minimise T.V. interference. **£29.10.0**

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



AMATEUR TRANSMITTER KIT Model DX-100U

The world's most popular "Ham" TX Kit

- Completely self-contained, compact "Ham" Transmitter.
- Built-in, high stable VFO and all Power Supplies.
- TVI: Careful design has reduced TVI to a minimum by use of effectively screened frequency-generating stages and pi tuned circuits at the input and output of the PA stage, and by 11 chokes and pi network filters to all outlets from the cabinet. No fewer than 35 disc-ceramic by-pass capacitors help to achieve the exceptional stability and high-performance for which this Transmitter is noted.
- The KT88 high-level anode and screen modulator stage gives over 100 watts of audio from less than 1.5 mV. input.
- Adjustable drive and clamp control ensure that valves are only driven sufficiently to maintain the required output.
- Keying on CW is via the VFO and buffer amplifier cathodes; the other RF valves are biased beyond cut-off. When zero-beating the TX with incoming signals, the exciter stages only may be run without the final amplifier being switched on.
- Provision has been made for remote control operation.
- VFO slow-motion drive is very smooth and back-lash free. ● VFO or Crystal control.
- Covers all Amateur bands up to 30 Mc/s. phone or CW **£78.10.0**



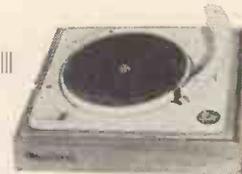
HI-FI F.M. TUNER

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

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

MATCHED HI-FI STEREO KIT

4-speed Transcription Record Player Model RP-1U **£12 10 0**
6 w. Hi-Fi Amplifier, Model S-33..... **£11 8 0**
Twin Stereo Speaker Systems Model SSU-1... **£20 11 0**
Total cost if purchased separately..... **£44 9 0**
YOURS for **£42/10/-** if all ordered together or **£8/8/-** deposit and 9 monthly payments of **£4/3/-**. Pedestal speaker legs **£2/14/-** optional extra.



TRANSCRIPTION RECORD PLAYER Model RP-1U

With 4-speed A.C. motor unit and Stereo-phonetic Pick-up completely assembled on plinth. **High performance at low cost.** This attractive Transcription Record Player incorporates many new features which make it suitable for all types of recordings on discs. It has the new Collaro RP.594 unit with the Ronette Stereo Pick-up and gives excellent results on stereo or mono (33, 45 L.P. or 78 r.p.m.) **£12.10.0** gramophone records.



COTSWOLD SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 x 23 x 15 in. and houses a special 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, Tygan grille cloth, etc. Left "in the white" for finish to personal taste, all parts are pre-cut and drilled for ease of **£19.18.6** assembly.



HI-FI SPEAKER SYSTEM KIT Model SSU-1

Ducted-port bass reflex cabinet, "in the white." Frequency response to 40-16,000 c/s. Power rating 25 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies. **£10.5.6** With legs **£11/12/6**

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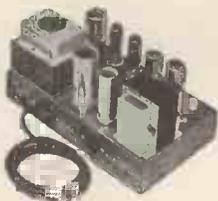
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HI-FI SINGLE CHANNEL AMPLIFIER KIT Model MA-12

A compact high fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereophonic system. Other applications include sound reinforcing systems, transmitter modulators, for use with tape recorders, also as a general purpose laboratory amplifier. **£9.19.6**

TAPE DECKS now available as "packaged deals" with other equipment.

Details on request.



AUDIO SIGNAL GENERATOR KIT Model AG-9U

10 c/s. to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's..... **£19.3.0**

AUDIO VALVE MILLIVOLTMETER KIT Model AV-3U

Very sensitive. High stability. 1 mV. to 300 V. A.C. 10 c/s to 400 kc/s. **£13.18.6**

Our Technical Consultation and Service Departments are always ready to help in the unlikely event of your experiencing any difficulty.



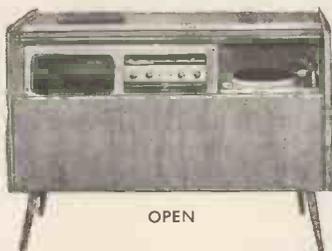
CAPACITANCE METER KIT Model CM-1U

This Direct-Reading Capacitance Meter is a very low priced, time-saving instrument which is so useful that it should be part of the general equipment of every electronic laboratory and production line. Easily built in a few hours. 0-100 μF , 0-1,000 μF , 0-0.01 μF , 0-0.1 μF . The meter has 4 1/2 in. scale and can be used by an unskilled operator after a few minutes' instruction. **£14.10.0**

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

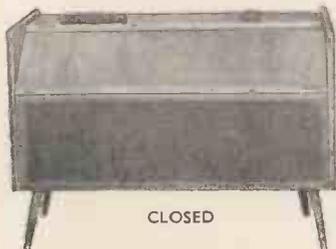
GLOUCESTER

STEREO CABINET KIT



OPEN

Specially developed to meet the varying needs of different homes. It will house Tape Deck and/or Record Player, F.M. Tuner and Stereo Amplifier. In addition, for the convenience of those to whom space is an overriding consideration, it is possible to house speaker systems at each end. For this purpose a loudspeaker kit, comprising two 4in. plus 8in. speaker systems, balance unit, speaker grille, cutting template, padsaw and mounting details is also available. Neutral hardwoods have carefully been selected so that the finished product can be stained and polished to individual choice. There is storage space for records, etc., also for power amplifiers. Dimensions: length 46 1/2", height 30", depth 21".



CLOSED

Mk. I for Tape Deck or Record Player **£15 18 6**
Mk. II for both T/D and R/P..... **£17 8 6**

We are also showing at the

'DO-IT-YOURSELF' EXHIBITION

Stand **97**

OLYMPIA

SEPT. 8th-23rd

STEREO-HEAD BOOSTER KIT Model USP-1



Hi-Fi Stereo Pre-Amplifier for low-output Hi-Fi P.U.s. Input 2 mV. to 20 mV. Output adjustable from 20 mV. to 2 V. 40-20,000 c/s. Also suitable as low-noise R.C.-Coupled high-gain monaural amplifier. **£5.19.6**



FREE ON REQUEST

A copy of our NEW (British) Heathkit Catalogue. Prices include free delivery in U.K.



To receive full details tick the kits which interest you.

S-88	Hi-Fi Stereo Amplifier
S-33	6-Watts Stereo Amplifier
UXR-1	Transistor Portable
DX-40U	"Ham" Transmitter
O-12U	5in. Oscilloscope
V-7A	Valve Voltmeter
SSU-1	Hi-Fi Speaker System
AG-9U	Audio Signal Generator
C-3U	Resistance-Capacitance Bridge
VF-1U	Variable Frequency Oscillator
USP-1	Stereo-Head Booster
USC-1	Stereo Control Unit
OS-1	2 1/2 in. Service Oscilloscope
B-1U	Balun Coil Unit
DC-1U	Decade Capacitor
MGP-1	Power Supply Unit
UJR-1	Dual-Wave Transistor Radio
S-3U	Electronic Switch
309-CU	R.F. Probe
DX-100U	Amateur Transmitter
—	Matched Hi-Fi Stereo
RP-1U	Transcription Record Player
—	Gloucester Stereo Cabinet
—	Cotswold Speaker System
—	"Chepstow" Equipment Cabinet
—	Hi-Fi F.M. Tuner
CM-1U	Capacitance Meter
MA-12	Hi-Fi Single Channel Amplifier
MM-1U	Multimeter Kit
—	Tape Deck "Packaged deals"
AW-1U	Audio Wattmeter
AV-3U	Audio Valve Millivoltmeter

NAME..... (Block Capitals)

ADDRESS.....

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DAYSTROM LTD.

DEPT. W.W.9, GLOUCESTER, ENGLAND

THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

BRENNELL BULLETIN

NEW HYSTERESIS SYNCHRONOUS MAIN MOTOR



3 STAR

When equipment enjoys a very high reputation among enthusiasts and professional users (as Brenell's does) the manufacturers are rightly expected to provide developments in keeping with that status. Sometimes the advance must even outdate existing standards.

Here is a development of that kind.

As of now, every Brenell tape deck and complete recorder will incorporate a new type of extremely high quality main motor.

An HYSTERESIS SYNCHRONOUS MOTOR with a balanced outer rotor and a heavy, statically and dynamically balanced flywheel. This brings 'wow and flutter' down to below .1% at $7\frac{1}{2}$ i.p.s. and adds to the already superlative qualities of Brenell equipment.



MK. 5

3 STAR
R/P STEREO

At the recent British Exhibition in New York, this feature aroused special interest. We demonstrated also, a piano recording at $1\frac{7}{8}$ i.p.s. We do not suggest that this should be indicative of standard practice, but its quality showed the remarkable extent of our products' capabilities.

Similar demonstrations will be given at the Radio Show.

Visit the BRENNELL DEMONSTRATION ROOM NO. 311, in the Audio Section, and see and hear for yourself just how good tape recording and reproduction can be.

3 STAR 58 GNS. | Mk. 5: 64 GNS. | 3 STAR R/P STEREO: 89 GNS.

Brenell

Sole manufacturers

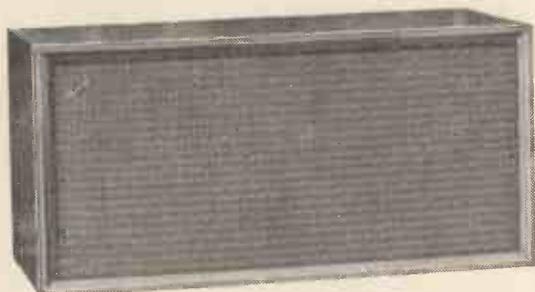
**BRENNELL
ENGINEERING
CO. LTD.**

1A Doughty Street, London, W.C.1.

Chancery 5809 and HOLBORN 7538

Wharfedale

REGISTERED TRADE MARK



SIZE 24 x 12 x 12in.
 WEIGHT 17lb. Cabinet only.
 Choice of Walnut, Oak or
 Mahogany veneers.
 PRICE £10/10/- tax free or
 £7/10/- in whitewood.

MODEL PST/8

This small enclosure is ideal where space is limited. It is constructed from extended polystyrene panels giving reduction of panel resonance and is designed to house a single 8in. unit.

The PST/8 is suitable for mono or stereo use and may be stood on a table or on the floor.

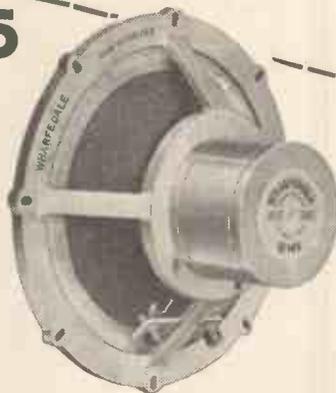
Recommended Units:

Super 8/FS/AL	£6 19 11	(inc. P.T.)
8/145	£6 19 11	(inc. P.T.)
8in. Bronze/FS/AL	£4 6 7	(inc. P.T.)

All available 12/15 ohms or 2/3 ohms.

8/145

A high-quality 8in. unit specially developed for use in column enclosures. The 8/145 is fitted with foam surround, aluminium voice coil and centre dome for optimum treble response.



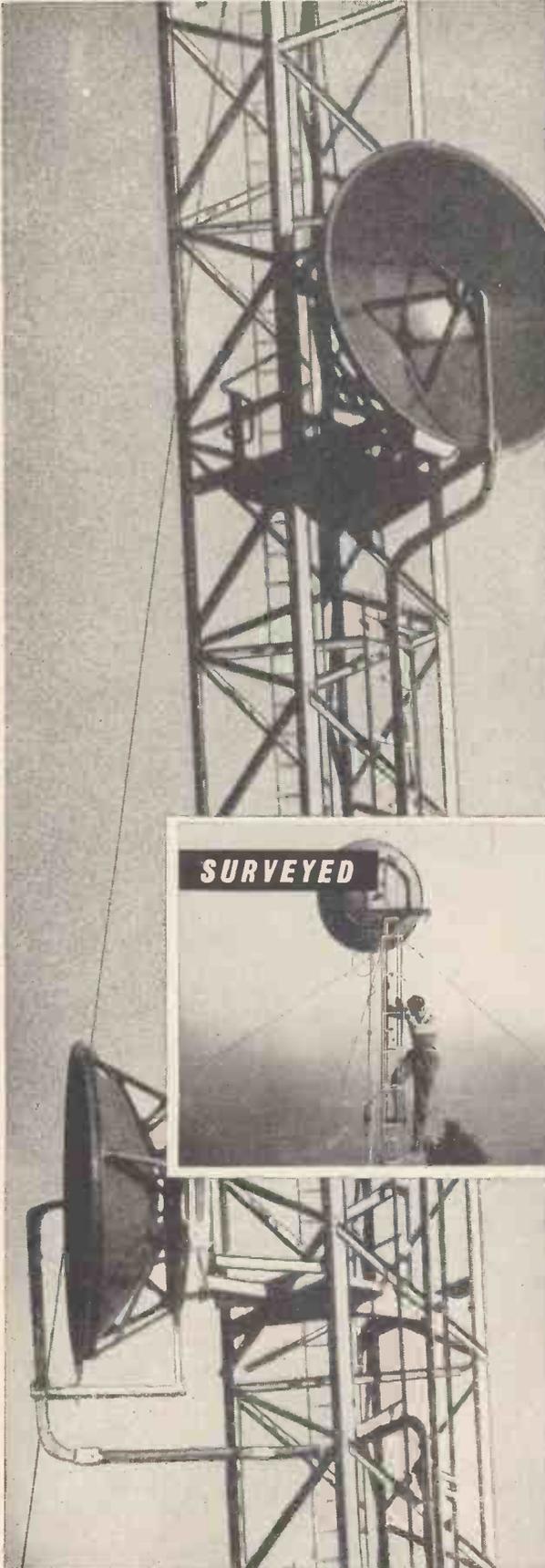
IMPEDANCE 2/3 ohms or 12/15 ohms
BASS RESONANCE 55/65 c/s.
FLUX DENSITY 14,500 gauss
TOTAL FLUX 60,000 maxwells
 On 1in. dia. centre pole
MAX INPUT 4 watts rms (8 watts peak)
 rated up to 10 watts rms in suitable enclosure.
PRICE £6. 19. 11 (Inc. P.T.)

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Illustrated leaflets and constructional details of suitable enclosures free on request.

Telephone: Idle 1235/6. Telegrams: 'Wharfdel,' Idle, Bradford.



MARCONI microwave communication systems



WORLD LEADERS IN
ALL TRAVELLING WAVE TUBE
MICROWAVE SYSTEMS

HIGH PERFORMANCE

Marconi microwave systems, with capacities from 60 to 960 channels and capable of carrying high quality television, are designed to meet exacting international standards of performance with margins in hand.

EXTREME SIMPLICITY

Travelling wave tube techniques ensure extremely simple circuitry and make full use of high gain and great band width available. A unidirectional repeater consists of only three travelling wave tube amplifiers and one frequency change oscillator with their power supplies.

GREAT RELIABILITY

The use of travelling wave tubes in the repeaters has allowed considerable reduction in the number of valves and components used. Thus the likelihood of unexpected failure has been considerably reduced.

EASY MAINTENANCE

The design of the units ensures easy access to all parts of the equipment and the extensive use of printed circuitry allows speedy and accurate replacement of precision circuits by technician staff, without realignment of the equipment.

EXTREME SAFETY

All high voltages are fully interlocked.



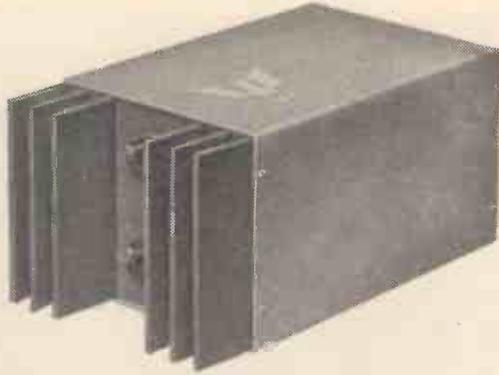
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more than 80 countries rely on*

MARCONI

COMMUNICATIONS SYSTEMS

*High Capacity
Mobile Microwave
Systems*





TRANSISTOR *Converters and Inverters*

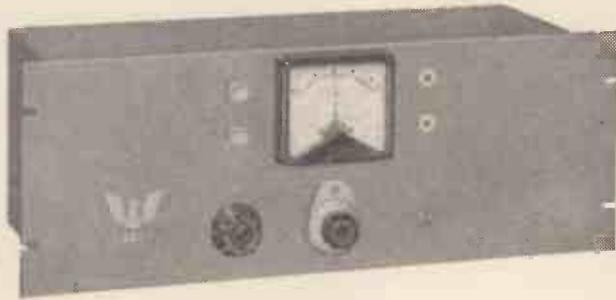
for fluorescent lighting and general applications. The range of operating voltages, powers and frequencies is under steady development.

Inverters for fluorescent lighting from 12 volt d.c. supplies cover the range from a single 6" tube to six 24" tubes or equivalent.

Inverters for 12v. d.c. to 50 c/s or 400 c/s a.c. up to 100 W.

Constant frequency and locked frequency inverters for camera and tape recorder operation.

Inverter-rectifier systems for d.c. to a.c. conversion.



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Magnetic amplifier intermediate stage, saturable reactor power stage. A temperature controller for use with a platinum resistance thermometer to provide power control up to 60 KW 3-phase. No mechanical switches. Constant current characteristic for platinum furnaces.

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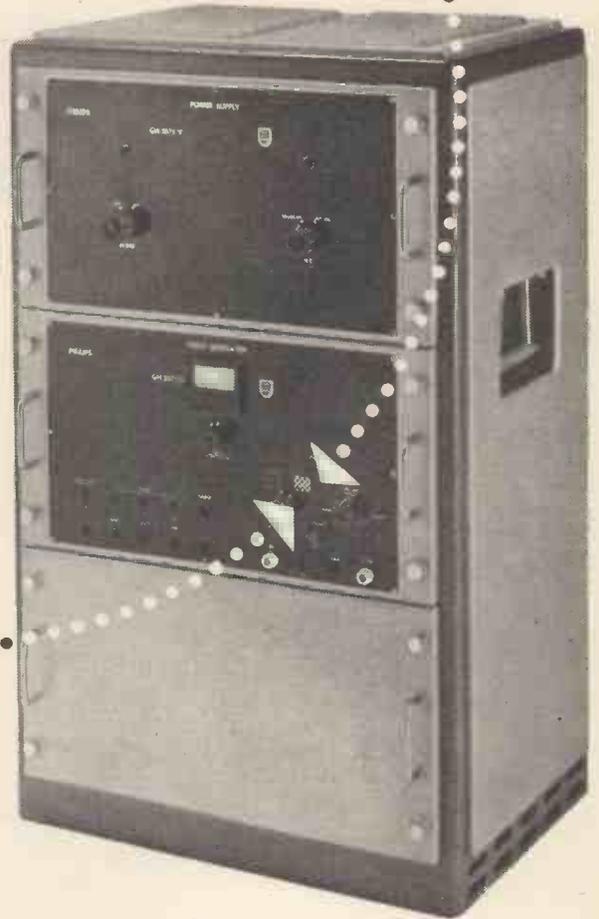
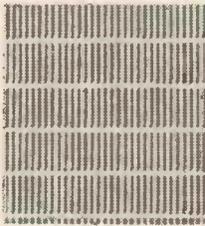
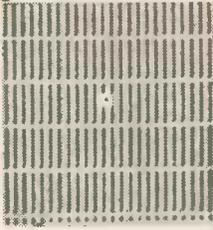
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Television



T.V. Pattern Generator
type GM 2671

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**VHF Television Generator
Type GM 2681**

generators



GM 2671

- Valuable tool for T.V. setmakers, development laboratories, T.V. stations, relay-transmitters etc.
- Fully complies with the C.C.I.R. 625 lines, F.C.C. 525 lines and French 819 lines specifications.
- Composite video pattern enables fast checking of picture geometry, linearity, ringing, overshoot, frequency characteristics, gamma etc.
- High accuracy and stability of waveforms by using binary dividers and delaylines.
- Checking of heater voltages and mains locking by means of a meter-instrument.
- Can also be supplied for 19" rack mounting.
- Suitable for all normal mains voltages (110 - 245 V).

TECHNICAL DATA

T.V. Systems CCIR 625 lines, 50 c/s
 FCC 525 lines, 60 c/s
 French 819 lines, 50 c/s

Master oscillator

Synchronisation by a crystal oscillator, mains comparison or external source.

Wave forms

The pulse timing, duration and rise times fully comply with the system specifications. The picture/sync ratio is adjustable around the standardized value.

Output

Video	Voltage	composite, 1 V _{p-p}
	Polarity	negative or positive (reversible)
	Impedance	75Ω

Auxiliary signals

total blanking	} Voltage 3 V _{p-p} Impedance 75Ω
total sync	
line sync	
frame sync	

External picture modulation

Voltage	1 V _{p-p}
Impedance	75Ω
Polarity	positive

GM 2681

- Suitable for the television bands I and III
- Can be used in connection with the Pattern Generator, type GM 2671 or separately
- Supplies picture and sound carriers separately or simultaneously, modulated or unmodulated
- Output voltages, modulation depth and sweep can be adjusted to standard specifications with the aid of the built-in voltmeter
- Suitable for all normal mains voltages (110-245 V)
- Available for incorporation in the GM 2671 rack, in separate casing or mounting in 19" rack (as below).

TECHNICAL DATA

TV System

Video modulation: negative
 Sound modulation: FM

Executions

CCIR 625 lines, 50 c/s,
 FCC 525 lines, 60 c/s or
 OIR 625 lines, 50 c/s system and special executions for Australia, Austria, Italy and New Zealand.

Output

Picture and sound carriers

Frequency up to 12 channels in band I and III, crystal controlled, accuracy 0.02%

Voltage,	
picture carrier	100 mV max.
sound carrier	30 mV max.
Attenuation	max. 80 dB, in steps of 4 and 20 dB
Accuracy	0.5 dB

Auxiliary oscillator

Frequency equal to the picture-sound distance
 Voltage ± V_{rms}
 Impedance 75Ω

Modulation

Video External

Voltage	1 V _{p-p}
Impedance	75Ω
Polarity	positive
Internal sound	1000 c/s
External sound	30 - 16,000 c/s
Voltage	1 V _{rms}
Impedance	600Ω



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A simple and logical
system of control



The Quad 22 Control Unit incorporates every practical refinement for the full appreciation and enjoyment of the discriminating listener. For instance . . .

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It is probably true that most bass and treble control systems—because of misuse—degrade quality more often than they improve it. Bass and treble controls should properly be designed for musical balance adjustment only, completely divorced from all filtering requirements and from all applications which can better be achieved by fixed networks.

Even so, bass and treble controls should be used sparingly with a proper reference to “cancel” to ensure optimum adjustment. With a very good loudspeaker it should seldom be possible to improve the balance professionally achieved at the transmitting studio.

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TRANSMITTING TETRODES

The ENGLISH ELECTRIC Type C.1112 has a maximum anode dissipation of 250W and is suitable for use as a power amplifier in transmitters up to 400W, or in R.F. heating equipment (up to 1 kW per valve). Type C.1108 is a smaller version designed for similar uses at lower power levels (anode dissipation 125W).



E.E.V. type	C.V. number	American equivalent	British equivalent
C.1108	2130	4-125A	QY3-125
C.1112	2131	4-250A	QY4-250

Full data relating to these valves will be sent on request

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Maximum Capacitance MFD	Working Voltage	Size (Diameter)	Size (Length)
50	6	1/4"	5/8"
40	6	3/16"	5/8"
12	3	1/8"	9/16"
2	6	1/10"	13/32"

WELDED WIRE TERMINATIONS—*Patent applied for*



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NATIONAL RADIO SHOW-1960

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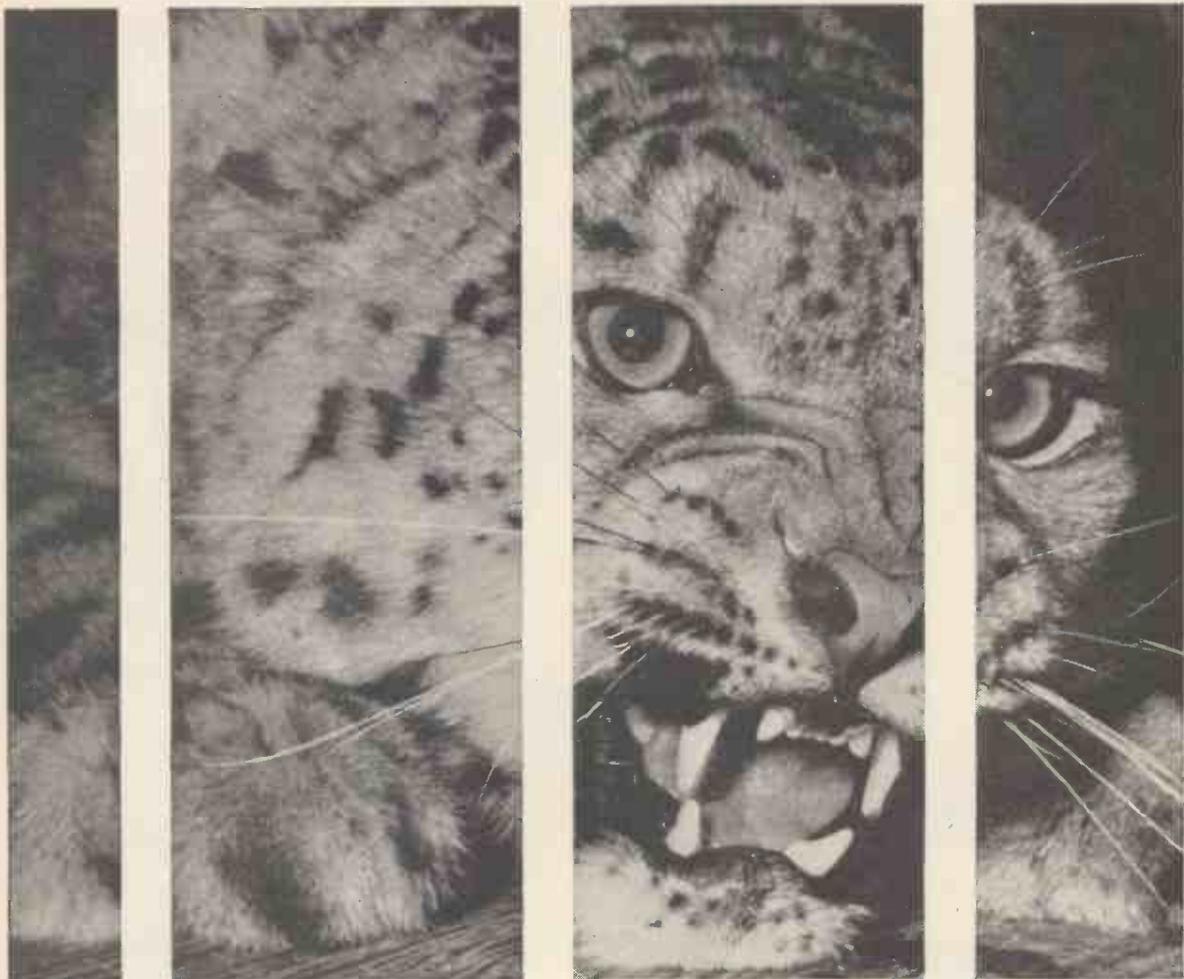
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The SCR96 silicon controlled rectifier is a three-junction semiconductor device developed and manufactured by G.E.C. for use in power control and power switching applications requiring blocking voltages up to 200V and load currents up to 10A. Series and parallel circuits may be used for higher power applications.

Type	Maximum Continuous P.I.V. (V)	Maximum Transient P.I.V. (5ms)* (V)	Maximum average current† (A)	Peak one-cycle surge current (A)	Maximum average gate power (W)	Average gate current to fire (mA)	Typical turn-on time‡ (μs)	Typical turn-off time‡ (μs)
SCR961	25	35	10	120	0.5	20	2	15
SCR962	50	75						
SCR963	100	150						
SCR964	150	225						
SCR965	200	300						

* For zero or negative gate voltages

† Depends on cooling system and conduction angle.

‡ Value depends on circuit.

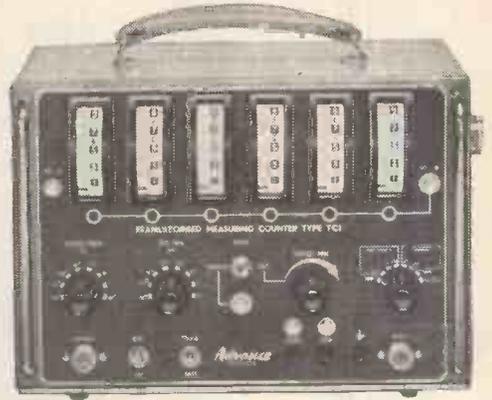


SEMICONDUCTORS

For full information please write (or in London area phone TEMple Bar 8000 Ext. 10) to:

THE GENERAL ELECTRIC CO. LTD., SEMICONDUCTOR DIVISION, SCHOOL STREET, HAZEL GROVE, STOCKPORT, CHESHIRE.

Advance TCI



1Mc/s TRANSISTORISED COUNTER

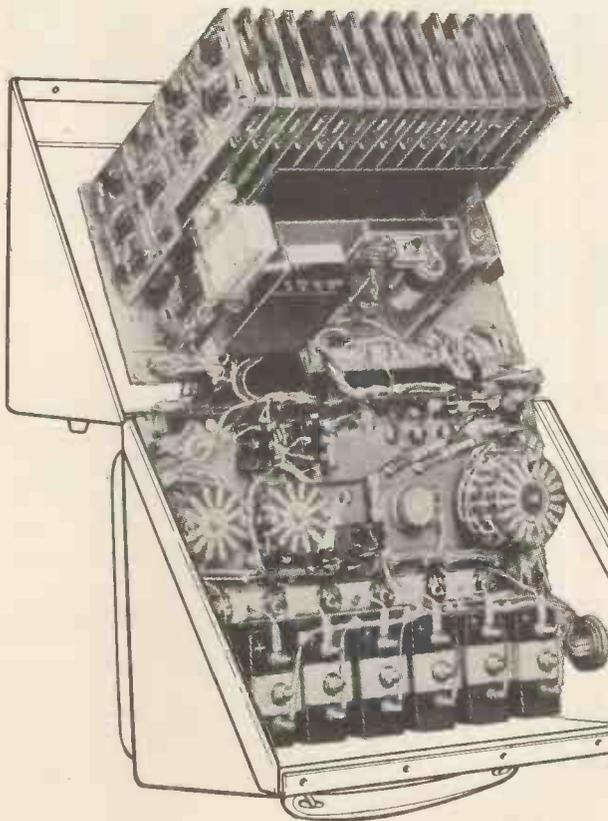


it's the inside that counts

... in this case up to 1 Mc/s. And the inside of the Advance time and frequency measuring counter type TCI is rather exceptional. Over 145 transistors and 21 printed circuit boards have been combined in an advanced design to provide the full facilities and high performance expected of a first grade laboratory instrument.

Nett Price in U.K. **£350**

Leaflet Y101 will be forwarded on request.



- | | |
|-----------------------------------|--|
| SIX FIGURE DISPLAY | accurate to ± 1 count |
| FREQUENCY MEASUREMENT | from 10 to 1,000,000 c/s |
| TIME MEASUREMENT | from 1 μ sec. to 2,777 hours |
| ★ PERIOD MEASUREMENT | 1 or 10 periods of input waveform down to 10 c/s |
| RANDOM COUNTING | totalling over any period |
| OUTPUT TIMING PULSES | from 10^{-1} to 10^6 p.p.s. |
| INTERNAL STANDARD | oven controlled 1 Mc/s crystal |
| STABILITY | ± 1 part in 10^6 at 25°C |
| SELF-CHECK FACILITIES | to internal crystal standard |
| FREQUENCY MEASURING PERIOD | 0.1, 1.0 or 10 seconds |
| REPETITION OF COUNT | manual or automatic |
| POWER CONSUMPTION | 3 W (battery), 14 VA (mains) |
| DIMENSIONS | length 12in., height 9in., depth 6in., weight 12 lb. |

★ **AND NOW—Virtually to d.c. with V.L.F. Converter type C.A.1.**

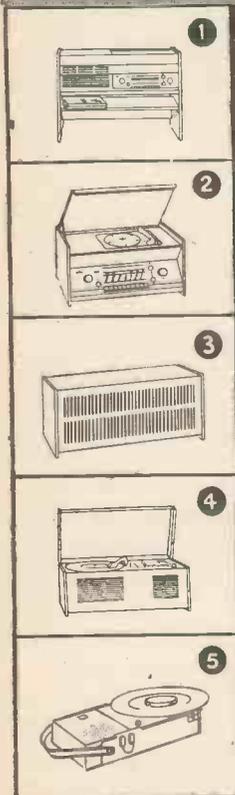
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INSTRUMENTS DIVISION

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1 Model PKG5 Radiogram, in natural sycamore

2 Model Atelier I, in sycamore and white

3 Loudspeaker LI, matching Atelier I

4 Model SK5 Table Radiogram, in sycamore and white with plastic lid

5 Model TPI Transistorised Battery Portable Radiogram

Model Atelier I. Table radiogram, with two LI Loudspeakers for monophonic or stereophonic reproduction of radio and record.

STYLED in beauty to delight your eyes and ears.

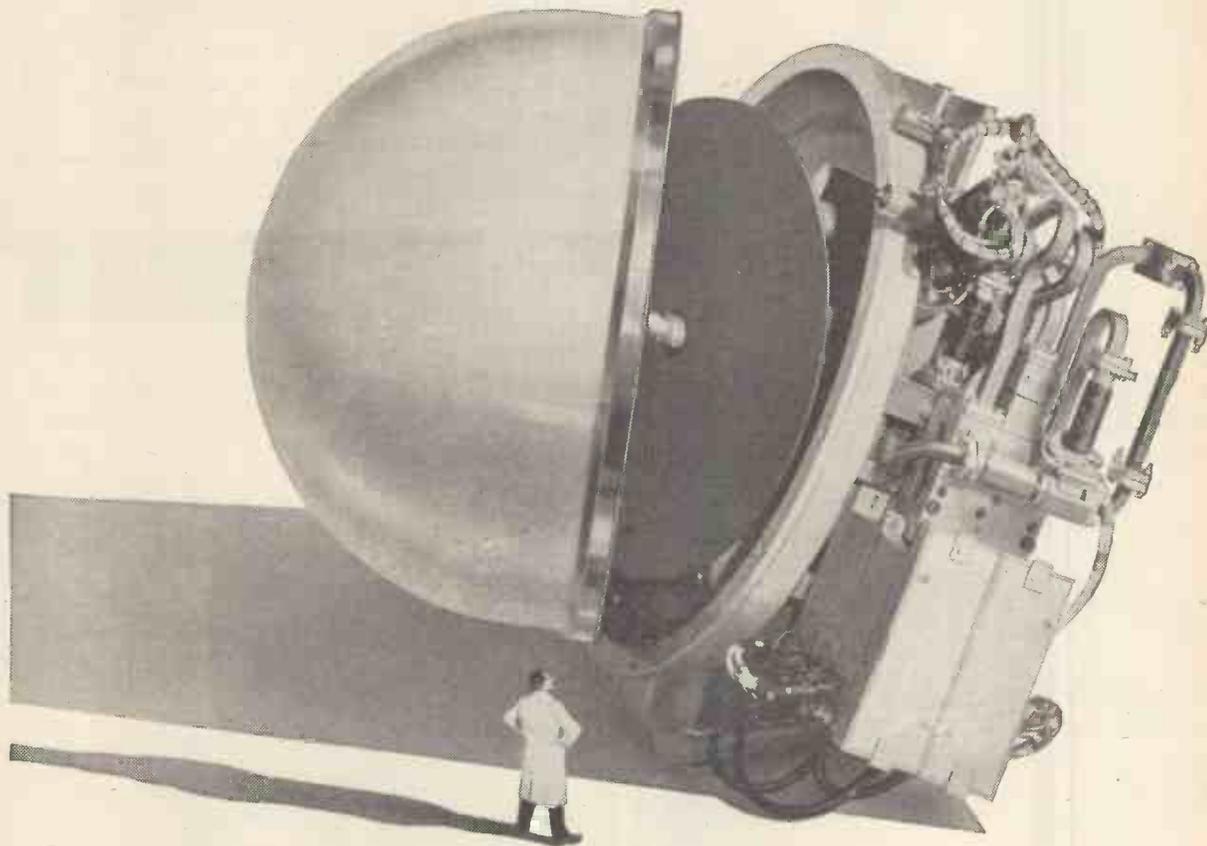
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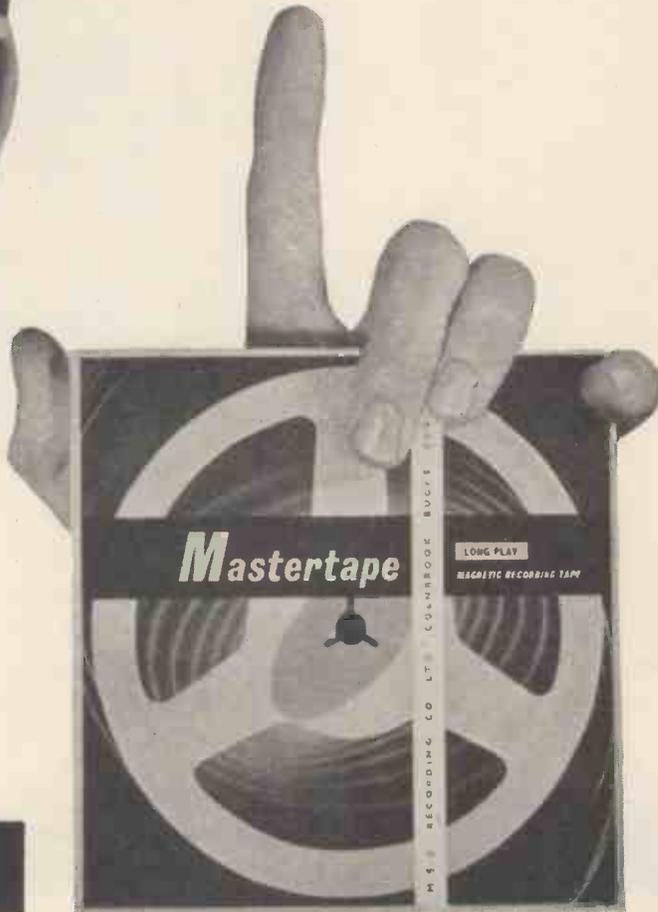
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3"	150	16 min	5 6	225	24 min	8 6	3"	300	32 min	10 6
4"	300	32 ..	10 6	450	50 ..	14 6	5"	1200	2 hr 8 ..	2 5 0
5"	600	1 hr 4 min	1 0 0	850	1 hr 31 min	1 8 0	5 1/2"	1700	3 .. 0 ..	2 17 6
5 1/2"	850	1 .. 31 ..	1 7 6	1200	2 .. 8 ..	1 15 0	7"	2400	4 .. 16 ..	4 0 0
7"	1200	2 .. 8 ..	1 15 0	1800	3 .. 12 ..	2 10 0	SUPERGRADE			
8 1/2"	1750	3 .. 6 ..	2 10 0	2400	4 .. 16 ..	3 10 0	7"	1200	2 hr 8 min	2 18 6

— naturally



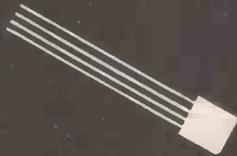
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ferrite driver transistor scaled down for ultra- compact equipments



OC123

The OC123 is a ferrite core driver transistor similar to the OC23, but scaled down into a small metal can for those applications where space saving is of cardinal importance—such as in closely packed printed circuit boards—and where the dissipation rating need not be so high as with the OC23.

The total dissipation rating of the comparatively small OC123 is, in fact, 200 mW at an ambient temperature of 45°C. The peak current is 1 amp, and the voltage rating and current gain are also high. Even at a collector current of 1 amp α' is 50 minimum.

The OC123 is particularly suitable for gating current pulses generated by its larger companion type OC23 for driving ferrite cores. In such an application, a 350mA 2 microsecond pulse with a leading edge rise time of 0.4 microsecond can be passed by the transistor when it is fully bottomed.

Abridged details are given below—for full data please write to Mullard House.

Mullard

industrial
semiconductors



V_{cb} max. ($I_e = 0$)	-50 V
V_{ce} max. ($V_{be} > +0.5V$)	-50 V
V_{ce} max. ($I_c = 0.5A$)	-25 V
i_c (pk) max.	1.0 A
I_c (av) max. (averaging time 20 ms)	0.5 A
P_{tot} at 45°C ambient	200 mW
T_j max.	90°C
Junction temp. rise above ambient in free air	0.22°C/W
Junction temp. rise above case	0.06°C/W
V_c (knee) ($I_c = 400$ mA)	-350mV
f_1 ($V_c = -2V, I_c = 100$ mA, $T_j = 25^\circ C$)	1.5Mc/s

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THE MAGAZINE TAPE DECK.

Designed by Garrard to bring quality tape recording and playing within the range of everyone. Controls reduced to an absolute minimum plus magazine loading—anyone can operate this deck. No threading, anchoring or spilling of tape. All the pleasures of tape recording without the headaches.

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The perfect product of combined design and engineering achievement. A brand new model to meet the demand for a Transcription Record Player with provision for automatic use if desired. Perfect playing from both stereo and monophonic records. This is a unit for the enthusiast.



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Measure dc currents 0.3 ma to 1 ampere with

No Breaking of Leads

No DC Connection

No Circuit Loading

HEWLETT PACKARD

428^A Clip-on

Milliammeter



Think of the measuring convenience, time saved and accuracy gained when you don't have to break into a circuit, solder on a connection or worry about probe loading.

With the new -hp- 428A Milliammeter and its new probe, you literally "clamp around" and read! You get maximum accuracy because there is no effective circuit loading from the 428A's dc probe. The instrument easily measures dc currents in the presence of ac. And insulation is more than adequate to ensure safe measurements at all normal voltage levels.

SPECIFICATIONS

Current Range: Less than 0.3 ma to 1 amp, 6 ranges. Full scale readings from 3 ma to 1 amp; 3 ma, 10 ma, 30 ma, 100 ma, 300 ma, 1 amp.

Accuracy: $\pm 3\% \pm 0.1$ ma despite line voltage variations of $\pm 10\%$, probe closure, ageing or Earth's magnetic field.

Probe Inductance: Less than 0.5 μ h maximum.

Probe Induced Voltage: Less than 15 mv peak.

Effects of ac in circuit: Ac with peak value less than full scale affects accuracy less than 2% at frequencies different from the carrier (40 KC) and its harmonics.

Power: 115/230v $\pm 10\%$, 70 watts.

Size: Cabinet mount, 7½ in. wide, 11½ in. high, 14¼ in. deep. Weight 19 pounds. Rack mount 19 in. wide, 7 in. high, 12½ in. deep. Weight 24 pounds.

Probe Tip Size: Approximately ⅝ in. x ⅞ in. Wire aperture diameter ⅞ in.

Price: delivered U.K. and exclusive of duty where payable.

£195 (cabinet mount)

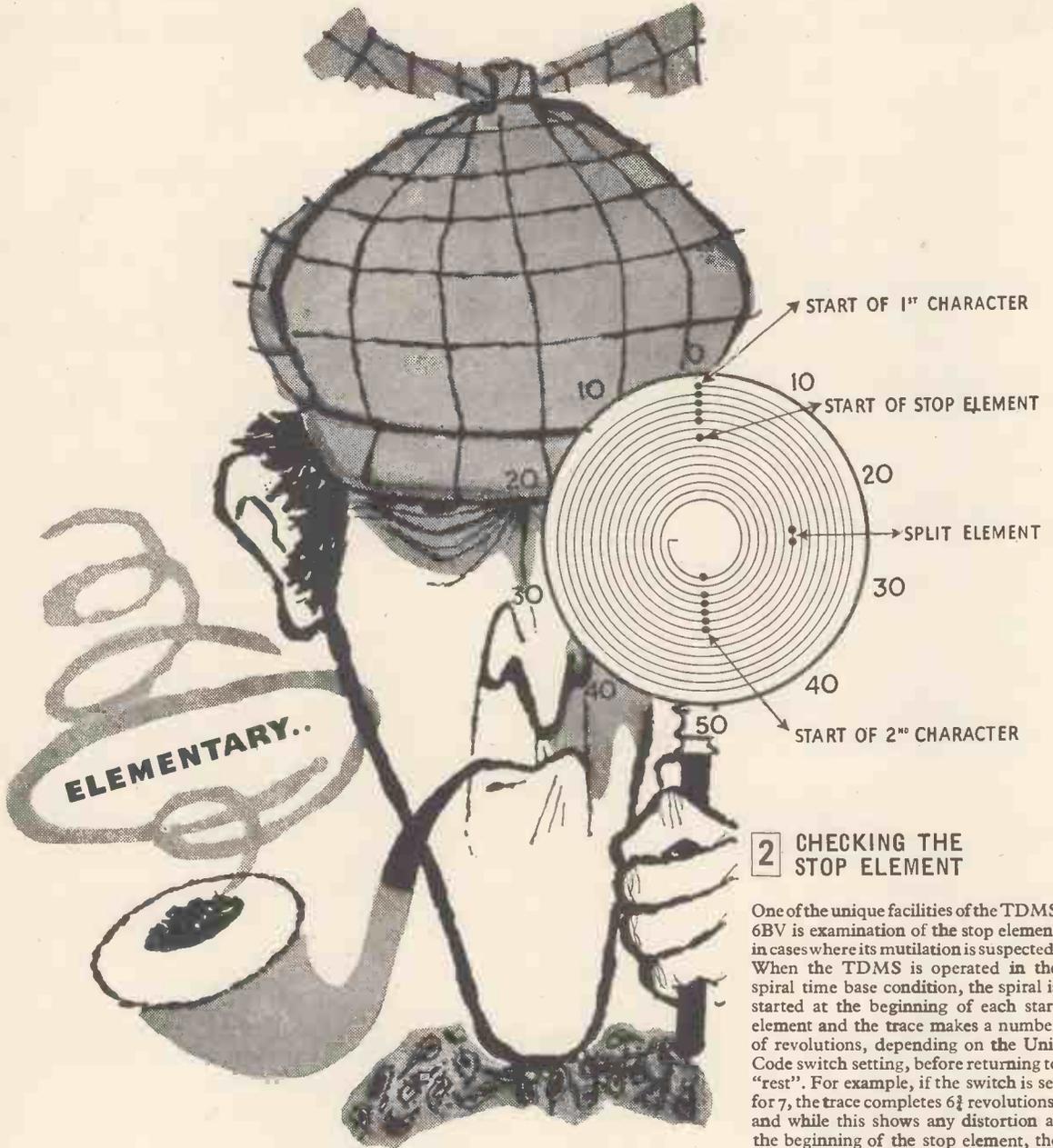
£197 (rack mount)

Continuous progress in design may affect the above specification which is therefore subject to change without notice.



LIVINGSTON LABORATORIES LTD.

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2 CHECKING THE STOP ELEMENT

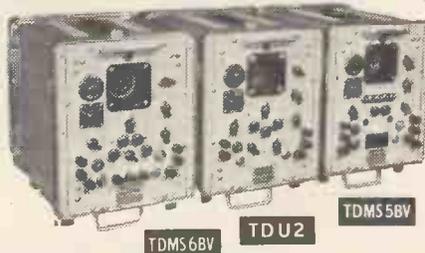
One of the unique facilities of the TDMS 6BV is examination of the stop element in cases where its mutilation is suspected. When the TDMS is operated in the spiral time base condition, the spiral is started at the beginning of each start element and the trace makes a number of revolutions, depending on the Unit Code switch setting, before returning to "rest". For example, if the switch is set for 7, the trace completes $6\frac{1}{2}$ revolutions, and while this shows any distortion at the beginning of the stop element, the duration of this element is not shown.

If the switch is set for 14, in examining a $7\frac{1}{2}$ unit code signal, two complete characters appear on the trace, one at zero and the other at 50%, or displaced by a percentage indicating the amount of stop element distortion. For a 7 unit code signal the characters appear under each other at zero, separated by the stop element length; for a 7.42 unit code signal the second character appears at 42%. Each alternate stop element length is thus shown for examination and any defect in the telegraph or transmission path, affecting the stop element, made apparent. The example above shows a 50 baud $7\frac{1}{2}$ unit signal, for the letter S, displayed against a 14 count. Here the stop element length is correct ($1\frac{1}{2}$ revs., $20 + 10 = 30$ ms) but the TDMS shows a split stop element, possibly due to a faulty transmitter.

The Transmitter TDMS 5BV — Provides telegraph test signals with or without distortion.

The Receiver TDMS 6BV — Enables a telegraph circuit to be monitored without interruption. The signal can be displayed against a circular or spiral time-base, each characteristic instant of modulation being shown as a bright dot on the screen.

The Telegraph Signal Display Unit TDU2 — A specialized oscilloscope, having a linear time-base of good short term stability and long term accuracy, for examination of the d.c. telegraph wave form against a continuous start/stop time-base. Valuable features of the instrument are an X shift calibrated in terms of code element transitions and an X expansion control.



Speed Ranges. The standard models cover the speed ranges 40-60, 60-80, 80-100, 160-180, and 180-200 bauds. Other ranges within the limits 20-200 bauds can be provided to special order.

AUTOMATIC TELEPHONE AND ELECTRIC CO. LIMITED
STROWGER HOUSE, ARUNDEL STREET, LONDON, W.C.2



from AIRPORTS

to ZYMURGISTS

Multitone leads in pocket staff location



By far the largest number of hospital and industrial installations of the pocket receiver type in this country, and overseas, are Multitone. Our selective induction system "Personal Call" is saving time, money and worry in well over 100 different types of industrial concerns from airports to zymurgists. (We are looking for a Quill Manufacturer to complete the alphabet.)

The New **MULTI-CHANNEL** equipment provides over 400 individual channels using the new flat receiver (as illustrated)

THE MULTITONE

personal call

system of staff location

Additional Facilities

ELECTRONIC TRUNCHEON

The Electronic Truncheon is no bigger than standard equipment carried by guards and serves the same purpose, but inside there is a transmitter which, when the button is pressed, sends out a signal. This is picked up by the loop of wire around the area to be protected. The pulse is used to operate a small receiver, which automatically switches on any form of electrical alarm. It can be operated from any point in the area.

INTERNAL TRANSPORT COMMUNICATION

The Multitone "Personal Call" loudspeaker-receiver has been designed to solve the problem of conveying verbal instructions to transport vehicles used for handling loads inside a given area. Messages can be conveyed to all or selected vehicles from the central transmitter.

MULTITONE INDUCTION SYSTEMS CAN SOLVE YOUR STAFF LOCATION PROBLEMS:

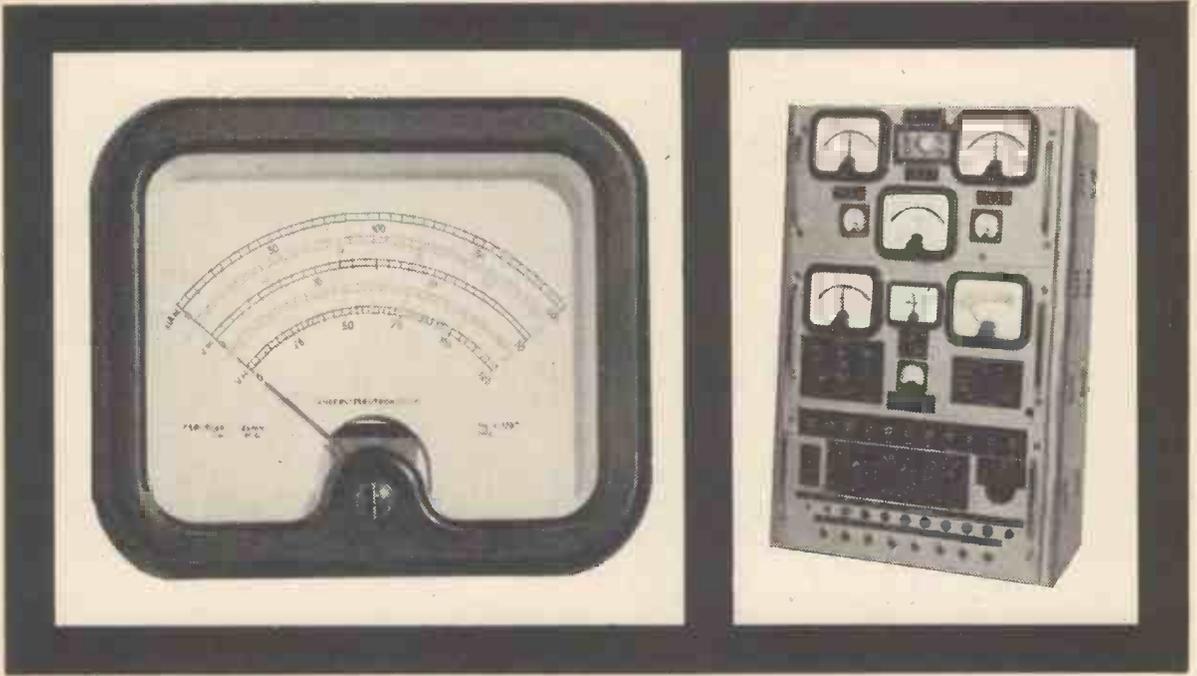
- ★ Equally suitable for large and small areas or concerns
- ★ Low rental terms
- ★ Virtually no internal wiring

(the 'peep-peep' in the pocket), the only staff location system worth installing

Write or 'phone for further particulars. We can be found in 10 seconds.

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seven-range meter, including V, mV, μ A, made for Elliott's at short notice

This seven-range meter, using Ernest Turner Model 605 was calibrated with special ranges by Anders at short notice for Elliott Brothers Ltd for the special-purpose test gear shown above. All the meters in this complex installation were supplied by Anders, who have the pleasure of carrying out similar work for a number of famous manufacturers. Anders are indebted to Elliott Brothers for kind permission to illustrate this equipment.

The Anders Instrument Centre commands the largest stocks of meters in the country, unique calibrating facilities, and detailed knowledge of metering problems. Most standard meters are supplied immediately. Non-standard meters of all kinds, shapes and sizes, for special voltage and current ranges, are accurately calibrated, tested and normally ready within 10-14 days. Makes include Avo, Crompton Parkinson, EAC, Elliott, Pullin, Taylor, Turner, Weir, Weston. Types include moving coil, moving iron, thermocouples, electrostatic, dynamometers, from 1½" to large switchboard instruments, and complete range of accessories. Please write or 'phone for details of the Anders meter service.

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Proxford Control Valve

Steam Pressure
10 lb/in² MAX.

Bellows $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{8} \text{ R/b} \times .005 \text{ wall}$
5 conv. (4 $\frac{1}{2}$ active)
Spring rate = $\frac{129}{4.5} = 28.5 \text{ lb/in}$

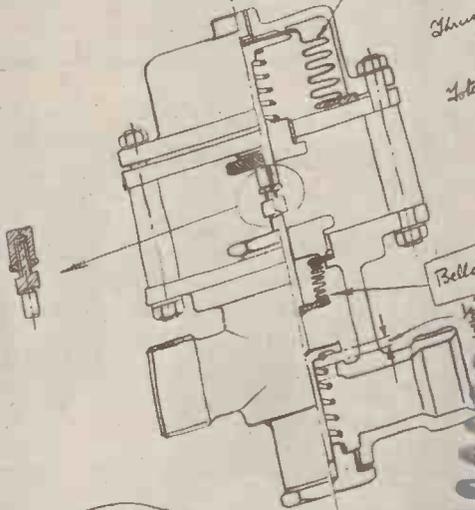
Thrust on bellows =
 $10 \frac{\text{lb}}{\text{in}^2} \times 2.25 \text{ in}^2 = 22.5 \text{ lb}$

Total spring rate of system (approx)
 $= \frac{22.5}{\frac{1}{8}} = 179.2 \frac{\text{lb}}{\text{in}}$

Bellows $3\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{8} \text{ R/b} \times .005 \text{ wall}$
7 conv. (6 active)
Spring rate = $\frac{46.5}{6} = 7.75 \text{ lb/in}$

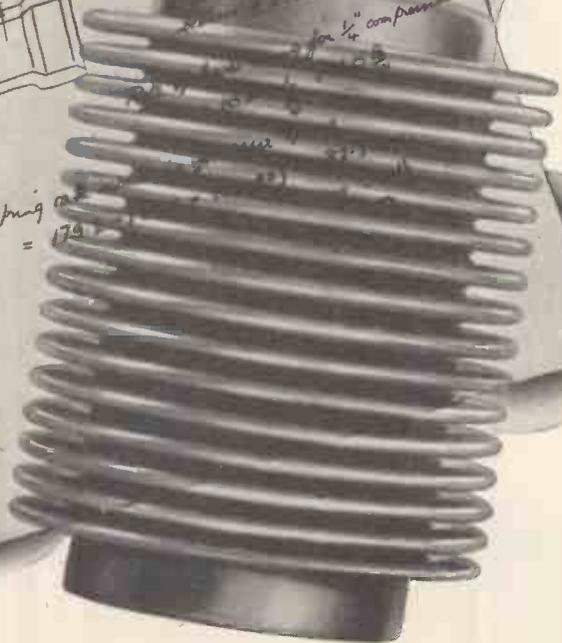
per
con. face gland
 $30 \times \frac{1}{8} = 9.75 \text{ lb.}$

for $\frac{1}{4}$ compression



$\frac{22.5}{\frac{1}{8}} = 179.2$
 $\frac{78}{4.5} = 17.3$
 $\frac{146.5}{92.7}$

Spring rate = 179



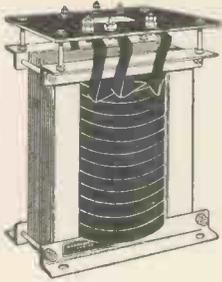
*design
with
bellows*

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DRAYTON REGULATOR & INSTRUMENT CO. LTD.
West Drayton, Middlesex. West Drayton 4012



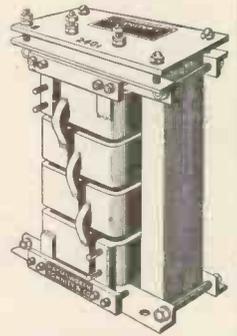
TRANSFORMERS



5 V	80 A	... £8
4 V	100 A	... £8
60 V	7 A	... £8
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
110 V centre tapped	25 A	... £28
6-12-18-24-30 V	12 A	... £11

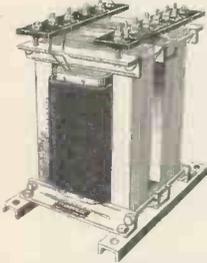
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2 V	10,000 A £98
3.5 V	20,000 A £127
2 V	30,000 A £130
10 V	2,000 A £103
10 V	1,000 A £59
10 V	900 A £55
10 V	500 A £38
10 V	300 A £28
20 V	800 A £80
20 V	3,000 A £150
5 V	1,000 A £39
22 V	1,000 A £90



TRANSDUCTORS

SATURABLE REACTORS



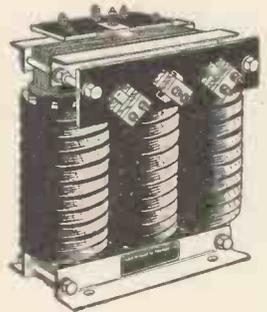
Saturable Reactors for controlling AC loads from .5kVA to 300kVA. Available for all standard AC supply voltages, single-phase and 3-phase. Standard DC control volts: 12, 24, 36, 110 and 240 V.

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Input 400/440 V.

40 V	50 A 3-phase	£40
230 V	50 A 3-phase	£78
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4 V	5,000 A 3-phase	£130

These and other Transformers can be supplied for 3-phase, 6-phase and 12-phase Rectifiers.



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30 A	£39	£50
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For 240 V AC. The larger outputs are available for 3-phase supply. Full load DC Volts and Amps are stated. Prices are without Meters and Regulators.

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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	220 V	130 mA £15
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24 V	30 A £33	250 V	10 A £70
24 V	60 A £41	250 V	15 A £89
24 V	105 A £70	250 V	20 A £110
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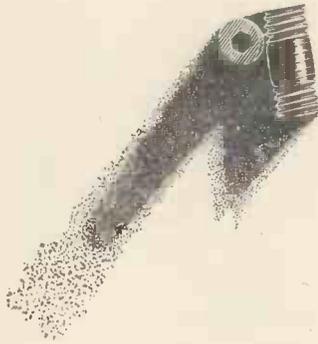
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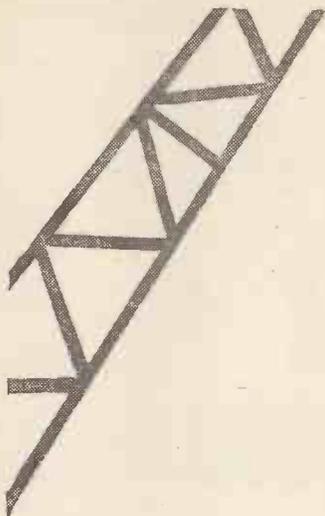
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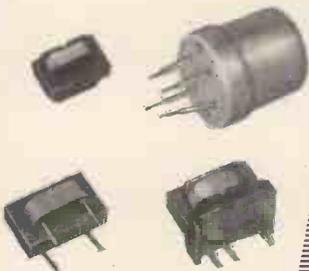
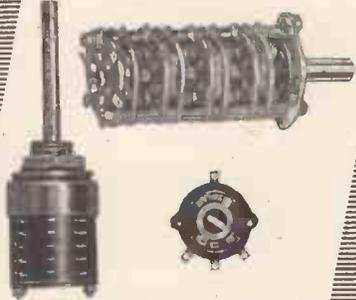
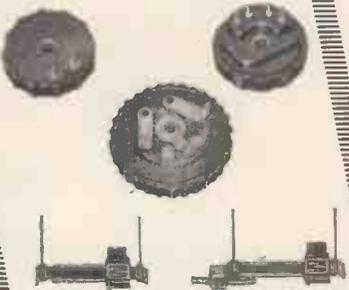
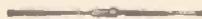


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(100 MC/S TO 220 MC/S)

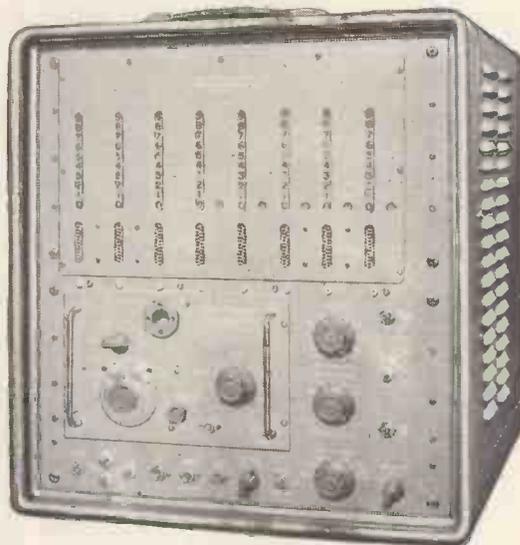
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OSCILLATOR — 1 PART IN 10^7 PER WEEK

BRIEF SPECIFICATION

High-speed counter/timer with built-in precision frequency standard. Stability: ± 2 parts in 10^7 short term. Readout by neon indicators on 8-decade digital display. Counts up to 10^7 per sec; measures frequency from 10 c/s to 10 Mc/s, period of waveforms up to 100 kc/s. Selection of plug-in accessories extends frequency range to 220 Mc/s, allows time measurement down to 1 μ sec, increases sensitivity to 10 mV. Display time: manual, μ or continuously variable from 0.1 to 10 sec. with automatic and repetitive resetting.

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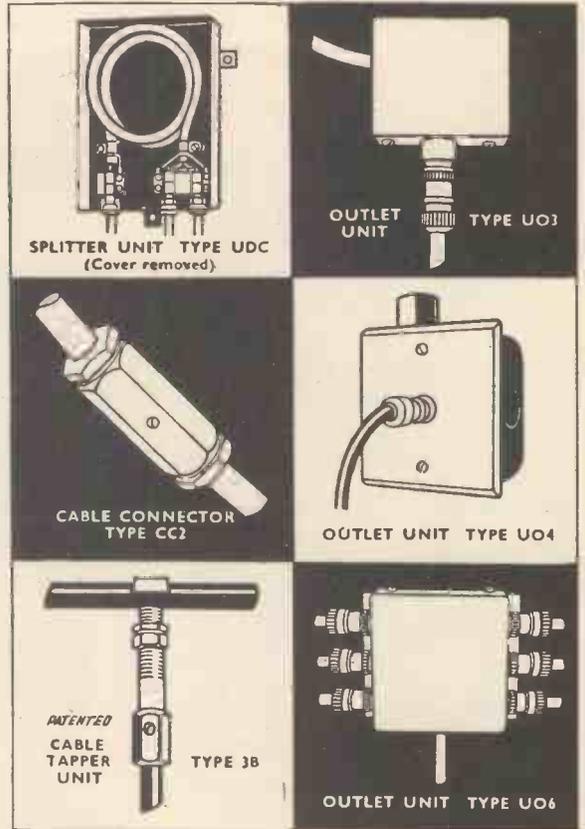
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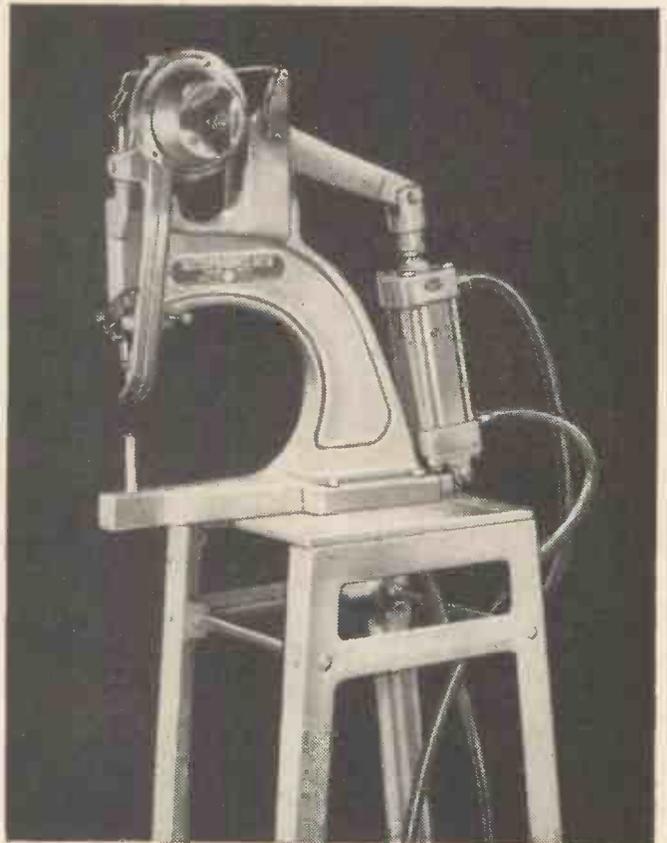
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We manufacture a large range of hand and automatic Eyeletting and Piercing Machines and also stock eyelets which we can supply in small or large quantities. Full illustrated brochure of the "Phoenix" machines, write for leaflet W.W.2.

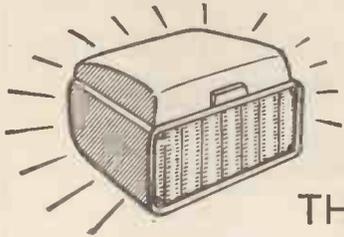
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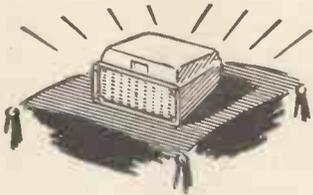
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7in. spools. 10 watts output. Records/Replays both directions. Twin speakers. Response 30-17,000 c/s.

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- "5-10" Amplifier Chassis, base, screen and screws 19 6
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- 20 Watt Amplifier Chassis, base, transformer covers, transformer adaptation plate and screws 68 6
- 20 Watt Pre-Amplifier Chassis..... 25 0
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- Mullard Tape Recorder, type "B" amplifier chassis 31 6
- Mullard Tape Recorder, type "C" and new type "C" amplifier chassis..... 32 6
- Mullard Tape Recorder, power pack chassis 11 6
- 7 Watt Stereophonic Amplifier Chassis, printed front panel and screws..... 24 6
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- Mullard 7 Watt D.C./A.C. Amplifier Chassis with Paxolin and bracket..... 20 0

Note: Transformer holes are not drilled in the above chassis excepting for the 20-watt amplifier.

MULLARD FRONT PANELS

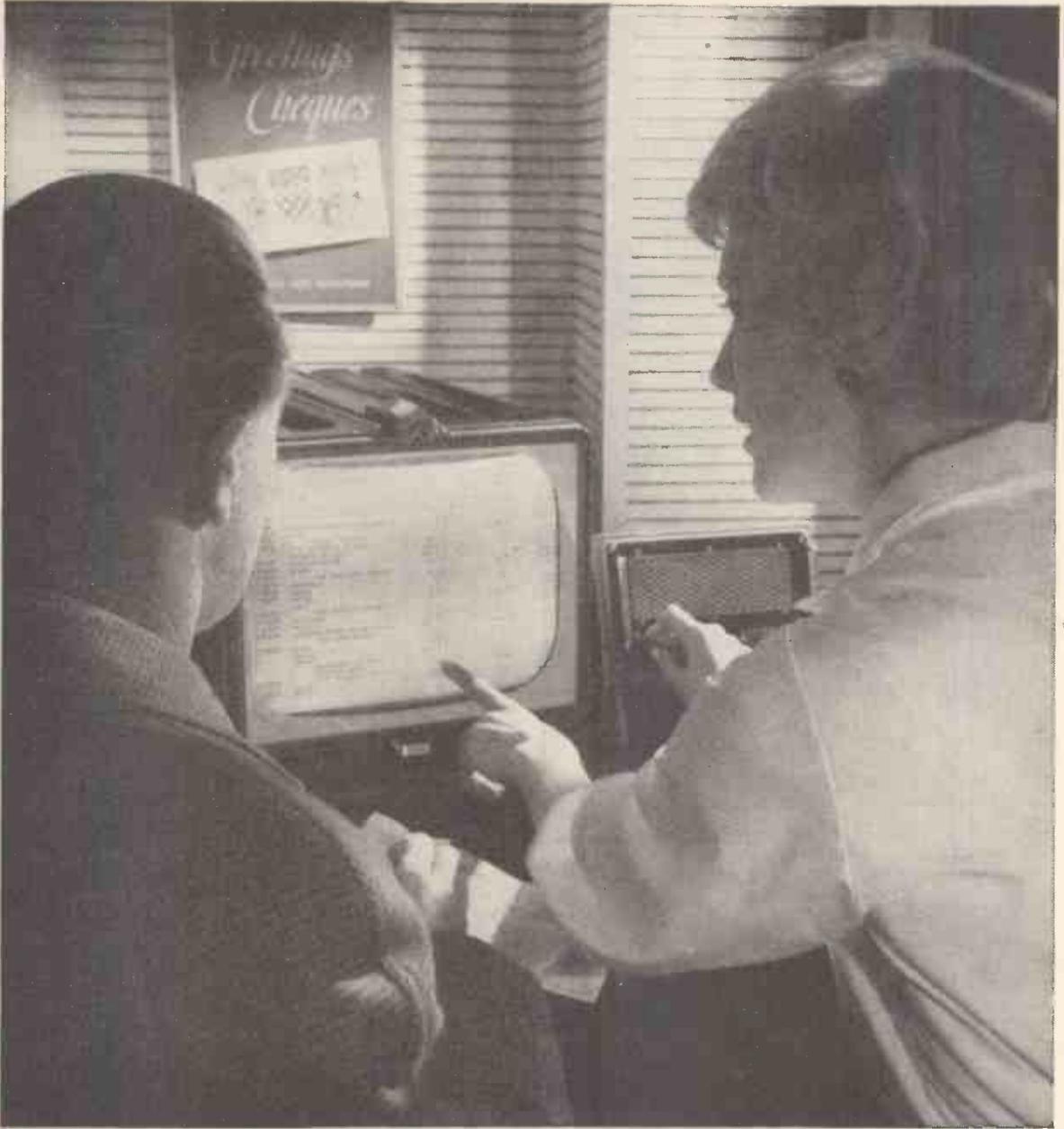
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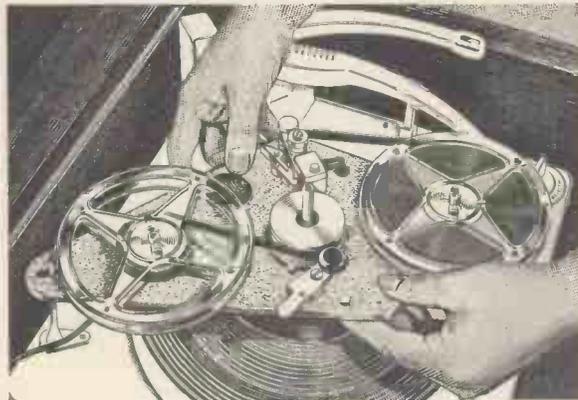


The Pye Industrial TV Division, a member of the Pye Instrument Group, has supplied all the television equipment to the Westminster Bank for the first inter-branch TV network. The new system which makes centralised book-keeping possible has been brought about by the closest co-operation with the GPO who have supplied Post Office lines to carry the signals. The illustration shows a customer checking his banking account.

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BRITISH INVENTION!

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GRAMOPHONE TAPE RECORDER



Ready to record, complete with 600 feet of twin-track tape.

11 GNS

Special moving coil microphone extra.

EASY TERMS

- Plays at 7 1/2 in. per sec. Other speeds if desired.
- Uses standard tapes.
- Erase head. Fast motor re-wind or hand re-wind.
- Instantly plays back through gramophone or radio.

MADE BY THE FIRM THAT MAKES RADAR RUNS FOR VISCOUNTS AND BRITANNIAS

Instantly turns your gramophone into a first class Tape-Recorder. You simply slip it on to your turn-table and you are ready to record direct from radio or microphone . . . the voices of your family . . . radio programmes . . . your favourite music—and you can instantly play it back through your own gramophone or radio **WITH LIFELIKE FIDELITY.** Gramdeck now brings full tape-recording and playing facilities to every gramophone owner, at little extra cost.

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"Ingenious—simply . . . why on earth did no one think of it before"—**THE TAPE RECORDER.**
"Better than many so-called hi-fi recorders . . . robust . . . carefully designed . . . excellent value."—**AMATEUR CINE WORLD.**

FREE BOOK—POST NOW

I would like to know how to turn my gramophone into a first-class tape-recorder . . . please send me the Gramdeck Book—FREE and without obligation (Write if you prefer not to cut coupon.)

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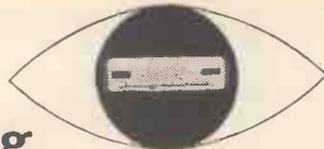
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Gramdeck

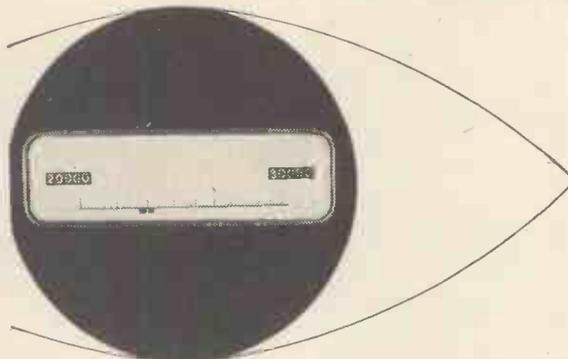
GRAMOPHONE TAPE RECORDER

(Dept. WW/811), 29 WRIGHT'S LANE, LONDON, W.8

GRAMDECK TURNS A TURNTABLE INTO A TAPE-RECORDER



seeing
is believing



A stable signal of very low harmonic content within the frequency range 10 c/s to 120 kc/s, plus direct reading: these are two outstanding advantages of the Wayne Kerr Audio Signal Generator Type S121.

This is a high grade laboratory instrument designed for use with circuits under test, development or service conditions. The output frequency is clearly and accurately shown and the amplitude remains constant to within 0.2dB at any setting, with a particularly low level of distortion. The unique dial display is designed for simple, rapid operation, permitting either the selection of major intervals by means of switches or the continuous fine control of frequency on an open horizontal scale.

Two outputs are available: 0-30 volts at high impedance and a 600-ohm attenuated output covering the range +10dB to -70dB on a reference level of 1mW.

For all these significant features, this is a compact, light and portable piece of equipment which combines high precision with great practicability. For these reasons the Wayne Kerr Audio Signal Generator is approved for Armed Services' use under the inter-Service reference No. CT416.

The Wayne Kerr Audio Signal Generator is fully described in Information Service Leaflet DS121, copies of which are available on request.



WAYNE KERR

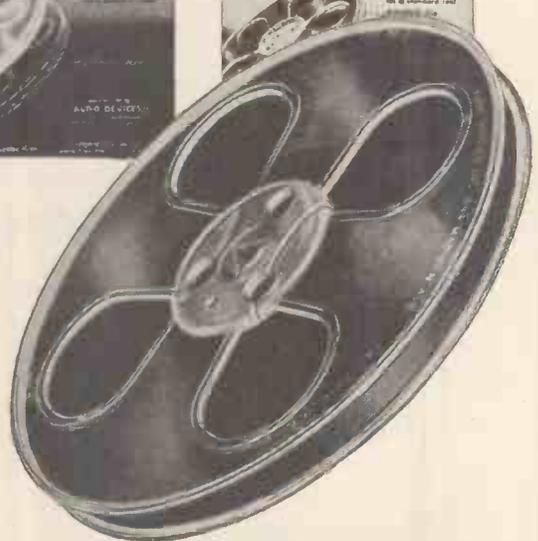
Audio Signal Generator S121

THE WAYNE KERR LABORATORIES LTD.,
Sales and Service, 44 Coombe Road, New Malden,
Surrey. Telephone: MALden 2202

Sensational Success of **audiotape**

TRADE MARK

Tape Recording experts and enthusiasts all over the country are changing to AUDIO-TAPE for its flawless perfection of sound reproduction over the entire audio range and its **consistent, uniform quality** from reel to reel.



Available on all standard reel sizes, there are eight different types to meet every recording requirement . . . AUDIOTAPE, manufactured in the U.S.A. by Audio Devices Inc., gives you the truest sound your recording equipment can produce—try AUDIO-TAPE . . . it speaks for itself.

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All 5in. and 7in. reels of AUDIOTAPE are supplied on the exclusive C-slot Reel—the fastest-threading tape reel ever developed. The tape end, dropped into a slot in the hub, anchors itself automatically at the first turn of the reel.

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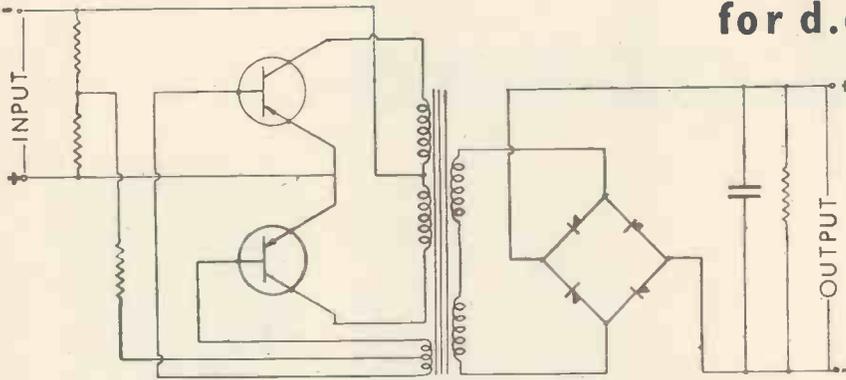
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for d.c. CONVERTERS



Transformers suitable for use in the circuits described in the recently published G.E.C. Application Reports on d.c. converters are now included in our standard range.

TYPICAL SPECIFICATIONS

INPUT	OUTPUT	RATING
6 V	100 V	1, 1.5, 2; 3 or 4 WATT
6 V	200 V	
6 V	400 V	
6 V	800 V	
12-18 V	250 V	50 WATT

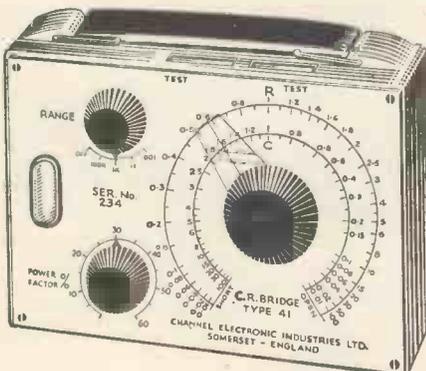
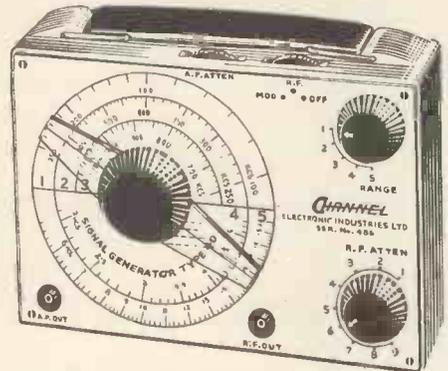
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MINIATURE TRANSISTORIZED SIGNAL GENERATOR TYPE 40

- ★ Up to 20 Mc/s on fundamentals.
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- ★ Accuracy better than 2%.
- ★ Miniature size only 4½ in. x 3½ in.

PRICE NET **£5.15.0.** Battery 2/6 extra
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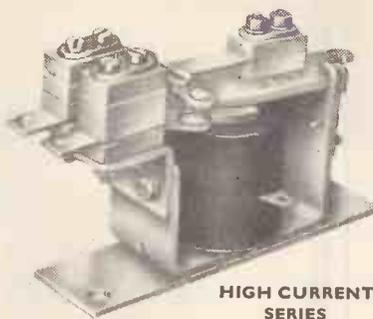
- ★ Capacitance 5 μF to 20 μF.
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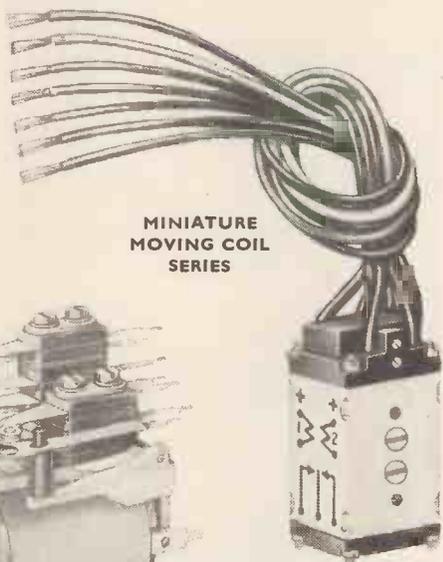
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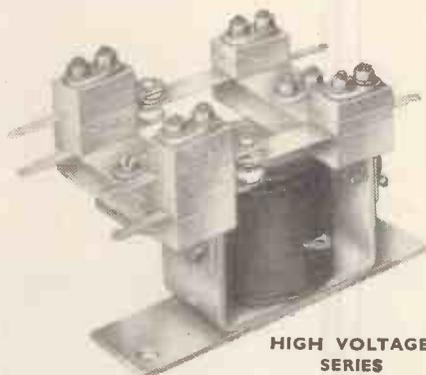
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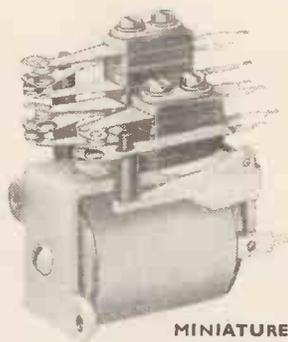
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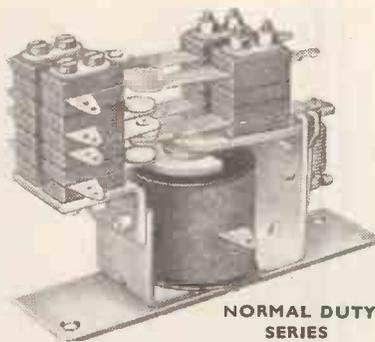
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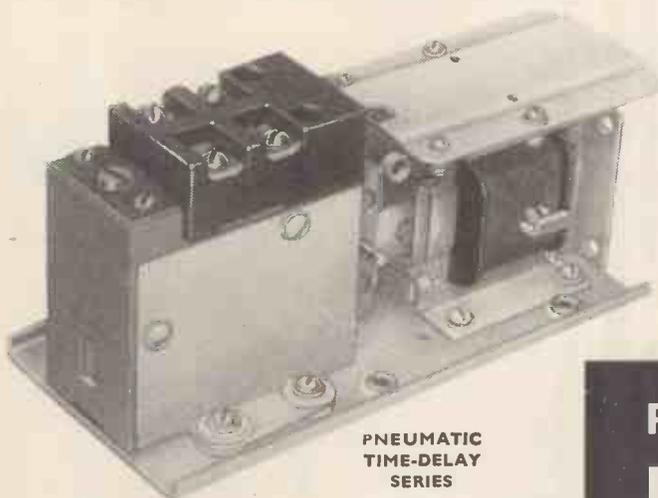
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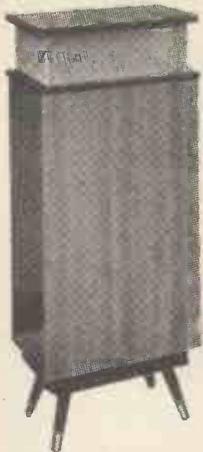
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Connoisseur

FOR STEREO OR MONAURAL



Omni-directional speaker enclosures in distinctive Formica Walnut finish designed to take 5in. speaker unit and a 3in. high frequency unit. Cabinet height 3ft. 4in. Length 1ft. 4in. Depth 12in. Provisional price £22/10/-.



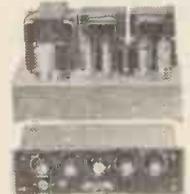
Stereo Pickup Mark III. Designed to accept both monaural and stereo heads. Adjustable for heights of various turntables. Pick-up head specification identical with the Type CS1. Arm only £3 plus 19/11 P.T.



Stereo Pickup Type CS1. The pick-up head employs miniature ceramic units, frequency range 20-18,000 c.p.s. output 20 mV. Diamond stylus. Will accept Mark II monaural heads.



2 speed transcription motor, 33 r.p.m. and 45 r.p.m. Full 12in. turntable as lathe turned. New nylon graphite bearings. Synchronous motor dynamically balanced. Neon indicator on/off warning light. £12/10/- plus £4/3/1 P.T.



Stereo Amplifier and Control Unit Type S66. Twin channel, delivering 7.5 watts per channel with ultra linear output stage. Inputs for P.U., Tape and Radio sensitivity being 8 mV. Separate treble and bass controls.

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A R SUGDEN & CO(ENGINEERS) LTD. MARKET STREET, BRIGHOUSE

EXTRA HIGH SENSITIVITY

INSTRUMENT TUBE 5CLP31

THE FIVE-INCH instrument tube 5CLP31 has a deflection sensitivity of 1.85V/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 5CLP31.

- * P.d.a. ratios of 15:1 possible without pattern distortion.
- * Sensitivity 1.85V/cm with useful y scan of 6 cm.
- * Sensitivity substantially independent of final p.d.a. voltages from 10 to 15kV.
- * High sensibility — only 200 mV for a deflection of one spot-width.
- * Versatility — by simply altering one electrode potential the 5CLP31 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 5CLP31.



Capacitances

C _{x'-x''}	2.0 pF	C _{y'-y''}	2.0 pF
C _{x'-all (x'' earthed)} ...	5.5 pF	C _{y'-all (y'' earthed)} ...	4.3 pF
C _{x''-all (x' earthed)} ...	5.5 pF	C _{y''-all (y' earthed)} ...	4.0 pF

Compare conditions shown in typical operation below

1 and 2 to see how deflection sensitivity is maintained over range of V_{a4} and V_{a5}.

1 and 2 with 3 for a slightly lower sensitivity condition giving higher brightness.

2 and 4 for the reduction required in V_{a4} potential to achieve higher writing speeds.

	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) ...	-28 to -60V	-28 to -60V	-42 to -90V	-42 to -60V
Deflection sensitivity ...	$\left\{ \begin{array}{l} 1.85V/cm \\ 7.5V/cm \end{array} \right.$	$\left\{ \begin{array}{l} 1.85V/cm \\ 7.5V/cm \end{array} \right.$	$\left\{ \begin{array}{l} 2.7V/cm \\ 11.2V/cm \end{array} \right.$	$\left\{ \begin{array}{l} 2.7V/cm \\ 11.2V/cm \end{array} \right.$
Line width	1mm	1mm	<1mm	<1mm
Useful screen area ...	$\left\{ \begin{array}{l} 6cm \\ 10cm \end{array} \right.$	$\left\{ \begin{array}{l} 6cm \\ 10cm \end{array} \right.$	$\left\{ \begin{array}{l} 6cm \\ 10cm \end{array} \right.$	$\left\{ \begin{array}{l} 4cm \\ 6.6cm \end{array} \right.$

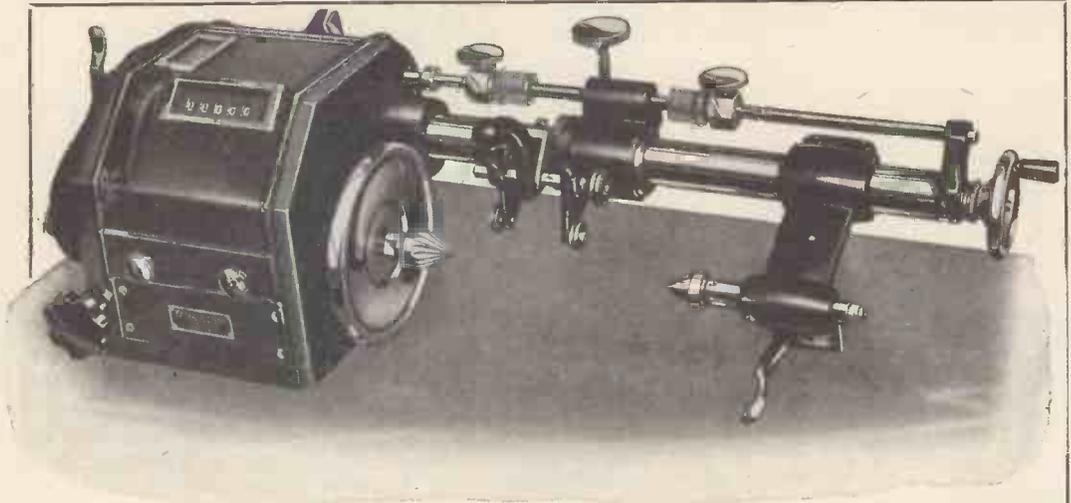
(The green medium persistence phosphor used by E.T.L. has now been designated P31. It is exactly the same as the E.T.L. phosphor previously called P1.)

CATHODE RAY TUBES

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AUTOMATIC COIL WINDING MACHINE TYPE A1/1 (25/50 S.W.G.) TYPE A1/X (19/46 S.W.G.)

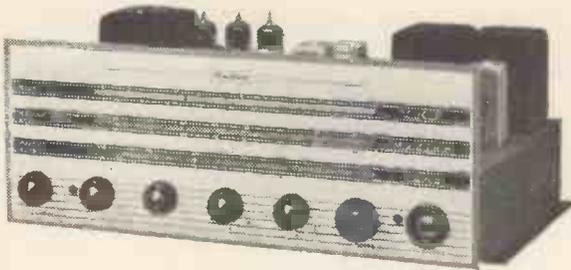
THESE MACHINES INCORPORATE THE FOLLOWING FEATURES:—
 Infinitely variable wire gauge adjustment with easily read scale calibrated in .001".
 Width of coil quickly adjusted within fine limits. Adjustable tailstock fitted with
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 at a required number of turns can be supplied.

We will be pleased to send you an illustrated leaflet giving a full technical specification on request.

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**STEREO 12 Mk. 2
 TUNER-AMPLIFIER CHASSIS**

- ★ **AM TUNER**
Ferrite rod aerial and unique 2nd IF stage provide good continental reception. Miniature tuning indicator.
- ★ **FM TUNER**
High fidelity tuner covering the full VHF band (87-108 m/cs). Automatic frequency control ensures complete stability.
- ★ **STEREO CONTROL UNIT**
Separate tone controls. Balance control. Inputs for all pick-ups, tape record and playback. Booster unit available for low output pick-ups. Stereo radio input.
- ★ **TWO HI-FI AMPLIFIERS**
Each amplifier provides 8 watts push-pull output, 16 watts total. Frequency response 20-30,000 c.p.s. ± 2dB.

The Stereo 12 Mk. 2 is a new and improved version of the famous Stereo-Twelve. A hi-fi system on one chassis, it includes AM and FM tuners, a stereo control unit and two hi-fi amplifiers, and the price is only 42 guineas. Compare the features and specification of each section with tuners and amplifiers sold separately and then compare the cost.

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NAME..... WSS

ADDRESS.....

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STEREO 55 32 GNS

A tuner-amplifier chassis giving 10 watts output, 5 watts each amplifier, covering full VHF and Medium bands. Similar in facilities and appearance to the Stereo 12 Mk. 2.

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A new Grommet development

THE DOUBLE SEALING EMPIRE RUBBER GROMMET

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



PAT. APP. No. 5255/59

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

Any one size will not only accommodate itself to a variety of mounting plate thicknesses, but (designed for cable or control rod) will take these in a variety

of sizes and be weather-, water- and dust-proof at a variety of angles to the cable or rod.

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

THE NEW BLIND GROMMET



FREE

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

THE NEW DESIGNED GROMMET

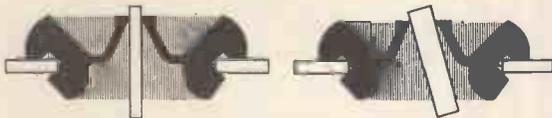


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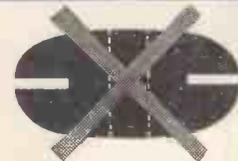


FITTED

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



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



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

Now being produced in a range of sizes
THESE GROMMETS WILL SOLVE
YOUR SEALING PROBLEMS



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R.B.101



HETERODYNE FREQUENCY METERS

BRITISH MANUFACTURED

Designed and built to rigid services specifications.

TYPE T75.

Frequency Range: 85 to 1,000 megacycles.

TYPE T74.

Frequency Range: 20 to 250 megacycles.

Frequency calibration accuracy: .002% at 25° C. (or .01% between -20° C. to +70° C.).

Crystal-controlled, portable heterodyne-type Frequency Meters used for Field testing and measurement of pulsed, modulated, or C.W.R.F. transmitters, receivers and signal-generators.

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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.**

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BOOKLET OF DETAILED ASSEMBLY INSTRUCTIONS AND CIRCUIT DIAGRAMS FOR 6-TRANSISTOR LONG AND MEDIUM WAVE SUPERHET PRICE **2'0d.**

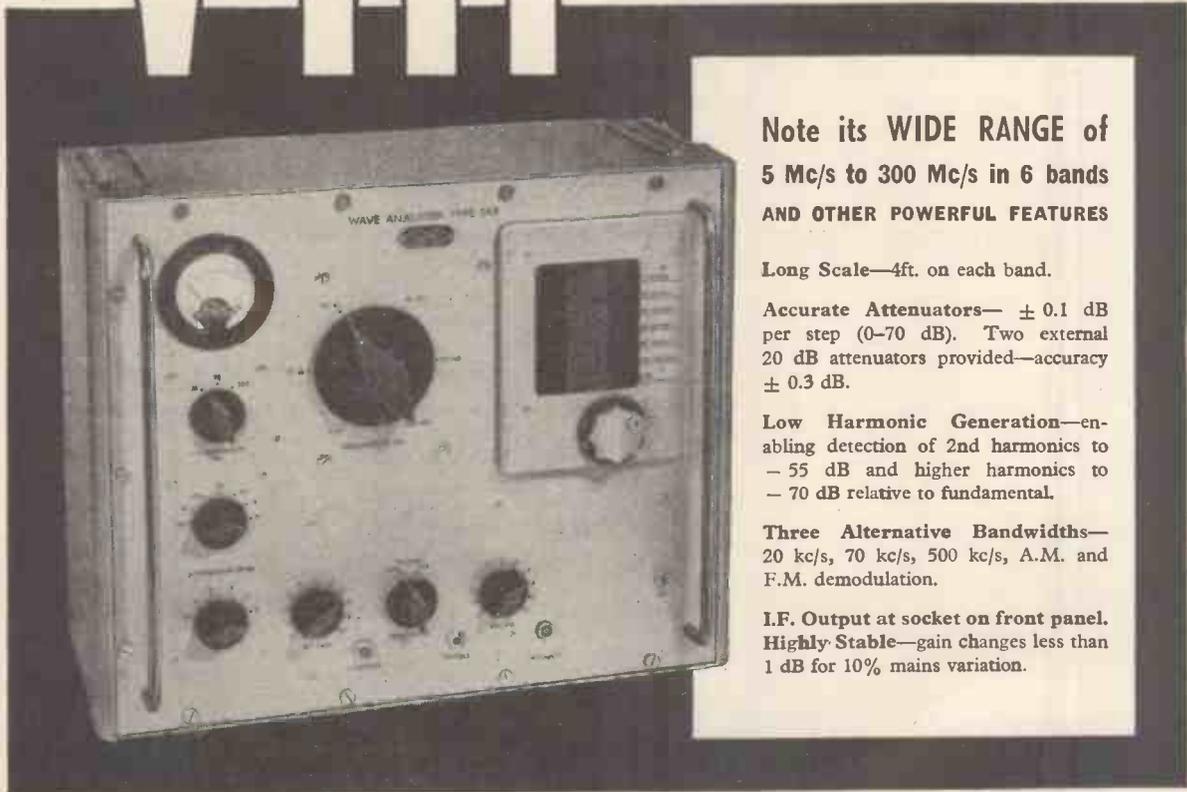
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**WEYMOUTH RADIO MFG. CO. LTD., CRESCENT STREET
WEYMOUTH, DORSET**

VHF

AIRMEC
VHF WAVE ANALYSER
 TYPE 248

*is the ideal instrument
 for the Harmonic Analysis
 of Wave Forms*



**Note its WIDE RANGE of
 5 Mc/s to 300 Mc/s in 6 bands
 AND OTHER POWERFUL FEATURES**

Long Scale—4ft. on each band.

Accurate Attenuators— ± 0.1 dB per step (0-70 dB). Two external 20 dB attenuators provided—accuracy ± 0.3 dB.

Low Harmonic Generation—enabling detection of 2nd harmonics to -55 dB and higher harmonics to -70 dB relative to fundamental.

Three Alternative Bandwidths—20 kc/s, 70 kc/s, 500 kc/s, A.M. and F.M. demodulation.

I.F. Output at socket on front panel.
Highly Stable—gain changes less than 1 dB for 10% mains variation.

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Accurate measurement of sound
equipment speed deviations

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- R.C.A. Photophone Ltd.
- Southern Instruments Ltd.
- Truvox Ltd.
- Vortexion.
- Westrex Co. Ltd.
- Wright & Weaire Ltd., and users in India, Poland and Kong Kong.



Gaumont-Kalee
Fluttermeter
Type 1740

Brief Technical Data

Operating carrier frequency 3,000 c.p.s. ± 5%
 Minimum input signal 50 mV R.M.S.
 Input Impedance 1 Megohm.
 Input amplifier bandwidth -3db at 2,500 and 3,500 c.p.s.
 Effective limiter range ± 10dB.
 Meter scaling—"Peak wow" 0 to ± 1% (centre zero).
 "Wow" and "Flutter" 0 to 1% and 0 to 0.2% R.M.S.
 Crossover frequency 20 c.p.s.
 "Flutter" meter response—3db at crossover.
 -3dB at 200 c.p.s.
 "Wow" meter response -3dB at crossover.
 -1dB at 0.5 c.p.s.
 J.R.O. output frequency response level down to zero frequency—3dB at 200 c.p.s.
 3,000 c.p.s. oscillator output level 5V R.M.S. into 0.5 Megohm 100 mV R.M.S. into 500 ohms.
 Accuracy: Meter presentations ± 2% f.s.d.
 Power consumption 35 watts.
 Mains 100/150v, and 200/250v.
 Single phase 45/60 c.p.s.

The Flutter Meter measures those components which are commonly described as "Wow" and "Flutter" resulting from speed variations in sound recorders and reproducers. This instrument is equally suitable for use with machines employing perforated film, tape, wire or disc records.

Type 1740 is of entirely new design. More compact, lighter in weight and costing considerably less than earlier Gaumont-Kalee Flutter Meters, but with the same high performance and facilities.

Dimensions: Height 10½" 26.04 cm.
 Width 12¼" 31.12 cm. Depth 14½" 36.47 cm.
 Nett Weight: 29lb. 13.15 Kilos.

Write for full details to:



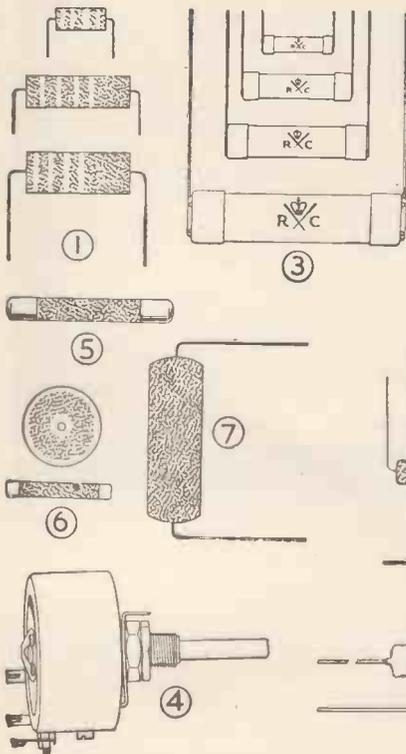
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Tel: SHEpherds Bush 2050.

Cables: RANKPRESTU, LONDON

A service for Designers



The possibility of a component change—due to shortage of supplies, increased costs or failure to meet specific conditions—is a problem facing every designer of electronic equipment. However, one basic component can be 'tailor-made' from the start, for LAB will supply the precise type of Resistor required, ex stock and at the right price. Write for full technical data, prototype samples and price schedules to:—

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 WEALDSTONE, HARROW, MIDDXX.
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CARBON	WATTS	OHMIC RANGE	TOLERANCES ±
1. Solid	½ 1 & 2	10—10M	5% & 10%
2. Cracked	1/30—20	1—500M	5% & 10%
3. *High Stability	1/10—3	1—50M	0.5% 1% 2% 5%
4. Variable	½	5K—2M	—
5. V. High Resistance	½—3	50M—10 ¹³	5% & 10%
6. V.H.F. (Rods & Discs)	1/10—1	10—1K	1% & 2%
WIREWOUND			
4. Rheostats	4—500	10—18K	—
8. Vitreous	3—500	1—150K	1% 2% 5%
7. Cemented	1—15	1—25K	5% & 10%
9. Metal oxide	½—2	100—4.2M	1% 2% 5%

*The ubiquitous blue (1%) grey (2%) "HISTABS"

Do you KNOW

THAT Rheostats (4) can be made up in twos and threes on a common spindle.

THAT the whole of the vast range shown under (3) can be delivered ex stock in all Preferred values.



MODEL 5G-5"



MODEL 6G-6½"



MODEL 58C-8"x5"



MODEL 8C-8"



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We have made this selection from our wide range of speakers as they cover practically all the requirements of the replacement trade.

The new prices are now operative.

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7 x 4in.	47G	6500 g	20/6	6/7
7 x 3in.	37G	6500 g	20/6	6/7
8 x 3in.	38G	6500 g	20/6	6/7
8 x 5in.	58C	8500 g	24/6	7/10
8in.	8C	7000 g	25/6	8/2

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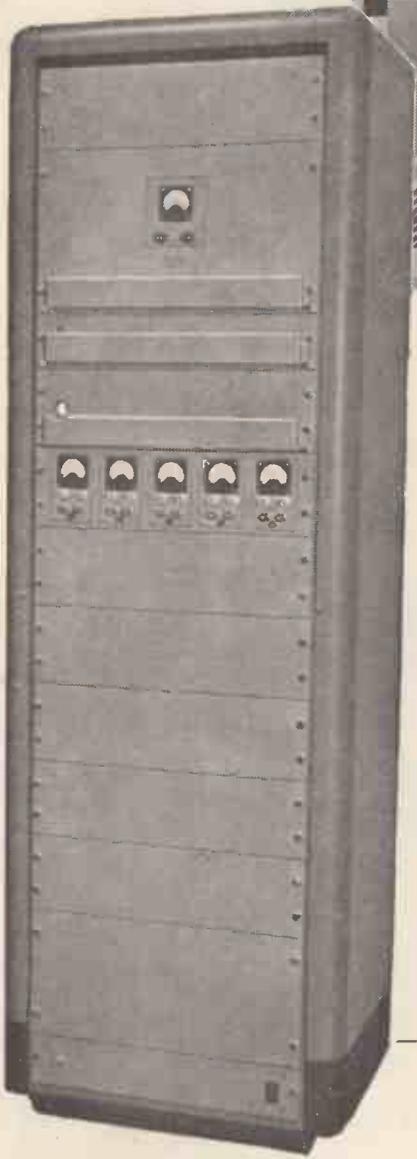
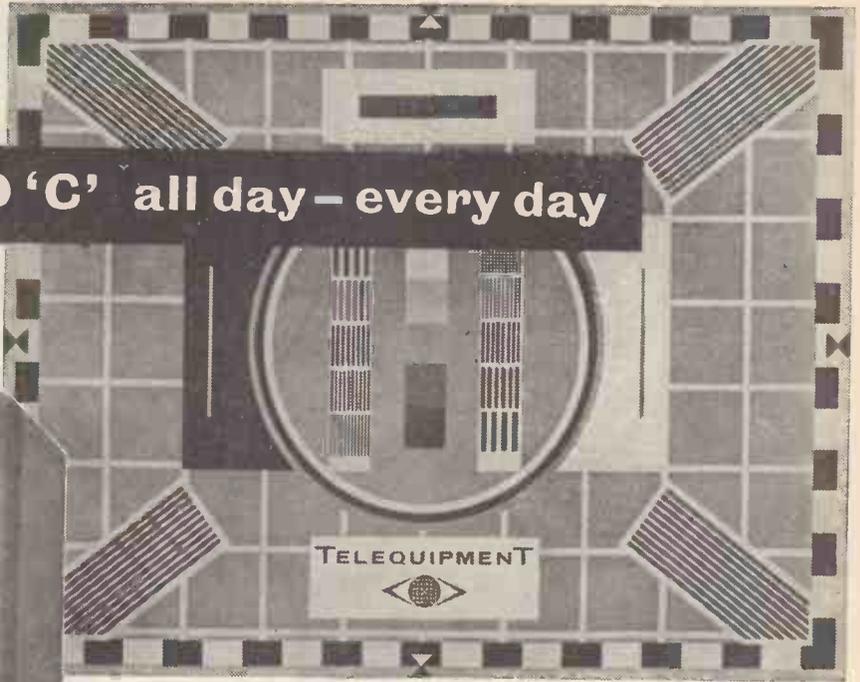
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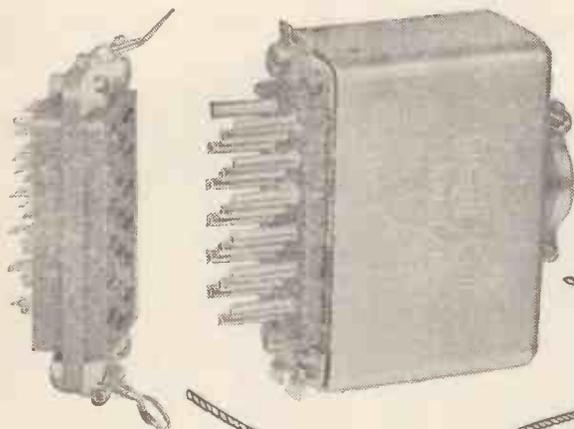
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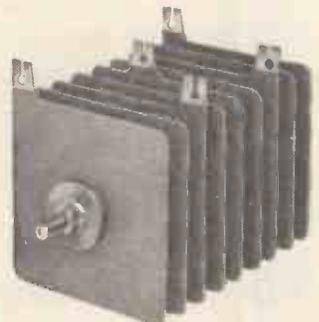
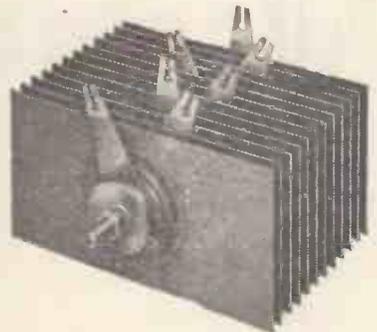
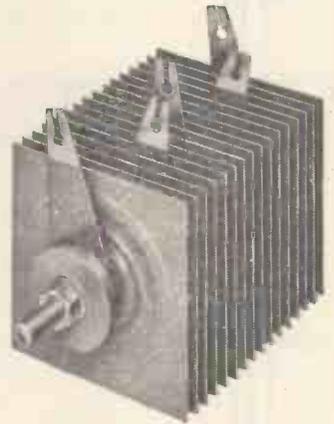
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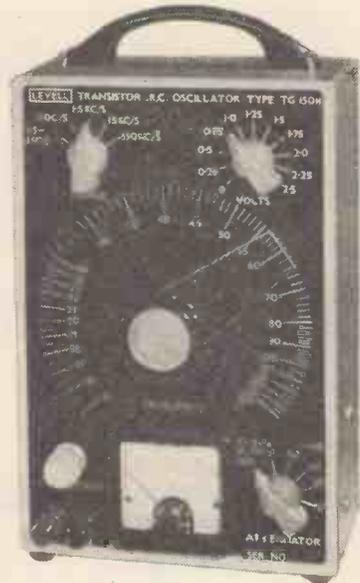
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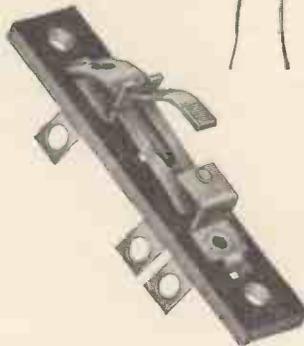
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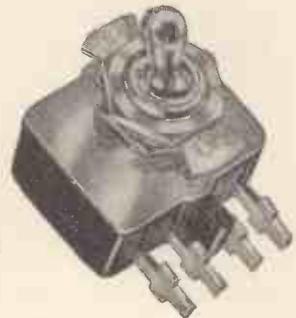
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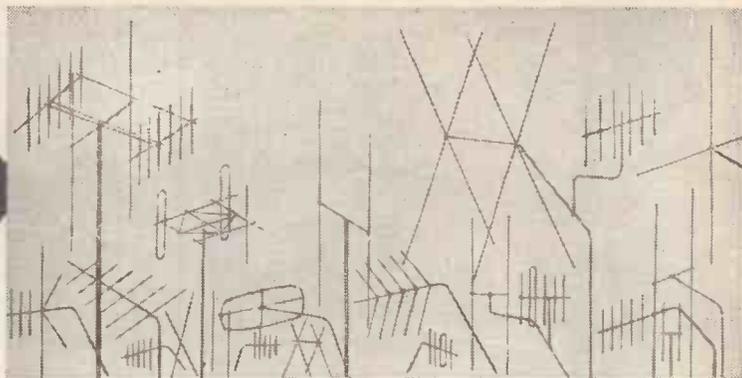
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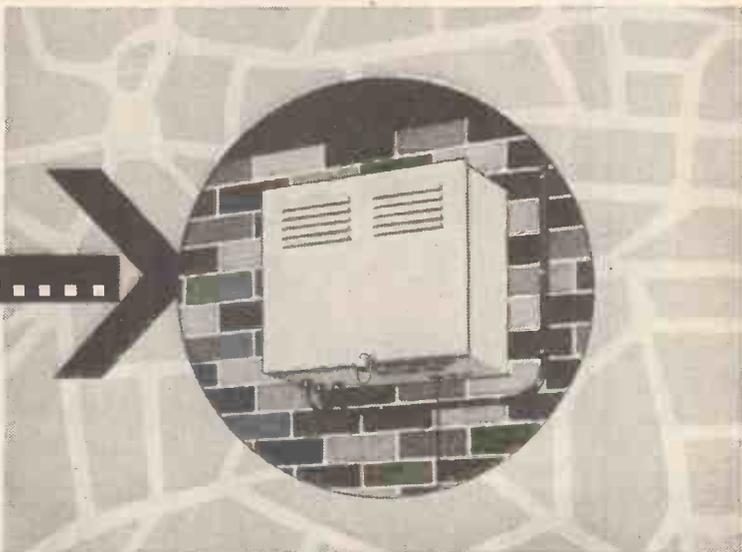
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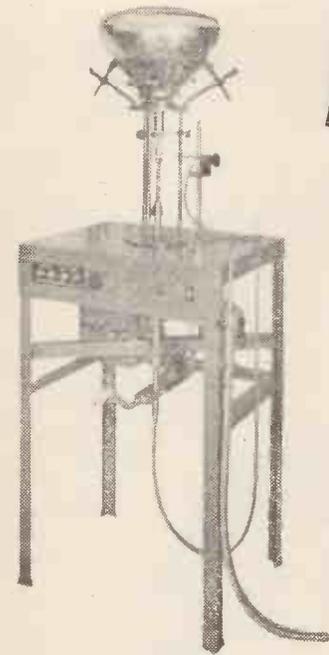
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P-2946	2 to 48V.	1.6A.	1.0A.	—	—
P-2947	1 to 24V.	3.2A.	2.0A.	—	—
P-2948	1 to 24V.	1.6A.	1.0A.	0-250V. (50V. Steps)	40mA
P-2949	2 to 48V.	1.6A.	1.0A.	0-250V. (50V. Steps)	40mA
P-2950	1 to 24V.	3.2A.	2.0A.	0-250V. (50V. Steps)	40mA
P-2951	2 to 48V.	3.2A.	2.0A.	0-250V. (50V. Steps)	40mA
P-2952	1 to 24V.	5.0A.	3.2A.	0-250V. (50V. Steps)	40mA
P-2953	2 to 48V.	5.0A.	3.2A.	0-250V. (50V. Steps)	40mA

A table showing method of connection is supplied with each transformer.

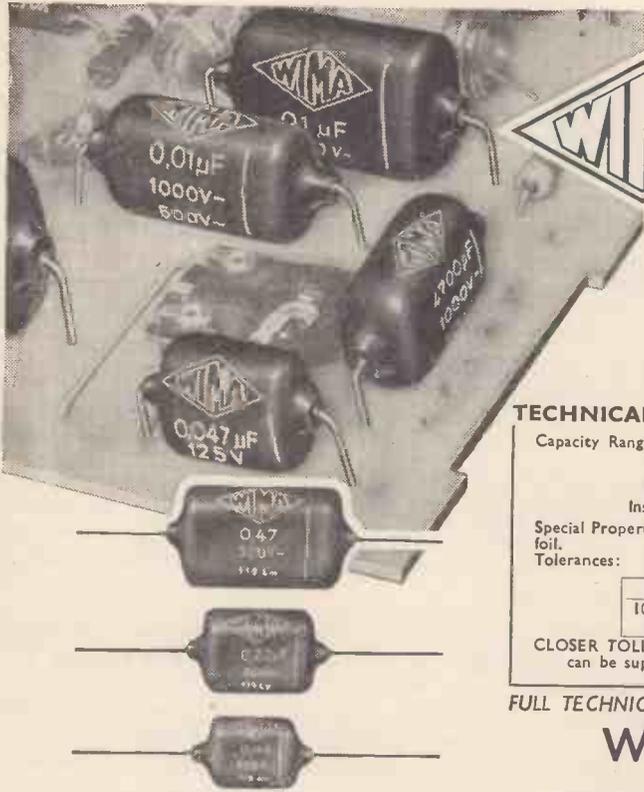
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P-2955	1.6A	60mH	0.90	9000/57	9-10
P-2956	3.2A	15mH	0.31	9000/49	2-3
P-2957	3.2A	35mH	0.39	9000/65	9-10
P-2958	5.0A	9mH	0.15	9000/57	9-10
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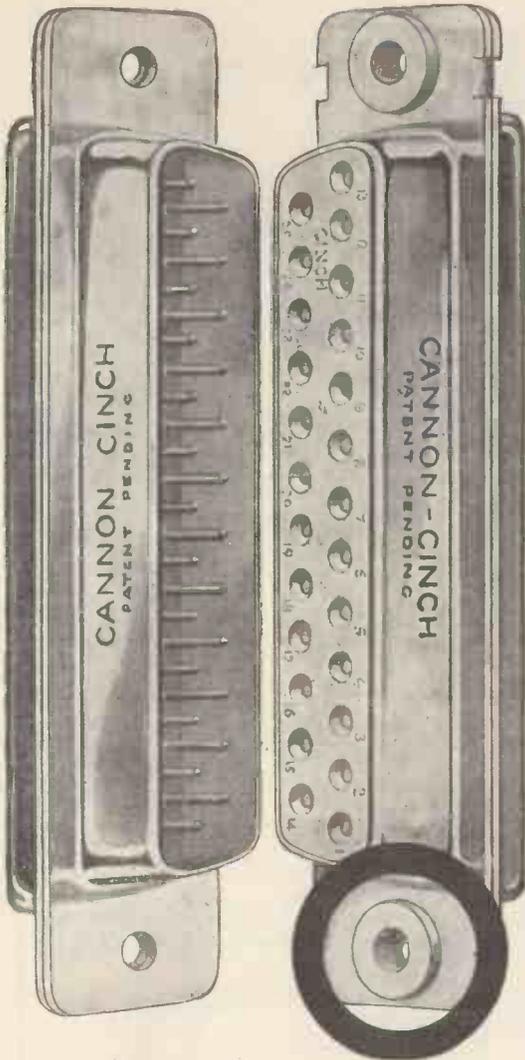
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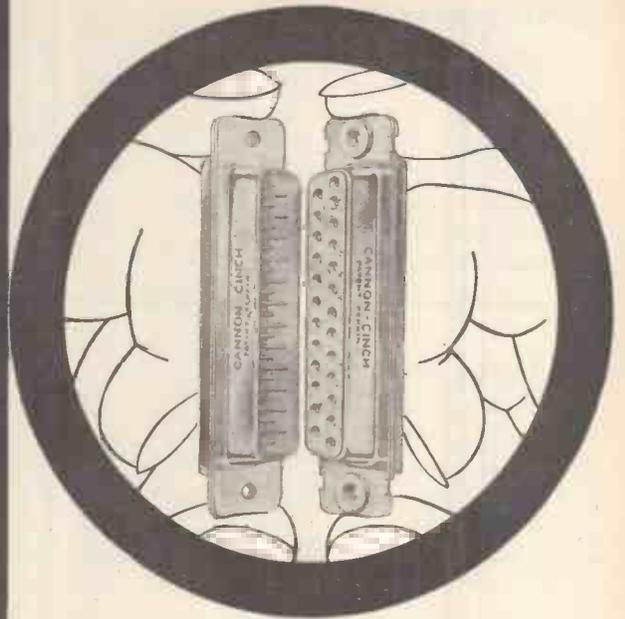
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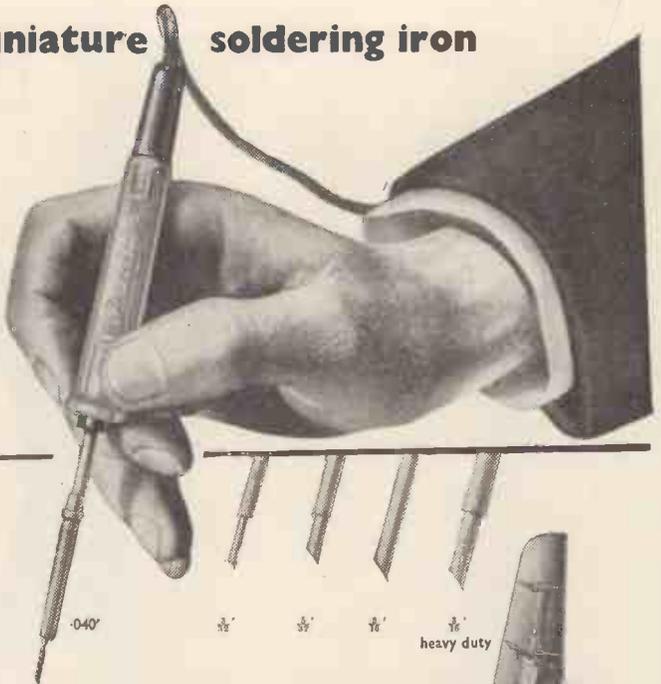
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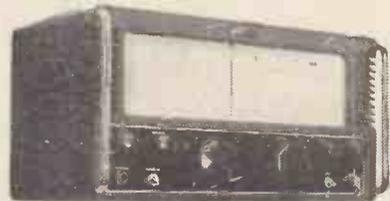
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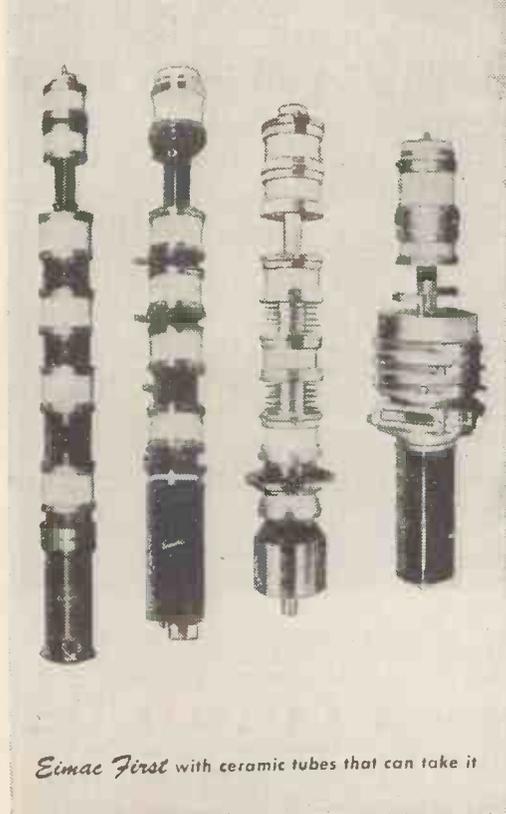
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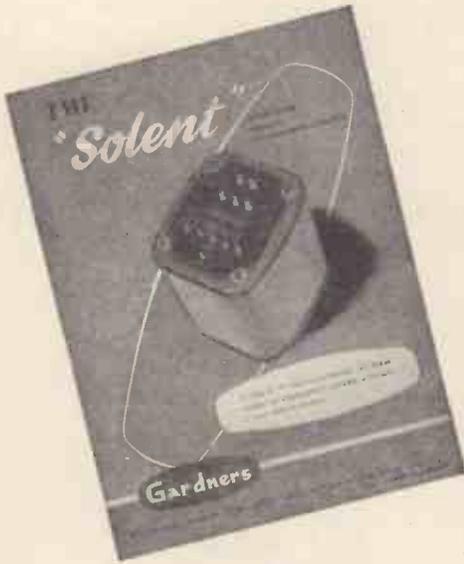
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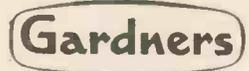
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163 Mains transformers for valve and contact-cooled rectifiers, audio output transformers and chokes and fully described in Gardner's new "S/M" Catalogue available on request.

Electrical characteristics, dimensions, weights, fixing centres and prices are fully described in this new publication which includes the latest additions to the Solent range (to BSS 2214 group 10/55) and the high performance but inexpensive "Mini-ford" range. Typical frequency response characteristics are also given.

Your copy of Gardner's "S/M" Catalogue can be obtained now by writing to GARDNERS RADIO LTD., SOMERFORD, CHRISTCHURCH, Hants.



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The advertisement features a background of a brick wall. At the top left is a circular logo with the letters "BL" and "Regd." below it. The word "COMPONENTS" is written in a large, stylized font across the middle. A white sign with black text is tilted in the foreground, reading "Bricks for the Electronic Industry". At the bottom is a black box with white text: "BELLING & LEE LTD" and "GREAT CAMBRIDGE ROAD, ENFIELD, MIDDXX., ENGLAND".

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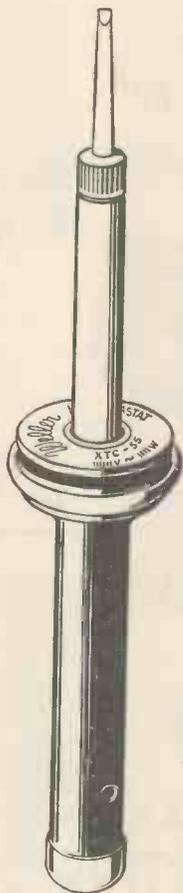
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Grams: Xtals, London, S.E.10

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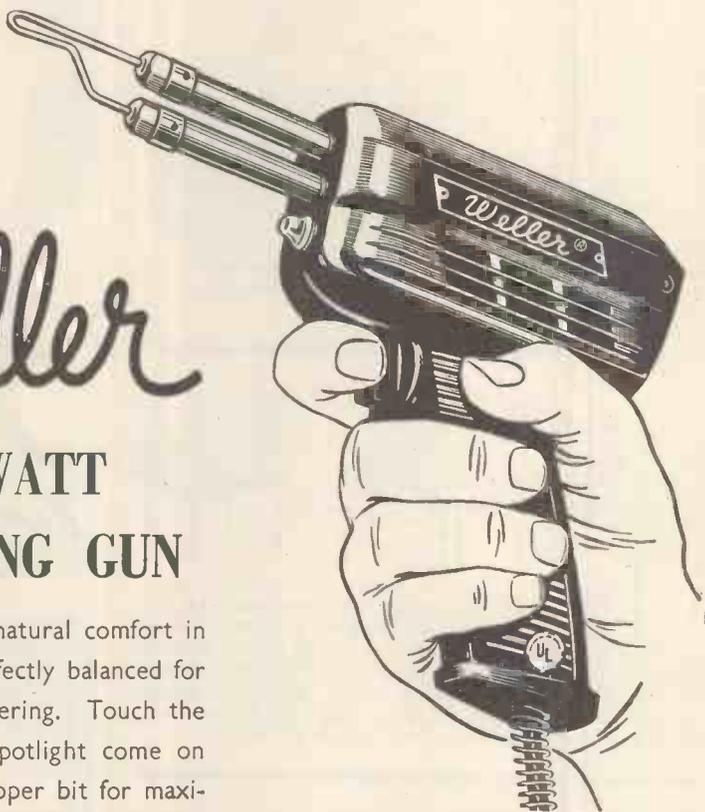
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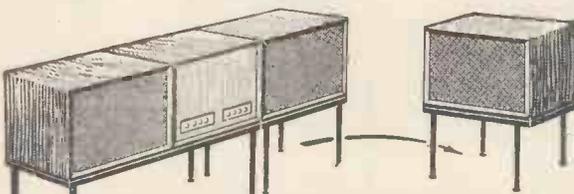
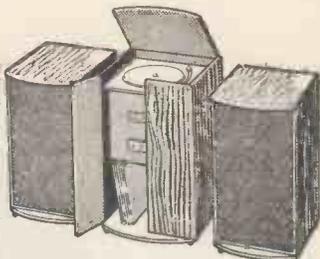
BEST SELLER

STEREO

How to live with it

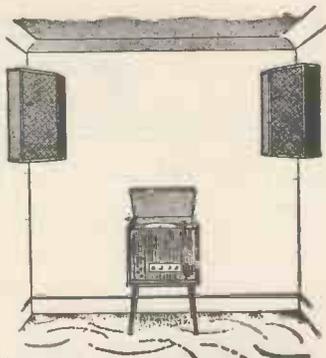
With the immense gain in clarity and realism that stereo has to offer, there comes the inevitable difficulty—where to put the speakers. As cabinet manufacturers and hi-fi enthusiasts, we show here three suggestions.

For those intending to use 12in. speakers we recommend two of our **CAPRIOL Enclosures** (£13/19/- each) in the upright position, with a matching **DELIUS Equipment / Record Cabinet** (£23/2/-) between them. The three form a handsome, compact arrangement and fitted with castors the Speakers can be easily positioned for full stereo effect. Castors 10/- per set extra.



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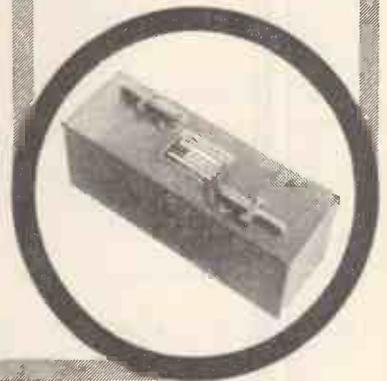
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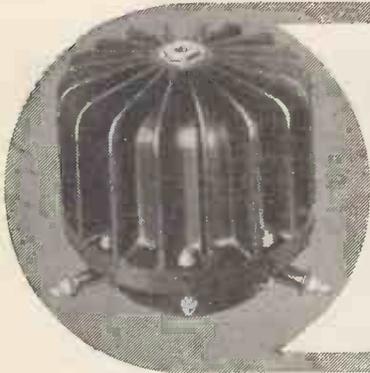
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This range includes X-band isolators, circulators, coaxial mixers, switches, folded tees etc.

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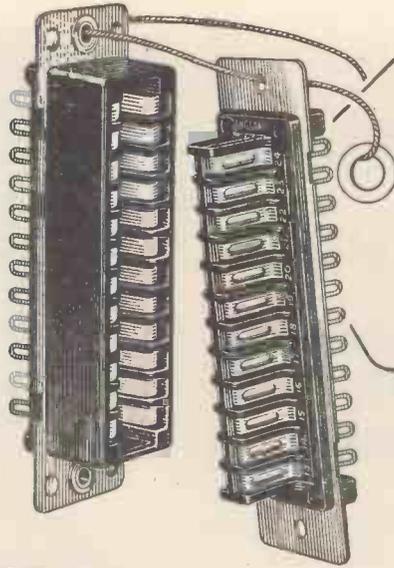


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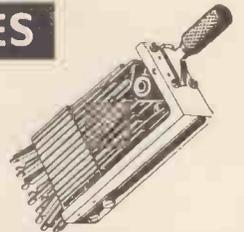
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L.P. 25 m.v.
78 r.p.m. 20 m.v.
Radio, 35 m.v.
Microphone, 2.5 m.v.

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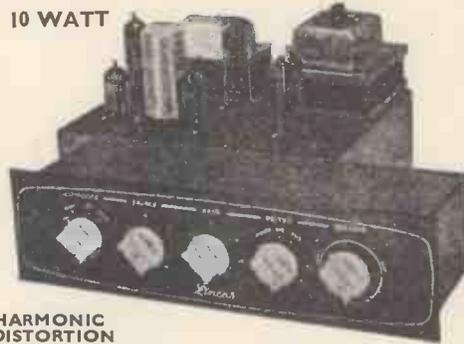
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(Inc. Pre-amplifier)
0.09% measured at 10 watts.
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ohms Lp 100H LL P-527mH
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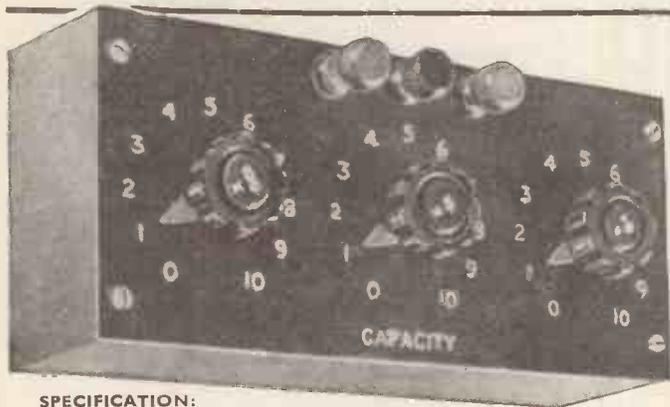
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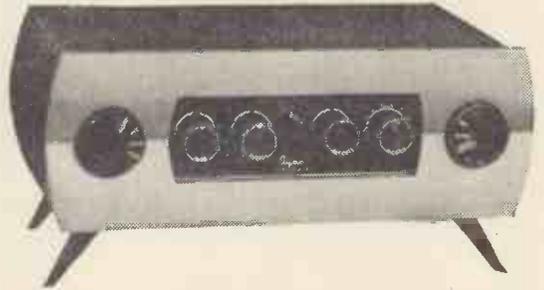
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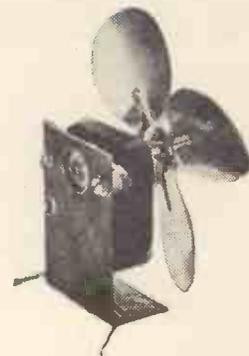
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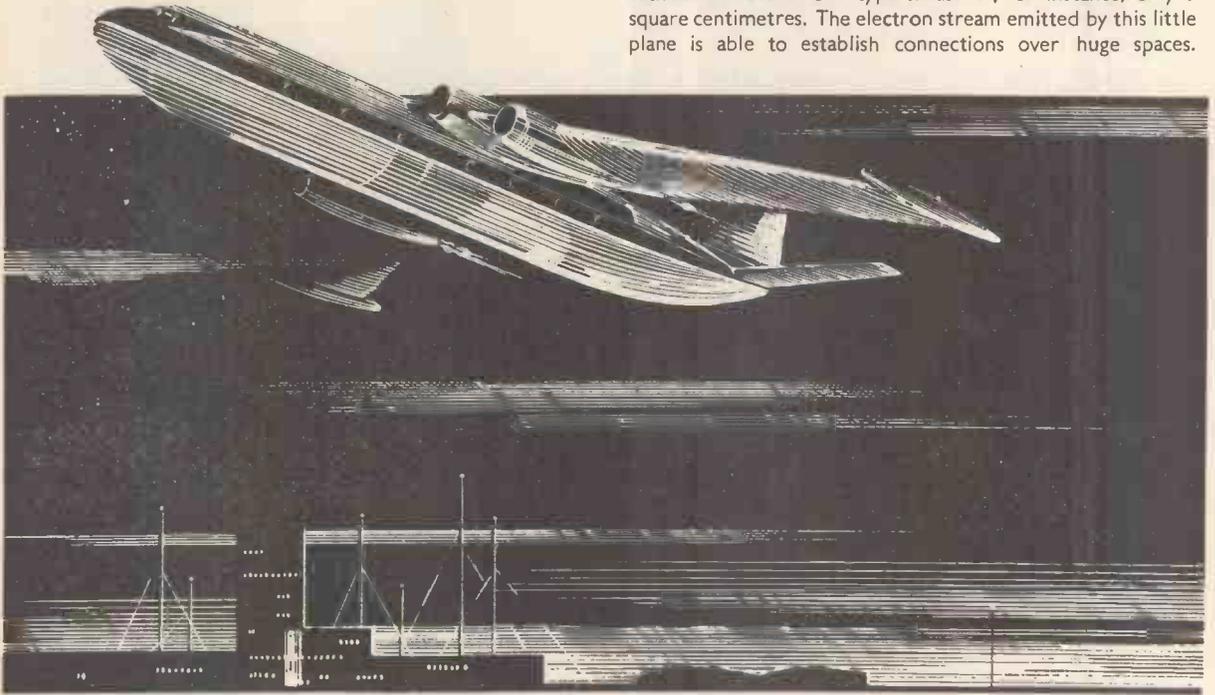
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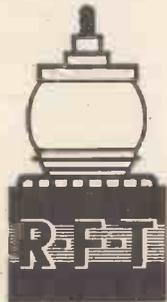
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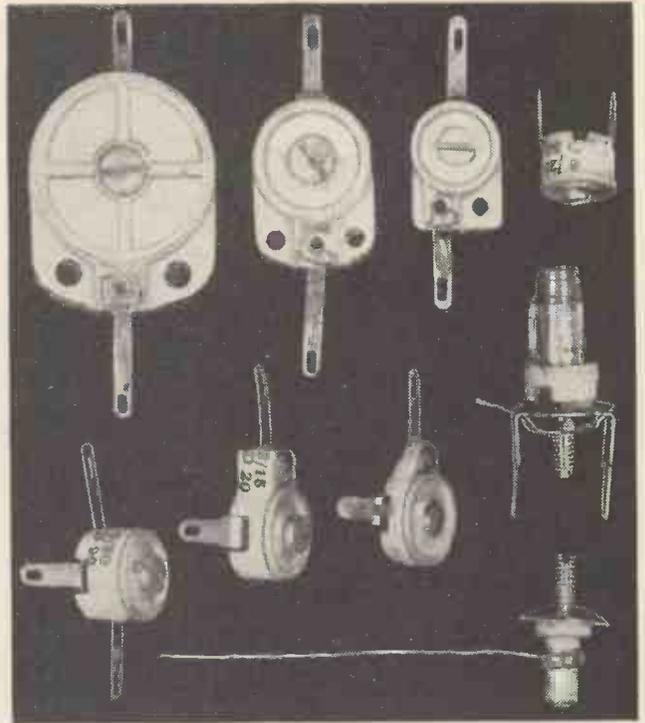
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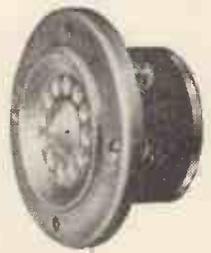
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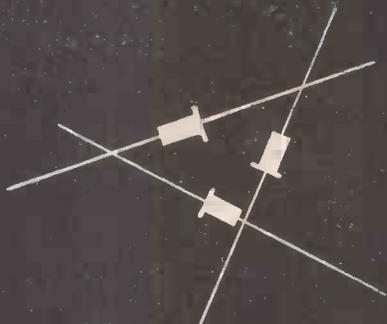


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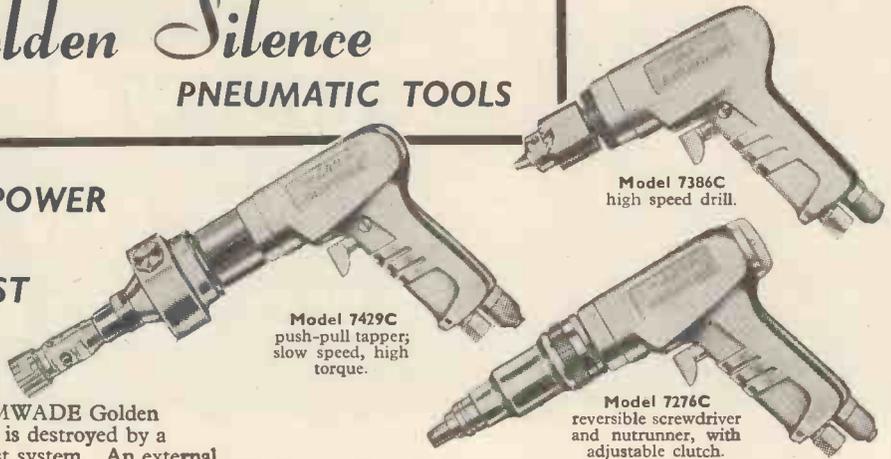
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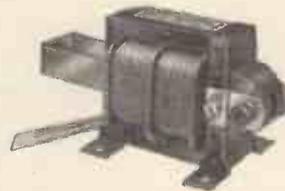
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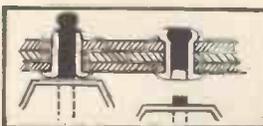
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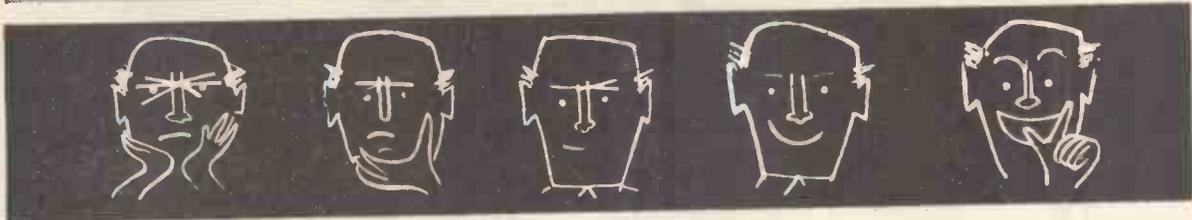
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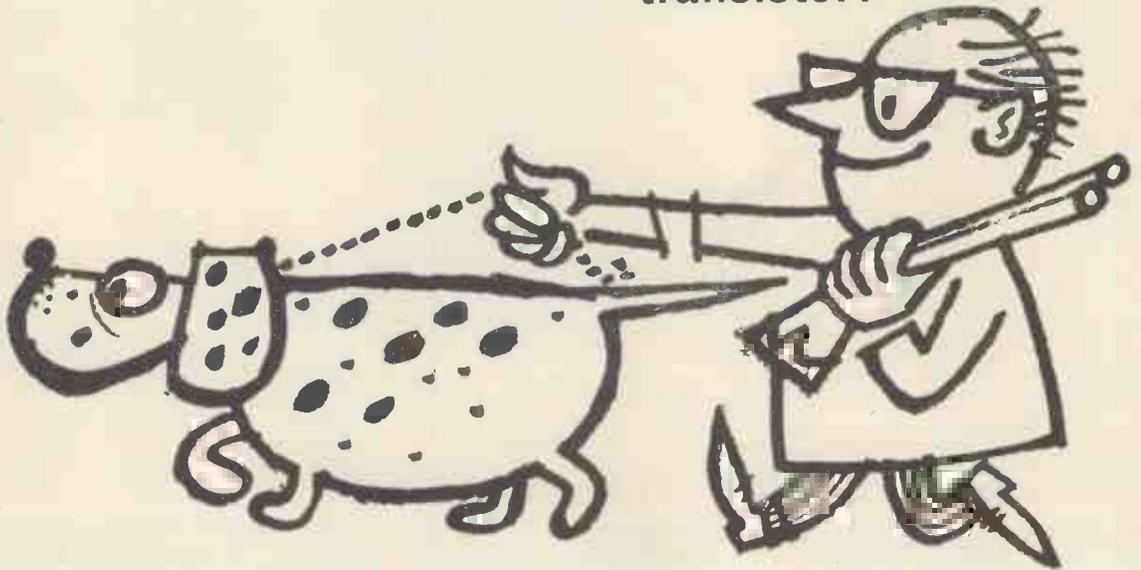
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SEPTEMBER 1960

Managing Editor :

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PUBLISHED MONTHLY (4th Monday of preceding month) by **LIFFE & 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 authorized 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**: 62, Buchanan Street, C.1. Telephone: Central 1265-6. **MANCHESTER**: 260, Deansgate, 3. Tel. phone: Blackfrairs 4412. **NEW YORK** OFFICE: U.S.A.: 111, Broadway, 6. Telephone: Digby 9-1197.

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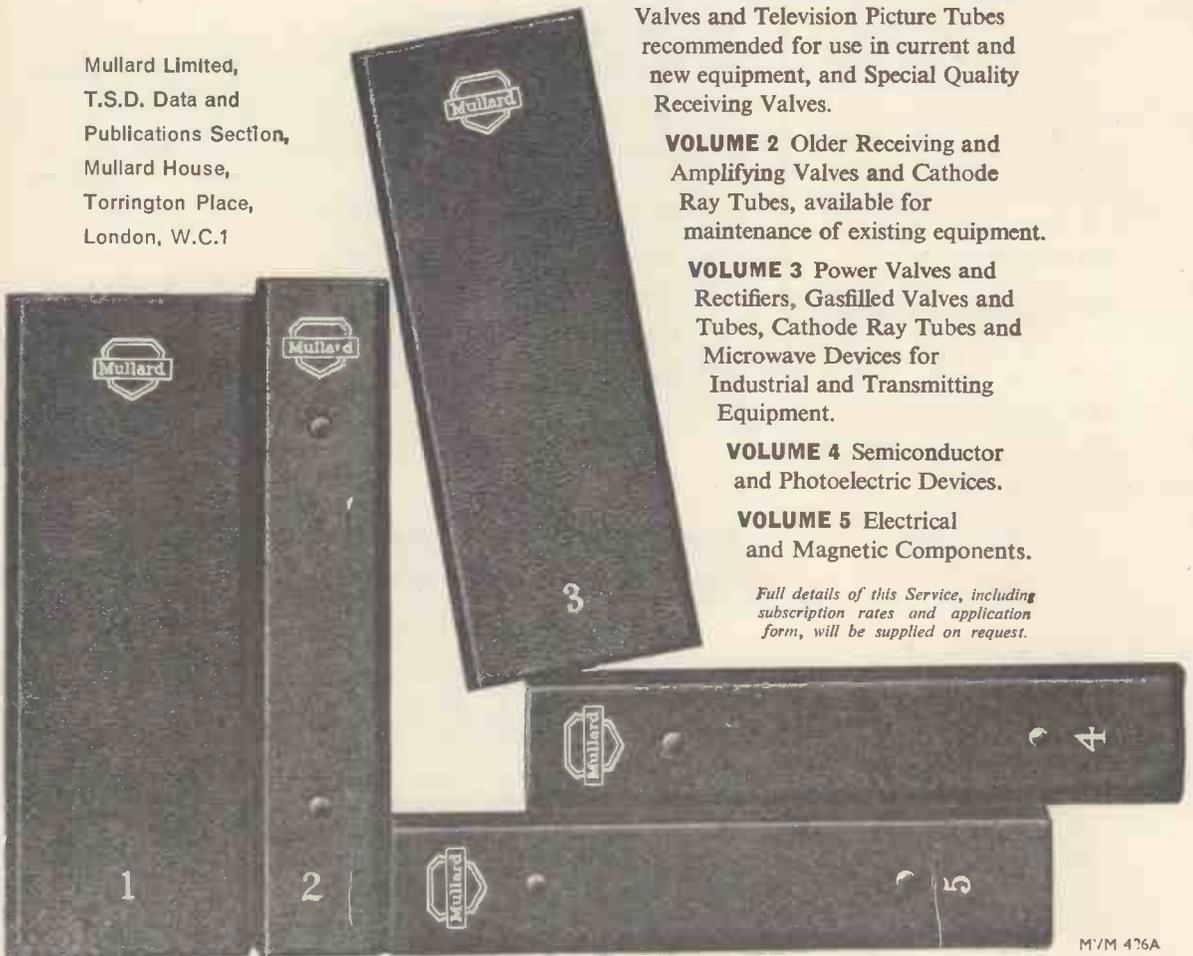
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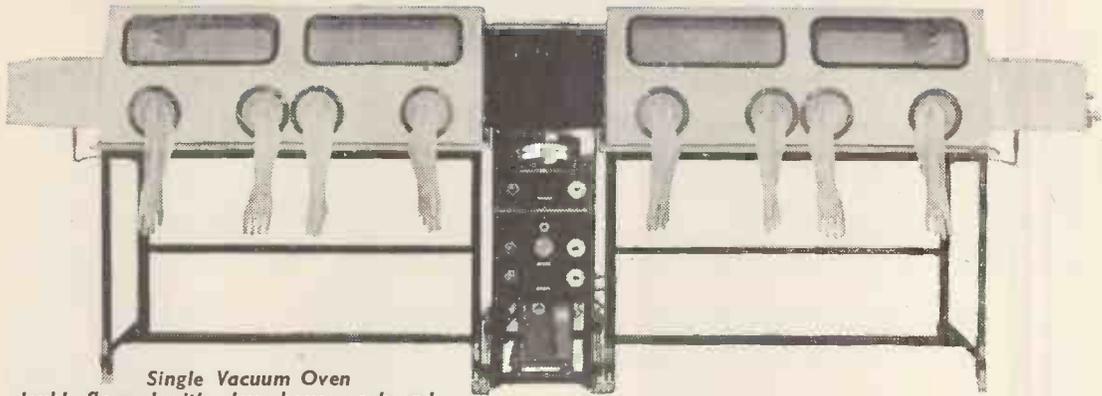
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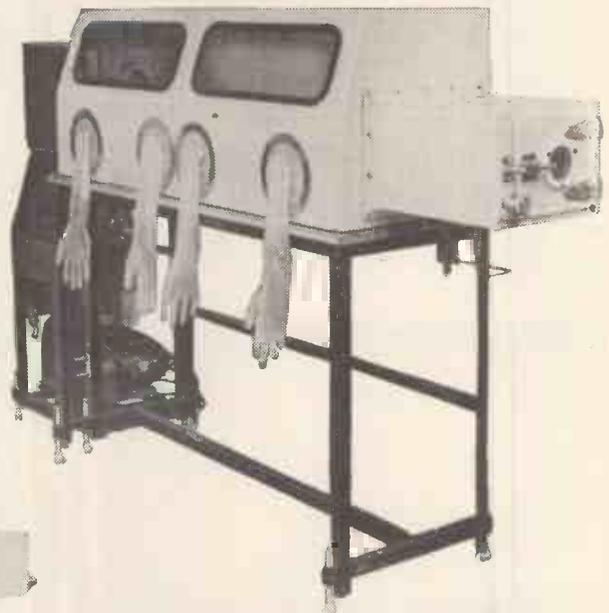


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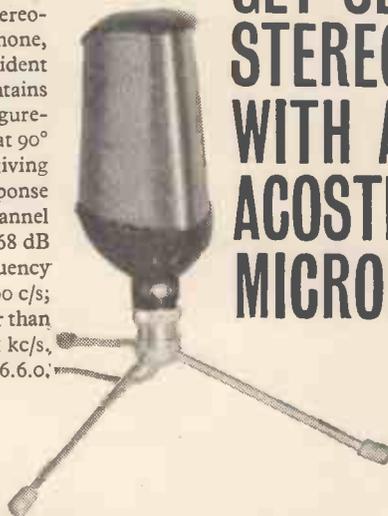
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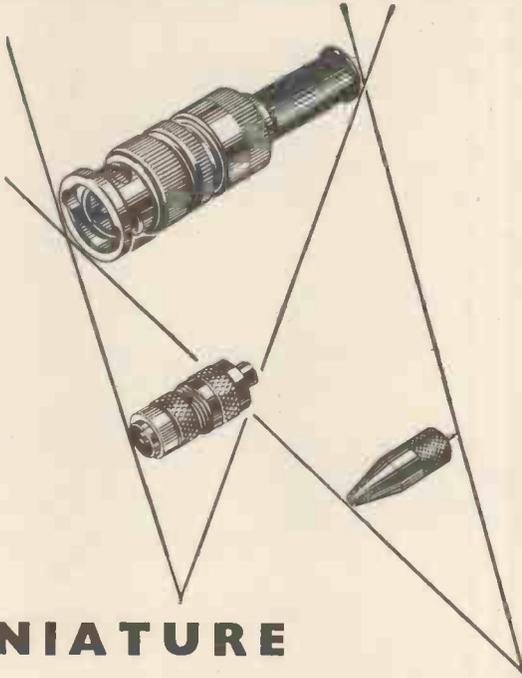


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For example, if a fuselink measuring 1½ in. long by ¼ in. diameter, is called upon to deal with the prospective current envisaged under category of duty 440 v. A.C.4 (33,000 amp.), it will have to withstand a sudden surge of power within its narrow confines equivalent to approximately 20,000 horse-power; the energy released would vaporize the element and burst a glass cartridge with the violence of a small bomb. For this reason, fuselinks for this and similar categories of duty are made with ceramic tubes, of far greater strength than glass, and the space surrounding the element is filled with finely divided silica to act as a shock-absorber, and also to interrupt and quench the arc which is formed along the path of vaporized metal.

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Aspects of design

26

LINE OUTPUT STAGES FOR 110° C.R. TUBES

This is the twenty-sixth 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-seventh of which will appear in the October 1960 issue.

The changes in techniques which have taken place in television line output stages with the introduction of 110° C.R. tubes have been concerned mainly with attempts to keep the power requirements within reasonable limits and to present a linear scan despite the increase in deflection angle.

POWER REQUIREMENTS

The circuit of a typical line output stage for a television receiver using a 110° cathode ray tube is shown below. The general form of the circuit is similar to that used with tubes of 90° deflection angle except in the method of control of picture width. In 90° receivers it was common practice to control picture width by a combination of two variable inductors, one in series with the deflector coil and one shunting a small portion of the transformer primary winding. The variable-position cores of these inductors were mechanically coupled so that as deflection power was by-passed from the deflector coil extra inductance was added in series with the deflector coil to keep the load on the transformer substantially constant. This method, although performing its function admirably, increased the power requirements of the stage by up to as much as 40%. With the higher deflection power requirements of 110° tubes this extra power consumption by the width control is undesirable and other methods have been adopted.

Most receivers control line linearity by means of two closed loops of copper foil inserted between the line deflector coils and the tube neck so as to intercept some of the line deflection flux. This control is moved longitudinally along the neck to a position of optimum linearity. Movement of this control affects both linearity and width of the line deflection and it is found that small movement of the control either side of the position of optimum linearity gives some control of width without seriously changing linearity. The use of this method represents a considerable power saving as compared with the series-parallel inductance control.

An alternative method of controlling width without wasting power may be applied if the stage operates with the working point of the tetrode below the knee of the i_a-v_a characteristic. Under these circumstances the valves behave as a switch connecting the constant voltage of the boosted ht line across the transformer. Picture width can then be controlled by varying the tapping point P of the deflector coil into the transformer. Since this would vary the total effective inductance load of the transformer and hence flyback time it is advisable, at the same time as varying the tapping, to switch into circuit appropriate values of the capacitor C₃ to maintain the flyback time of the transformer, and hence eht, constant.

LINEARITY

The linearity corrector referred to above compensates for asymmetrical non-linearity resulting from the small but finite resistance present in the inductive load of the line output stage. In addition to this non-linearity the greater deflection angle of 110° tubes has necessitated the introduction of measures to correct symmetrical non-linearity introduced by the closeness of the centre of deflection to the screen. If, under these conditions, the current through the deflector coil changes linearly with time, objects at the sides of the picture will be stretched as compared with similar objects in centre. This is most obvious in the line direction where the deflection angle is greater than in the frame. In order to correct this form of distortion the rate of increase of current must be slower at the beginning and end of the stroke than in the middle.

It was necessary to make some correction of this kind when using 90° C.R. tubes but the amount required was small and choice of a suitable value of boost capacitor C₁ usually proved sufficient. This capacitor, passing a roughly sawtooth waveform of current, has across it a voltage waveform approximately parabolic such that the voltage of point O is low at the beginning and end of the deflection stroke and high in the middle. In a stage operating with the output tetrode behaving merely as a low resistance switch this waveform provides the required form of correction.

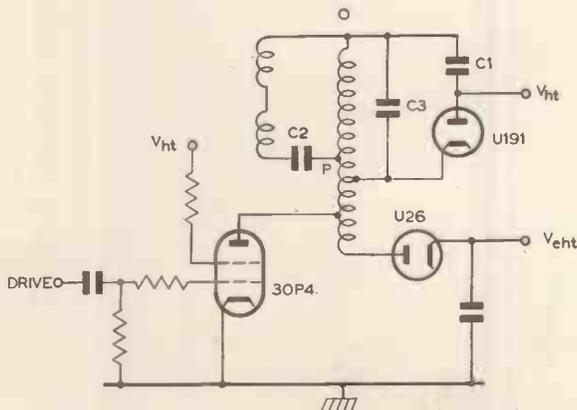
With 110° output stages the amount of correction required is higher than for 90° and by the time sufficient correction voltage has been provided by reduction of C₁ efficiency of the stage has been adversely affected. An alternative method is therefore used. This takes the form of a capacitor C₂ inserted in series with the deflector coil and at the same time returning to a fairly high value of C₁. C₂ carries a sawtooth waveform of current and so has across it a parabolic voltage waveform which reduces the voltage applied to the deflector coil at the beginning and end of the deflection stroke as compared with the voltage in the middle.

In use a difficulty is often encountered with this form of correction. The deflector coil and its series capacitor represent a series tuned circuit of about 4 kc/s resonant frequency. If, due to noise on a synchronising pulse in a directly synchronised receiver, one line is triggered very slightly before its correct instant then there will be a momentary change from the steady state operating conditions of the stage. This change shock excites the tuned circuit and since the circuit has little damping the disturbance remains for the duration of several lines. The consequence is that in directly synchronised receivers operating in areas of poor signal strength noise will cause considerably more "raggedness" of vertical edges than if this form of correction were not in use. A compromise can often be achieved by carrying out part of the correction by a series capacitor and part by a suitable choice of boost capacitor.

FLYBACK PEAK VOLTAGES

In order to effect the greatest possible economies in power consumption it is preferable to operate the stage in such a mode that high boosted ht voltages are produced. This is achieved by tapping the cathode of the efficiency diode into the transformer at such a point that both diode and tetrode are conducting for most of the deflection stroke. High boosted ht voltages result in high peak voltages on tetrode anode and diode cathode during the flyback time. The maximum peak voltages which these valves can tolerate often set a limit to the extent to which this course can be pursued. Techniques such as "Third Harmonic Tuning" and operation with long flyback times are used to lower these voltages as far as possible.

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 Radio and Electronic Components Division
 Technical Service Department
 155 Charing Cross Road, London, W.C.2
 Tel: GERrard 8660. Grams: Sieswan, Westcent, London

EDISWAN MAZDA U381

The U381 is a half wave rectifier, giving a maximum output current of 110 mA, for use in radio receivers and audio amplifiers with series connected heaters.

Heater Current (amps)	I_h	0.1
Heater Voltage (volts)	V_h	38

PRELIMINARY RATINGS AND DATA

Design Centre Ratings			
Maximum Anode Voltage (volts)	$V_{a(max)}$	250	
Maximum Peak Inverse Voltage (volts)	$PIV(max)$	700	
Maximum Heater to Cathode Voltage (d.c. + a.c. pk: cathode positive) (volts)	$V_{h-k(max)}$	550*	
Maximum Mean Anode Current (mA)	$I_{a(max)}$	110	
Maximum Peak Anode Current (mA)	$i_{a(pk)max}$	660	
Maximum Reservoir Condenser (μF)		100†	
Minimum Surge Limiting Resistance (Absolute Value) (ohms)	$R_{lim(min)}$	90‡	

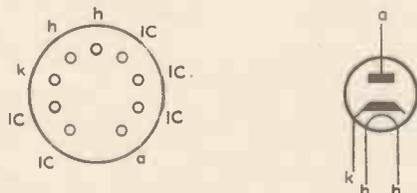
*Measured with respect to the higher potential heater pin.
 †Maximum tolerance + 80%.
 ‡When using a reservoir condenser of 100 μF + 80% with anode voltage 250 V rms.

TYPICAL OPERATION

Input Anode Voltage (volts rms)	$V_{a(rms)}$	110	220	250
Output Load Current (mA)	I_a	110	110	110
Reservoir Condenser (μF)		100	100	100
Surge Limiting Resistance (ohms)	R_{lim}	0	90	100
Rectified Output Voltage (volts)	V_{out}	112	215	245

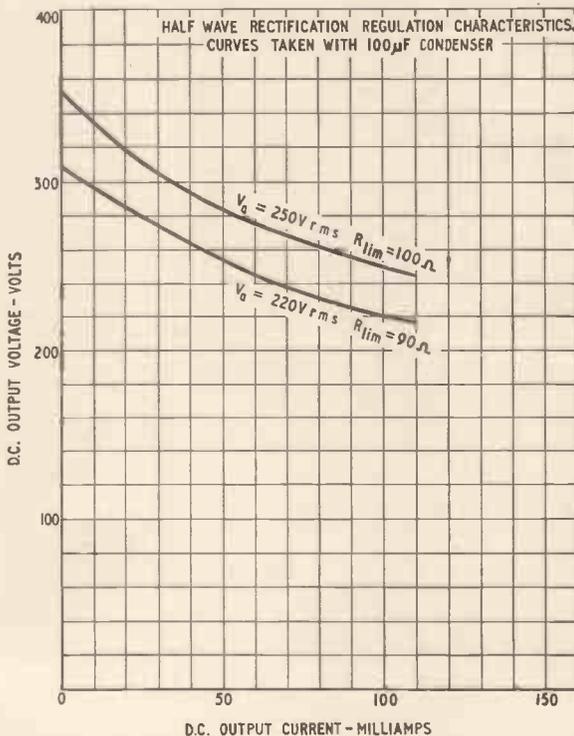
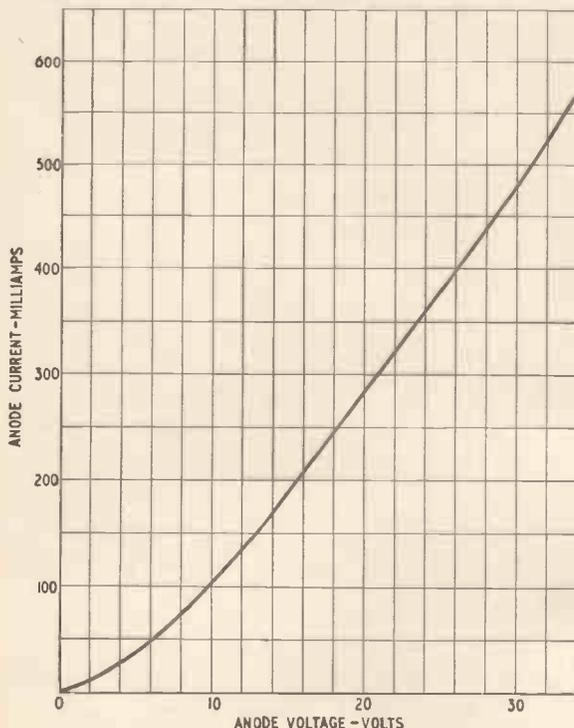
Mounting Position: Unrestricted.
Base: B9A (Noval).

Maximum Dimensions (mm)
 Overall Length 67.5
 Seated Height 60.5
 Diameter 22.2



Characteristic curves of Ediswan Mazda Valve Type U381

Characteristic curves of Ediswan Mazda Valve Type U381



EDISWAN
 MAZDA

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TRADE MARK

SOLDERING EQUIPMENT

*Specialising for the
Electronic Industry.*

Illustrated

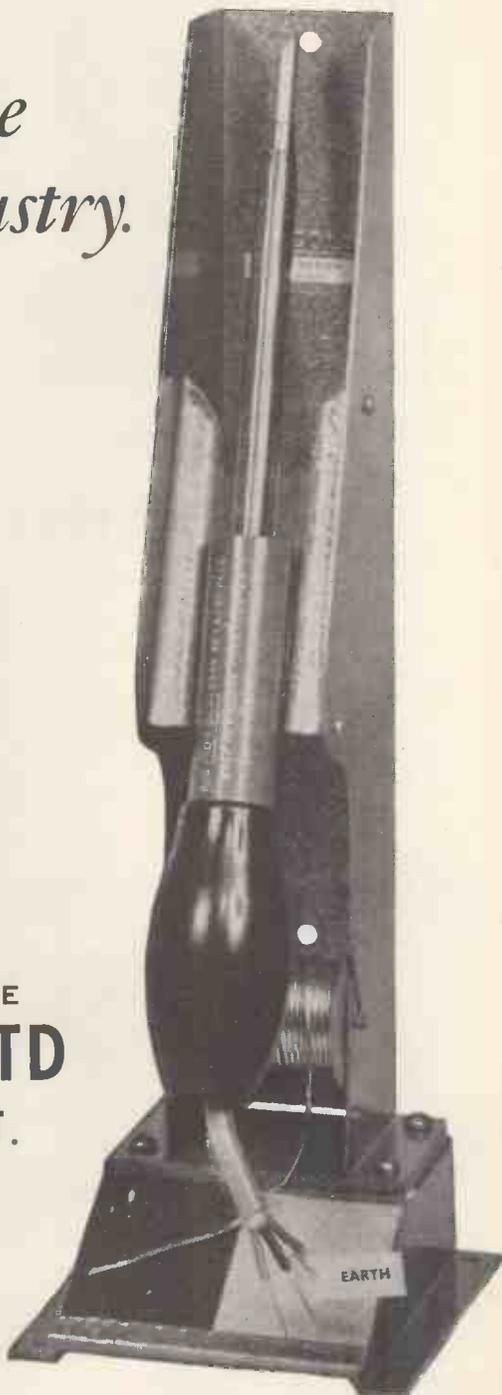
INSTRUMENT LIST No. 64 WITH
COMBINED PROTECTIVE UNIT LIST
No. 700 SHOWING WIPER/ABRASION
PAD AND SOLDER REEL.

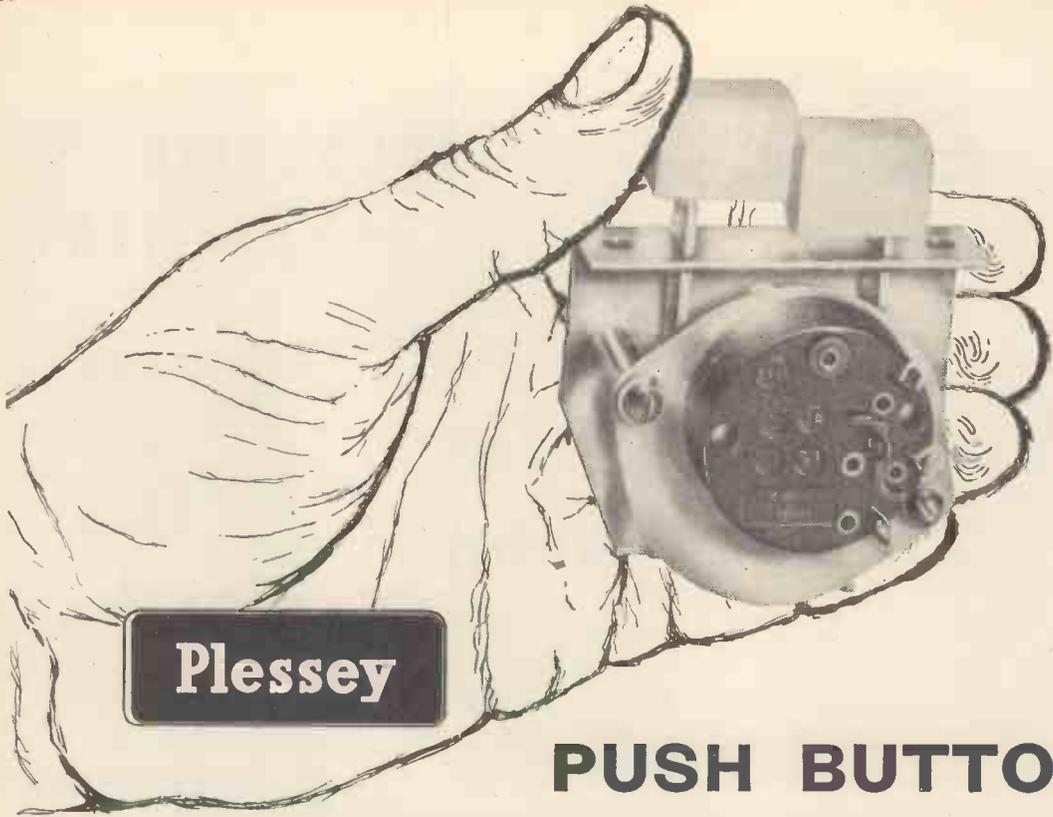
ALL ADCOLA DESIGNS MEET THE
REQUIREMENTS FOR CONTINUOUS
BENCH LINE PRODUCTION.

*British & Foreign Patents
Reg. Designs, etc.*

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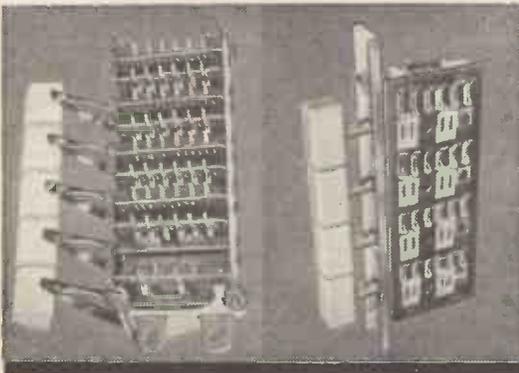




PUSH BUTTON & PIANO KEY SWITCHES

A whole range of PB and PK switches is provided by Plessey to meet the contemporary requirement in TV, radio and audio equipment design. And whether you plan to employ the one or the other, you will find a suitable Plessey switch with the shape of key or button you prefer—in the colour of your choice.

By the use of Plessey switches you can give your equipment the advantage of self-cleaning, positive contact switching with low contact resistance. All Plessey switches are free from electrical noise, due to their unique 'Wedgelock' riveted construction—which represents a great advance over conventional eyeleted methods. Standard or printed circuit contacts.



MINIATURE PIANO KEY SWITCHES

Among the many universally employed ranges of Plessey switches is featured a miniature piano key series, available with either standard or printed circuit contacts.

** May we suggest that you talk to a Plessey Technical Representative about your switch requirements.*

THE PLESSEY COMPANY LIMITED

New Lane · Havant · Hants

Telephone: Havant 1701

Plessey

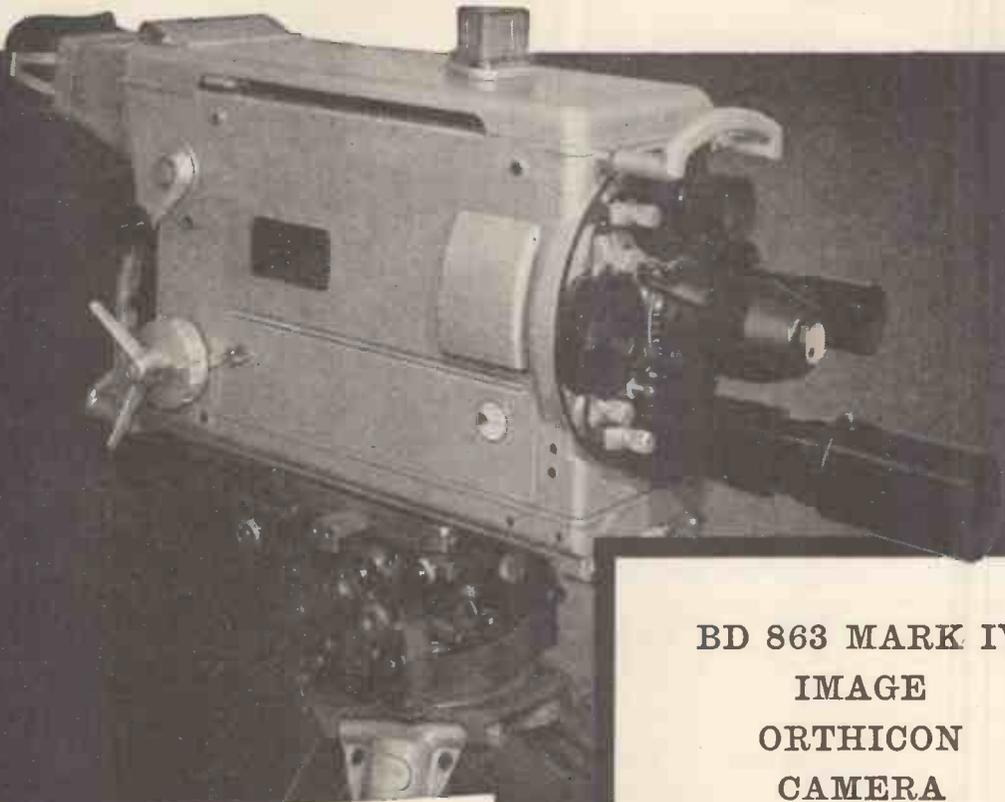
Overseas Sales Organisation: Plessey International Limited · Ilford · Essex · Telephone: Ilford 3040



THE MARK IV CAMERA CHAIN

EXPERIENCE COUNTS

Marconi's pioneered the use of the 4½ inch Image Orthicon Camera using the tube developed by their associates, the English Electric Valve Company. Marconi's have amassed more 'know-how' on the use of the 4½ inch Image Orthicon than any other manufacturer.



**OVER 500 MARCONI IMAGE
ORTHICON CAMERA CHAINS
HAVE BEEN SOLD
THROUGHOUT THE WORLD**

BD 863 MARK IV IMAGE ORTHICON CAMERA

EXTREME STABILITY

Novel circuit design and careful choice of components give such a high degree of stability that operational controls have been removed from the camera.

FIRST CLASS PICTURE QUALITY

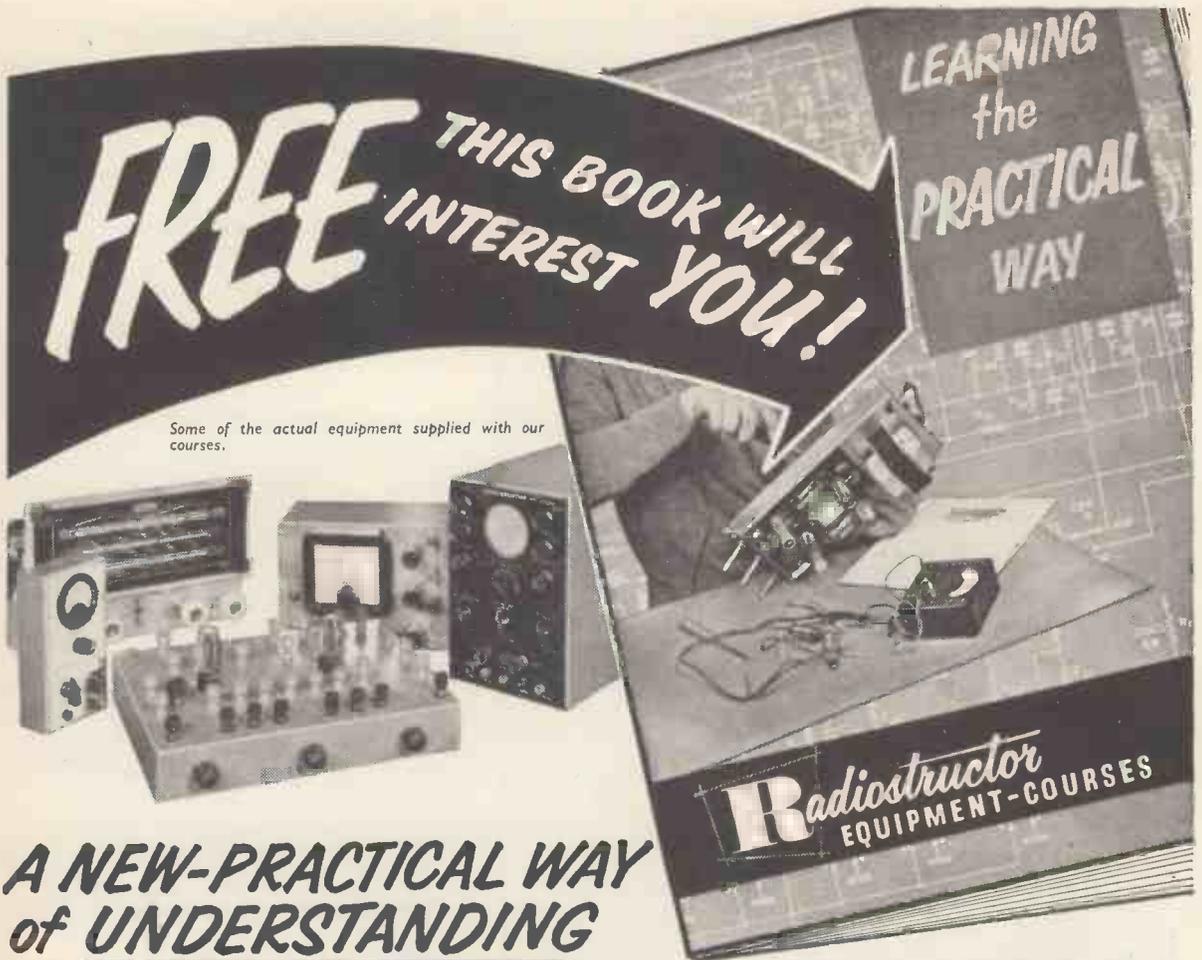
The 4½ inch Image Orthicon tube gives a picture quality substantially better than any other type or size.

LIGHT AND COMPACT

By reducing and simplifying the camera electronics its weight has been held below 100 lb. and its size made correspondingly small.

MARCONI

COMPLETE SOUND AND TELEVISION SYSTEMS



Some of the actual equipment supplied with our courses.

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RADIO · TELEVISION · ELECTRONICS

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Radiostructor—an organisation specialising in electronic training systems—offers a new self-instructional method using specially designed equipment on a “do-it-yourself” basis.

You learn by building actual equipment with the big kits of components which we send you. You advance by simple steps, performing a whole series of interesting and instructive experiments—with no complicated mathematics! Instructional manuals employ the latest techniques for showing the full story of electronics in a practical and interesting way—in fact, you really have fun whilst learning!

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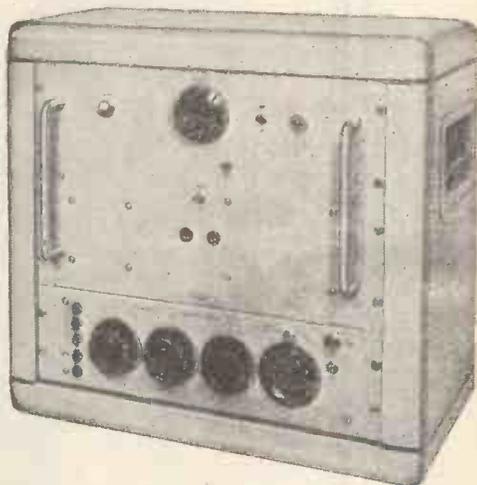
Model W.V.A.

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.

Vortexion quality equipment

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 12½ inches of standard rack space by 11 inches deep. Weight 60lb.

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.

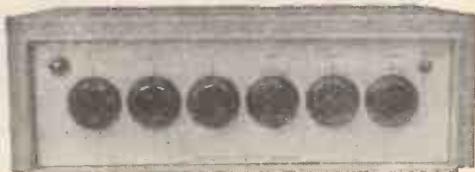
Size 18 x 7½ x 9½ in. deep.

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: LIBerty 2814 and 6242-3

Telegrams: "Vortexion, Wimble, London."

We can get you out of a transmitting valve problem



For over 40 years we have been at it.

Solving problems about valves.

Hard valves, soft valves, RX, TX.

The lot, in fact! And so far as

TX valves are concerned, here's

a tetrode that's truly something

to beam about! The TT21 is capable

of outputs in excess of 150 watts

at frequencies up to 30 Mc/s.

TT21				
f	V_a max	I_a	P_{out}	P_{dtr}
30 Mc/s				
CW	1250 V	175 mA	174 W	0.9 W
CAM	1000 V	150 mA	123 W	0.5 W
AB1 SSB	1000 V	116 mA	80 W	0 W

G.E.C.

valves are obtainable from

THE M-O VALVE CO. LTD

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A subsidiary of the General Electric Co. Ltd

Make a wise choice . . .

buy **LEAK** . . . the first name in High Fidelity

● **Britain's Best**

Hi-Fi Equipment . . .

● **Britain's Best Selling**

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● **Britain's Best Value in**

Hi-Fi Equipment . . .

For over twenty five years we have devoted our activities exclusively to the design and manufacture of Hi-Fi equipment. We were the first manufacturers in the world to design and market amplifiers with a distortion content as low as 0.1%.

This technical lead resulted in a demand for LEAK amplifiers from professional engineers in 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 broadcasts. Also, many gramophone records are cut via LEAK Amplifiers. This acceptance by professional engineers led to a demand from music-lovers throughout the world.

The concentrating of our resources exclusively on Hi-Fi equipment and our world-wide market enables us to offer the best equipment at the lowest prices.

The New "Varislope Stereo"

The New "Varislope Stereo" pre-amplifier incorporates facilities which make it the most comprehensive pre-amplifier presently available.

Price **£25**



Monaural

VARISLOPE III ●
PRE-AMPLIFIER

TL/12 PLUS ●
POWER AMPLIFIER

SOUTHDOWN ●
CABINET

TOTAL

£55:13s.



Stereo

● POINT-ONE
STEREO PRE-
AMPLIFIER

● STEREO 20
POWER
AMPLIFIER

● SOUTHDOWN
CABINET

TOTAL

£72:9s.

**Ask your dealer
for a Demonstration**

Please send details of your equipment including your new "Varislope Stereo" unit to :-

Name

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..... WW/3/60

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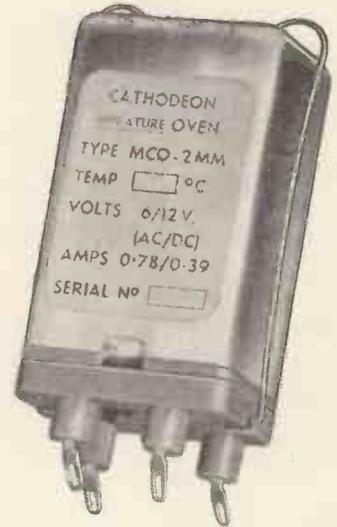
CATHODEON

MINIATURE
THERMOSTATICALLY
CONTROLLED
OVEN

GENERAL DESCRIPTION

This oven was designed specifically for accurate temperature control of Style "J" Quartz Crystal Units but is ideally suited for other components such as transistors, diodes, thermistors, etc., which are sensitive to ambient temperature variations. Heat control is achieved by a bi-metallic thermal switch.

Capacity of the inner shell $1\frac{3}{8}$ " x $\frac{3}{8}$ " x $2\frac{1}{8}$ " (2.0 x 0.9 x 2.3 cms). Overall dimensions $1\frac{1}{4}$ " x $1\frac{3}{8}$ " x $2\frac{1}{2}$ " long (3.2 x 2.0 x 6.6 cms). Weight $1\frac{1}{8}$ oz. (43 grms).



ACTUAL SIZE

OPERATING DATA

6v or 12v supply. Power consumption 4.5 watts. Temperature settings between 50°C and 85°C. Standard tolerance on setting is $\pm 2^\circ\text{C}$ but $\pm 1^\circ\text{C}$ can be supplied. Temperature differential over the operating temperature range is within $\pm 2^\circ\text{C}$ of the setting-up temperature. The heating-up time is less than 5 minutes from $+20^\circ\text{C}$ to $+85^\circ\text{C}$.

CATHODEON CRYSTALS LIMITED
LINTON CAMBRIDGESHIRE

TELEPHONE LINTON 501 (4 lines)



A.C./D.C. Multimeter Kit

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.



Unique Opportunity to build Fine Transistor Set



Constructor's parcel consisting of cabinet approx. size 4 1/2in. x 3 1/2in. x 1 1/2in. with handle and embellishments as illustrated, turning dial tuning condensers and easy-to-follow constructional data. You can build a pocket Transistor set as currently being sold at 17 gu. We can supply all necessary parts at highly competitive prices. Alternatively build your own circuit. Price 22/6 plus 2/6 post and insurance. Circuit diagram and constructional data supplied separately 1/6.

Component Storage Drawers

Stout board construction these drawers are ideal for small parts. Supplied complete with simple erection instructions—1/6 each or 12 drawers each 6 x 2 1/2 x 6 1/2in. 13/6, post 2/-.



The Taylor Meter Model 127A

A pocket size meter but with a big scale and a sensitivity of 20,000 ohms per volt D.C. therefore an ideal unit for television servicing—robustly made and complete with leads and prods—20 ranges as follows: D.C. current 50 micro-amps. to 1 amp. D.C. voltage—0-1,000 volt in seven ranges (25 kV. with external probe, optional extra). Volts A.C.—0-2,500 in six ranges. Ohms—0-20 ohm in three ranges (self-controlled). Self-contained, 3 1/2in. movement. Price £10 or 10/- deposit and 21 fortnightly payments of 10/-. Non-callers add 5/- carriage and insurance.



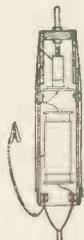
Pocket Transistor Loudspeaker 3

A 2-transistor plus 1 crystal diode receiver for medium and long waves. Easy to carry about, as size only approx. 5 x 4 x 1in. All parts including cream plastic case, miniature loudspeaker. In fact everything needed down to last nut and bolt. Only 22/6 plus 1/6 P. & P. Batteries 10d. extra. Full constructional data included in above price or separately 1/6. Money refunded if not fully up to your expectations.



Transistorised Stethoscope

Trace signal right through—Radio, T.V., Tape amplifier, Hi-Fi, etc.—simplest way to fault find—carry it like a fountain pen—all parts including transistor barrel circuit, everything except battery, 12/6 plus 1/6. Battery 6d.—data included, or separately 1/6.



Philips Transcription Unit

Philips AG2009 Record Player, 4 speed. Ideal for the enthusiast. Pick-up arm wired for stereo, fine adjustment on all four speeds. Continuously variable pick-up weight (2-12 gms.). Supplied with Philips Hi-Fi crystal head, type AG3019 for micro-groove and 78 r.p.m. Frequency response 30-15,000 c/s. Pick-up lifting and lowering device. Individually balanced heavy turntable. Muting switch. Can be used with any amplifier or radio set. Complete with monaural pick up. £21/10/-, or 2 gns. deposit and 19 fortnightly payments of 10/-. Available also with stereo head, diamond or sapphire stylus. Prices on request.

Where the value of your order for small articles exceeds £2 these are post free. Under £2 add sufficient to cover and where carriage or postage specifically mentioned, add this in any case.

SPECIAL THIS MONTH

Twin Twisted Lighting Flex—equivalent 14/36, rubber insulated, cotton covered, 12/6 per 100 yard coil

- Moving Coil Meters
- 0-500 microamp 2in. flush... 17/8
- 250-0-250 microamp ... 2 1/2in. surface 27/6
- 750 microamp 2 1/2in. surface 17/6
- 5-0-5 milliamp 2 1/2in. flush ... 17/6
- 0-30 milliamp 2 1/2in. flush ... 17/8
- 0-100 milliamp 2 1/2in. flush ... 15/-
- 0-200 milliamp 2 1/2in. flush ... 15/-
- 0-500 milliamp 2 1/2in. flush ... 15/-

Unbreakable Mains Lead type of lead fitted to electric razors makes fine lead for test meters and any other devices where subject to continuous bending. Twin figure eight construction, soft cream p.v.c. covered. Normally costs 2/- per yard. Three 6ft. leads for 2/-.

Filament Transformer, 6.3 v., 1 1/2 amps. 6/6. 3 Amp Dropper—tappings marked 200/220/250 3/6.

Output Transformer—standard pentode—4/6, multi ratio, 6/6.

Bi-metal Strip with heavy duty contact—ideal for thermostat, fire, lamp, etc., 2/6.

Neon Lamp—mid-geet wire ended, ideal mains tester, etc., 2/-, ex Govt., 1/6.

5 amp. 12 v. full-wave Charger Rectifier, normal price 17/6. Price 10/-, plus 1/6 post and ins.

Install those extra points, 3,029 twin flat T.R.S. cable. Big purchase enables us to sell this at 45/- per 100 yds., carriage 8/6. Head Phonos, DLRB. Ideal crystal sets, etc., 7/6.

Goodmans Multi Ratio Output Transformer, 6.3 v., 8 ratios, from 1.1 to 72.1. Centre tapped for push/pull, 7/6, plus 1/-. Ditto unbranded, 6/6, post 1/-.

Cold Cathode Valve CV413. Voltage regulator or trigger switch—unused but ex-equipment, 2/6 each.

Tag Panels. Ideal for constructors, experimental circuits, etc., 2 of each of 12 different types. 5/-, post 1/6.

Belling Lee 2BA fully insulated terminals for mounting through metal panels, 1/6 each.

Terminal Heads, insulated 4BA, 2/- doz. .1 mFd. 350 v. Small tubular metal cased condensers made by Dubilier, 2/6 doz.

50 Assorted Resistors. Well mixed and useful values—1/2 and 1/4 watt, 5/- for 50. Ditto, but 1 watt, 6/6 for 50.

Mains Transformer. Standard 230 v. input 250-0-250 at 80 mA., 6.3 v. at 5 A. 12/6, post 1/6.

Toggle Switch. Standard metal body, type with round dolly, fixing ring and on/off indicating plate, 1/3 or 12/- doz.

Metal Rectifier, 250 v. 60-80 milliamps, ideal for mains set or instrument or to replace that expensive valve, 4/6.

Screened Cable. Rubber covered flexible with metal braiding, ideal for microphones or gramophone extensions. 4d. per yd., 30/- per 100 yds.

Sub-miniature electrolytic Condensators, for transistor sets: 1 mfd., 18 v.; 1.5 mfd., 6 v.; 2.5 mfd., 6 v.; 8 mfd., 6 v.; 6 mfd., 6 v.; 5 mfd., 12 v.; 8 mfd., 6 v.; 10 mfd., 6 v.; 16 mfd., 12 v.; 25 mfd., 6 v.; 30 mfd., 3 v.; 2/- each.

Transistor Ferrite Rod Aerial, with minimum and long wave coils with circuit, 8/6.

I.F. Coils, standard size by Weymouth 465KC, dust cores, normally 12/6. Price 6/6 per pair.

Yaxley Switches

- 1 Pole 3 Way 1/6
- 1 Pole 5 Way 2/6
- 1 Pole 12 Way 2/6
- 2 Pole 2 Way 2/6
- 2 Pole 4 Way 2/6
- 2 Pole 6 Way 2/6
- 2 Pole 8 Way 3/6
- 2 Pole 12 Way 4/6
- 3 Pole 3 Way 1/6
- 3 Pole 6 Way 3/6
- 4 Pole 4 Way 2/-
- 6 Position Shorting 2/-
- 6 Pole 3 Way 2/6
- 6 Pole 3 Way Ceramic 3/6
- 8 Pole 2 Way 2/-
- 8 Pole 3 Way 2/6
- 12 Pole 2 Way 2/6

Hi-Fi Snip Infinite Walls Baffle

Nice lily veneered and polished. Corner fitting (attaches to picture rail). Takes up no floor space. Gives really fantastic results with only low priced 8in. speaker. Fitting for tweeter. Only 45/- each. Carriage and insurance 3/6.

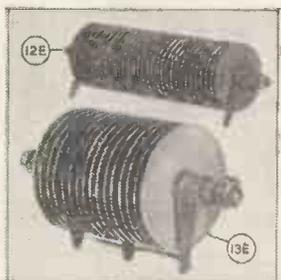


Crystal Mike by Acos



Mod. 39/1, this is ideal for tape or general amplifiers, complete with screened lead, 39/6, plus 1/- post.

Rectifier Bargains



Selenium rectifier type 12, 500 v. 1/2 amp. half-wave, easily rebuilt into full wave or multiple type, contains 30 35 mm. discs. Price 3/6, 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. 1/2 amp., 7/6.

Miniature Microphone

American made. Dynamic type. Real bargain at 2/6, plus 6d. postage.



Heavy Duty Thyatron

Heater 5 volt 20 amp. Peak anode 16,000 volts. Peak plate current 120 amps. Unused perfect condition. £5.

High Voltage Rectifiers

- CV19 63 kV., Peak 800 mA. ... £4 17 6
- CV1504 60 kV., Peak 1200 mA. ... £5 17 6
- CV74 40 kV., Peak 600 mA. ... £2 17 6
- CV1505 8 kV., Peak 1000 mA. ... £2 17 6
- CV1111 14 kV., Peak 350 mA. ... 7 6

ELECTRONIC PRECISION EQUIPMENT, LTD.

post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66 Grove Road, Eastbourne, marked Department 2. Callers may use any of the Companies below.

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266 London Road,
Croydon.
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,
Manor Park, E.12.
Phone: ILFord 1011.
Half day, Thursday.

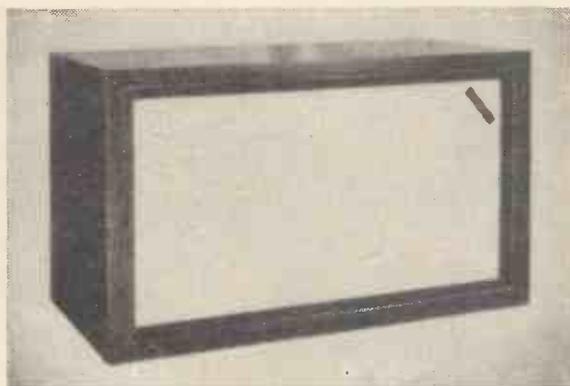
Electronics (Ruislip) Ltd.,
42-46 Windmill Hill,
Ruislip, Middx.
Phone: RUISLIP 5780.
Half day, Wednesday.

GOODMANS

A.L. SERIES NOW INTERNATIONALLY ACCLAIMED . . .

Pioneers of compact Loudspeaker Systems. There was once a time when Full Range High Fidelity reproduction from a Loudspeaker housed in a small enclosure was considered impracticable—the text books said so and this appeared to be confirmed by experimental work.

The first real break-through came in 1939—from GOODMANS—with the introduction of a high compliance twin-cone unit mounted in a totally enclosed 18" cube. After the war, development was taken up again and complete multiple Loudspeaker Systems were developed for use specifically in very small enclosure volume. Again GOODMANS led the market. Then the research development effort was directed to overcome the remaining disadvantages; complexity, low efficiency, high cost. The result was Model A.L./120—



A.L./120 . . . Price £29. 10. 0

(Price applicable in U.K. only)

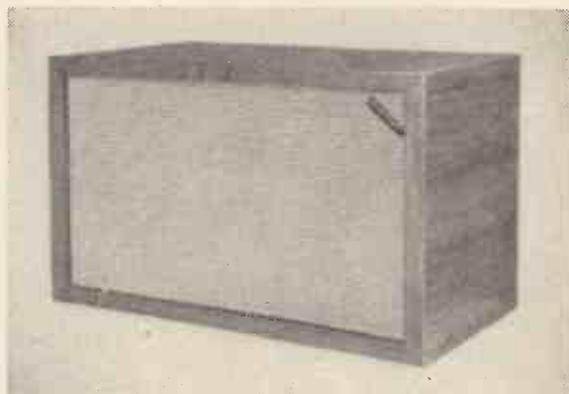
incorporating all the valuable experience gained over many years as well as the latest developments in enclosure loading, diaphragm design, high frequency radiation, magnet design, to say nothing of advanced methods of precision manufacture. This achievement is best judged and appreciated by ear; the actual description of the A.L./120 is as follows:—Frequency range 35 c/s to 20,000 c/s with a maximum power handling capacity of 15 Watts, (U.S.A. 30 Watts). Overall enclosure size—24" x 11½" x 14¼". Enclosure loading—Acoustical Resistance: (GOODMANS Patent No. 790997 [British]).

GOODMANS INDUSTRIES LIMITED
Axiom Works, Wembley, Middlesex

Tel.: WEMbley 1200 (8 lines) Grams: Goodaxiom, Wembley, England

In every sense the greatest range—in every country the greatest name.

Drive unit: 12" Triaxial unit comprising three concentrically mounted radiating elements, each designed to specialise in low distortion reproduction of one part of the overall scale; bass, middle, treble; and integrated on to a common axis to approach the ideal of the "point source" radiator with its freedom from phase interference between the separate units. Bass radiation is from a large diaphragm with plastic treated high compliance suspension, with mechanical crossover to a moulded high stability mid-range radiator; and finally electrical crossover (twin ½-section L.C. network 12 db/octave) to a high precision horn loaded high frequency pressure unit, with separate L-pad balance control.



A.L./100 . . . Price £23. 10. 0

(Price applicable in U.K. only)

Model A.L./100 also follows these lines in most respects, except that it employs a two element drive unit and provides smooth coverage from 35 c/s to 15,000 c/s., with a power handling capacity of 12 Watts, (U.S. A. 24 Watts).

Both Models available in Walnut or Mahogany finish.

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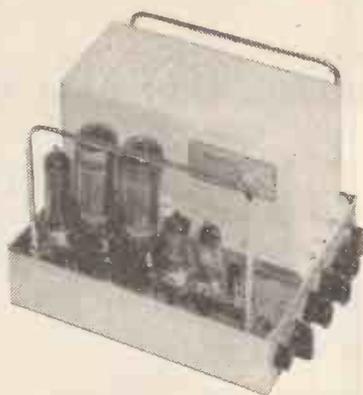
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Trade Office—Stand No. 220. Audio Hall
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RADFORD STYLED

M.A.15 POWER AMPLIFIER

SPECIFICATION

OUTPUT POWER	15 watts nominal. 12 watts <0.1% distortion.
OUTPUT IMPEDANCE	4 Ω, 8 Ω, 16 Ω selected by switch.
SENSITIVITY	250 millivolts input for 15 watts power output.
HUM & NOISE OUTPUT	-85 dB.
FEEDBACK	27 dB.
STABILITY MARGIN	>27 dB.
VALVE COMPLEMENT	1-EF86, 1-ECC83, 1-EZ81, 2-EL34.
POWER OUTLET (preamplifier)	6.3 v. @ 2 A., 360 v. @ 20 M.A.
Consumption	Approx. 90 watts @ 240 v. A.C.
Size (chassis)	8½ x 6¼ x 7in. (overall height).
PRICE	23 gns.



PRECISION EQUIPMENT



D.S.M. STEREO CONTROL UNIT

A STEREOPHONIC CONTROL UNIT OF ENTIRELY NEW CONCEPTION IN ELECTRO-MECHANICAL DESIGN AND STYLING. PROBABLY THE SMALLEST PREAMPLIFIER CONTROL UNIT IN THE WORLD YET EMPLOYING 6 STAGES PER CHANNEL, INCLUDING A LOW NOISE TRIODE CONNECTED PENTODE INPUT STAGE AND A CATHODE FOLLOWER OUTPUT. IT HAS NEGLIGIBLE HUM AND NOISE AT FULL POWER OUTPUT GAIN SETTING. THE SUPERIOR PERFORMANCE OF RADFORD POWER AMPLIFIERS CAN BE REALISED FROM HIGH QUALITY LOW LEVEL INPUT SOURCES WITH THIS UNIT. VALVE COMPLEMENT: 4 x EF86 + 4 x ECC83.

PRICE

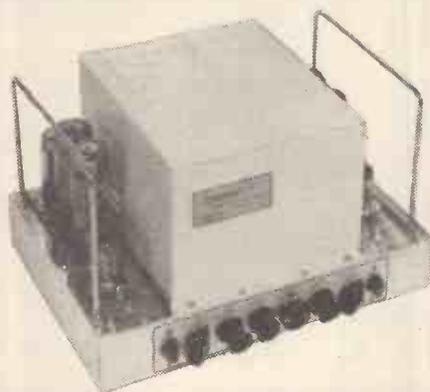
33 gns.

YOUR FINAL CHOICE

STA 12 STEREO POWER AMPLIFIER

SPECIFICATION

OUTPUT POWER	12 + 12 watts <0.1% distortion.
OUTPUT IMPEDANCE	4 Ω, 8 Ω, 16 Ω selected by switch.
SENSITIVITY	225 millivolts input for 12 watts power output.
HUM & NOISE OUTPUT	-85 dB.
FEEDBACK	27 dB.
STABILITY MARGIN	>27 dB.
VALVE COMPLEMENT	2-EF86, 2-ECC83, 4-EL34, 1-GZ34.
POWER OUTLET (Preamplifier)	6.3 v. @ 2 A., 350 v. @ 20 M.A.
CONSUMPTION	Approx. 150 watts.
SIZE (chassis)	12½ x 9½ x 7¼in. (overall height).
PRICE	37 gns.



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RADFORD AUDIO EQUIPMENT WILL BE AVAILABLE ONLY THROUGH AUTHORISED DEALERS WHO ARE SPECIALISTS

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Communications for Oil Pioneers



TYPE 800

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High or low power versions to suit propagation conditions.

Will work into any type of telephone exchange with improved 'outband' tone signalling facilities.

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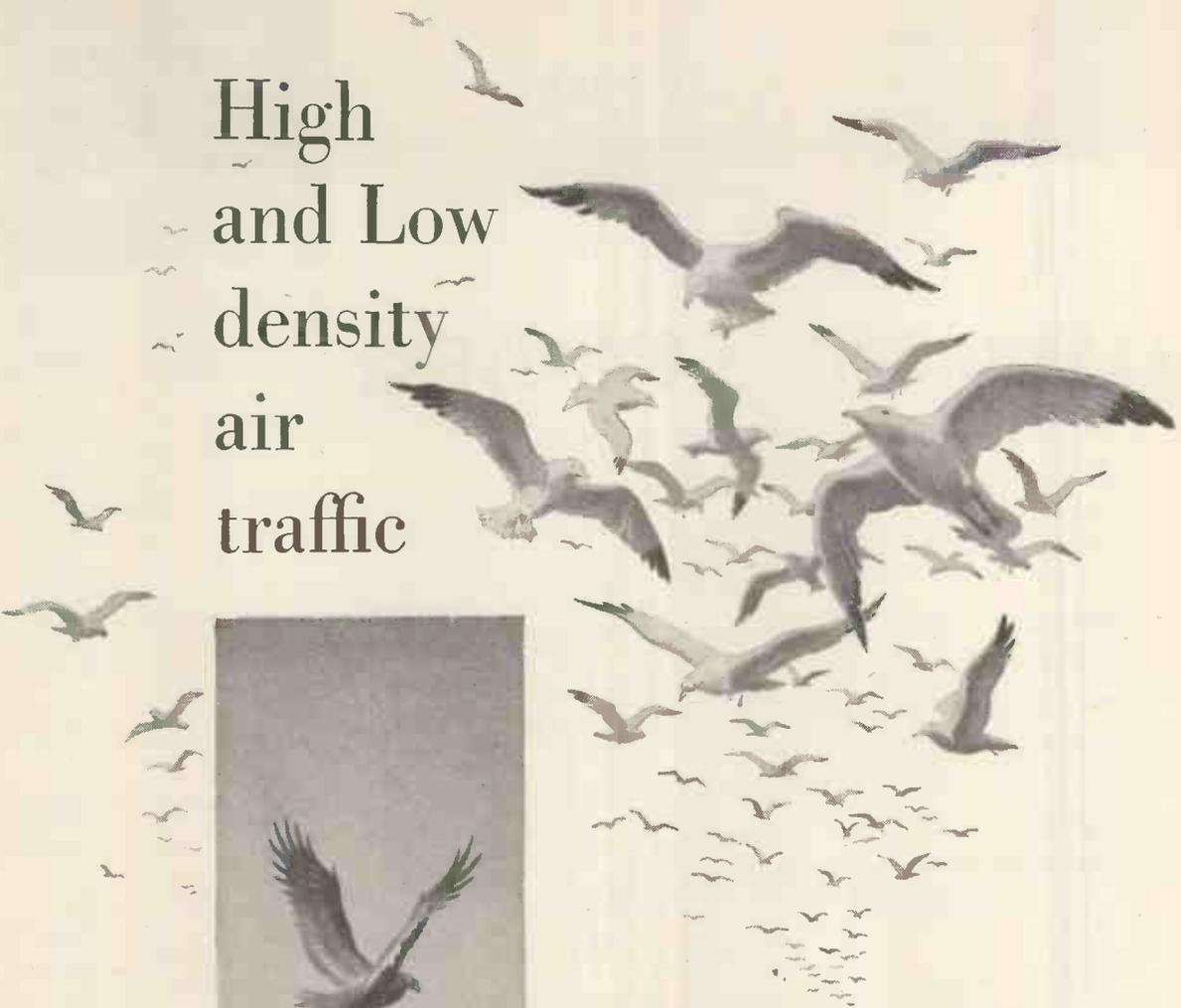
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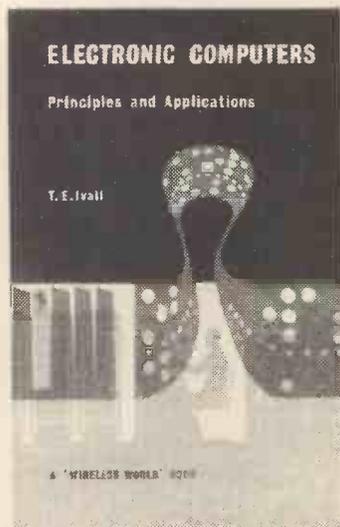
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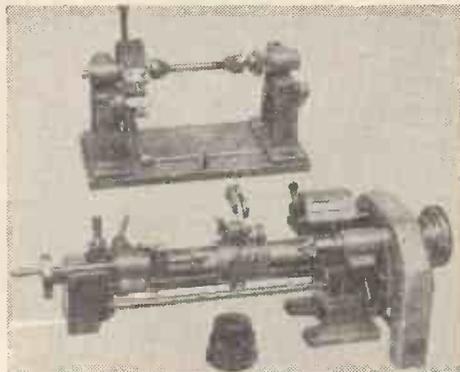


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Model 'E' is a new addition to the famous range of Eta Coil Winding Machines. It will wind coils 6in. x 6in. also may be arranged to wind Flat Resistance Strips up to 6in. long.

A large diameter Lead-screw gives the feed great accuracy and runs in Ball-Races. The reverse is manual and only One Gear needs changing for the alteration to feed.

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Record-Playback-Erase Heads for recording 4 Tracks on $\frac{1}{4}$ " Tape

NOW AVAILABLE AT A PRICE TO SUIT ALL TAPE RECORDERS

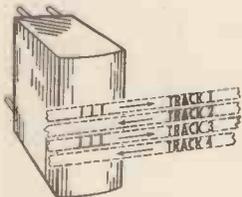
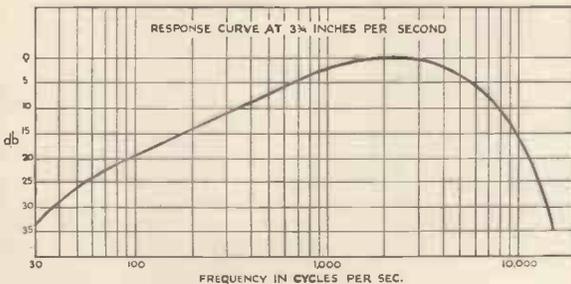
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The new 4-Track Standard has been brought out so as to take the maximum advantage of developments over the past few years in the manufacture of Tapes—of Heads—and in Tape Recorder Design. Most Technical Experts now agree it is unlikely that any further advances in the future could be of sufficient magnitude to suggest the use of more than 4 Tracks on $\frac{1}{4}$ in. Tape for Standard Tape Recorders.

One factor alone has held up the adoption of this Standard and that has been the high cost of manufacturing the Heads. We have now removed this obstacle.

THESE ARE THE ADVANTAGES OF FOUR TRACKS

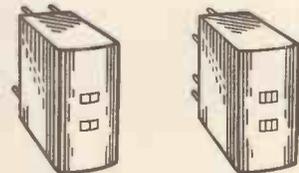
- ★ Tape Recorders fitted with 4-Track Heads will give **DOUBLE THE PLAYING TIME** on a reel of Tape (compared with the Two-Track System); so for the small additional cost of a Four-Track Head you **HALVE** the entire cost of Tape.
- ★ The new 4-Track Standard calls for a gap of **ONE TEN-THOUSANDTH OF AN INCH**. MARRIOTT Heads comply with this standard, they have a guaranteed frequency response which allows for as good results at $3\frac{1}{2}$ IPS as was previously obtainable at $7\frac{1}{2}$ IPS.
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ACTUAL SIZE OF HEAD
HEIGHT $\frac{1}{8}$ " DEPTH $\frac{1}{4}$ " WIDTH $\frac{1}{8}$ "

TECHNICAL SPECIFICATIONS

PLEASE NOTE — Heads for the Four-Track Standard are themselves made to record on TWO Tracks, so that with the tape reversed (other way up) they record a total of Four Tracks (see Diagram).

RECORD/PLAYBACK HEADS

Track width	0.043 in.
Impedance	400mH at 1 Kc/s.
Gap	0.0001 in.
Bias Current	0.45-0.8mA.
Record Current	30-80µA.
Output	1.4-2.5mV. (at 2 Kc/s. at $3\frac{1}{2}$ in/sec.)
Recorded Crosstalk	Better than -70 dB.
Playback Crosstalk	Not measurable

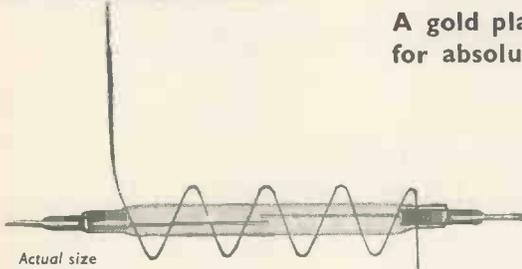
ERASE HEADS

Track width	0.056 in.
Gap	Double Gap each of 0.004 in.
Impedance	200Ω at 50 Kc/s.
Volts	10 V at 50 Kc/s.
Current	50-60 mA.

XS2

Dry Reed Relay Insert

A gold plated relay contact hermetically sealed in inert gas for absolute reliability, high speed and low contact bounce.



Actual size

maximum current ...	250 mA
maximum resistive load ...	15 W
maximum closed resistance...	50 mΩ
minimum open resistance ...	5 x 10 ¹¹ Ω

nominal operate ampere turns	120 AT
nominal release ampere turns	60 AT
operate time less than ...	2 mS
bounce time less than ...	0.5 mS
release time less than ...	0.5 mS

our Technical Service Department is ready to provide further details of characteristics on application.

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PP10—a mains operated power pack with a switched output of 10, 50, 70, 90, 110, 130, 150, 170, 190, 210, 230 or 250 volts fully smoothed D.C. at 100 milliamps. A separate, fully insulated supply at 6.3 volts 3 amps. is included. The pack is housed in a silver grey metal case size only 7in. x 5in. x 4 1/2in. Price £5/10/-.

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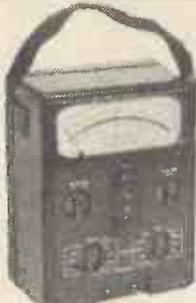
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No. 2. Capacity 18 gauge mild steel x 24in. wide	£5 5 0
No. 3. Capacity 16 gauge mild steel x 18in. wide	£5 5 0

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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.	Resistor: 1,000Ω
750 v.			10,000Ω

ONLY £8/10/6 (Postage, etc., 3/6).



OSCILLOSCOPE No. 01 by Cossor. A First Grade L.F. Oscilloscope incorporating a Hard Valve Time Base with speeds of 1.5-40 milliseconds, but easily converted for a few shillings to produce 3 c.p.s. to 30 kc/s. Has High Class Amplifier with Fine and Coarse Gain controls, Brightness and Focus controls, X and Y shifts. A.C. mains pack for 115 v.-230 v. nominal, fully fuse protected. Employs 2 2 1/2in. Tube ACR 10. Front panel 19in. x 7in., for rack mounting, depth 12in., or can be used in Steel Transit Case on bench. Complete with suggested Modification data. **BRAND NEW AND UNUSED. ONLY £12/10/-** (carriage 15/-).

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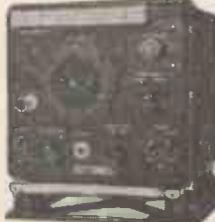
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1 milliamp	D.C. 2 1/2in. Flush circular	30/-
1 milliamp	D.C. 2 1/2in. Flush circular	25/-
1 milliamp	D.C. 3 1/2in. Flush circular	50/-
200 milliamp	D.C. 2 1/2in. Flush circular	12/6
20 amps	D.C. 2in. Proj. circular	7/6
40 amps	D.C. 2in. Proj. circular	7/6
5 amps	D.C. 2in. Flush square	12/6
300 volts	A.C. 2 1/2in. Flush circular	25/-
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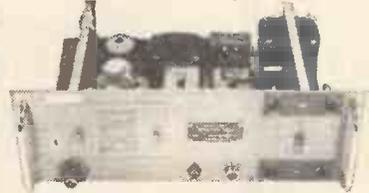
INTERCOM. TELEPHONE SET. Two pairs of Brand New Headphones connected to Breast Microphones, with leads, etc., in fitted carrying cases. Supplied with 4 1/2 volt battery, 10 yards twin flex, and full instructions for connecting to make super intercom. **ONLY 27/6** (Post 3/6). Extra flex 3d. per yard.

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Utilises 4 valves, 1 each 5Z4G 6V6G 6J7G, 6J5G and high quality components such as "C" Core Transformers and Block Paper Smoothing Condensers. A.C. Mains Pack for nominal 110 x 230 volts. Provision for 500 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 Valve Inspection Panel. **BRAND NEW IN MAKER'S PACKING. ONLY £49/6** (carriage 10/6).

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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 CR2/S. Incorporates the new COLLARO "STUDIO" TWIN TRACK 3-speed Deck..... **£39.10.0**
H.P. Terms: Deposit £7/18/- and 12 months of £2/17/11.
- MODEL CR3/T. Incorporates the very popular 3-speed COLLARO Mk. IV "TRANSCRIBTOR" Deck, which has both upper and lower tape tracks..... **£47.10.0**
H.P. Terms: Deposit £9/10/- and 12 months of £3/9/8.
- MODEL TR3/Mk. VI. Incorporates the New TRUVOX Mk. VI TWIN TRACK 3-speed Tape Deck..... **£49.10.0**
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7.

TAPE AMPLIFIERS and PREAMPLIFIERS presented from MULLARD DESIGNS

MODEL HF/G2A-D

A complete self-contained Tape Recorder chassis incorporating Loudspeaker and comprising the Model HF/G2A Amplifier connected to the Garrard Tape Deck. Operates at 3 1/2 in./sec. speed and supplied fully tested and ready for immediate operation. Designed for easy fixing into a portable case or cabinet, only four fixing screws being required.

£25.0.0

Complete working unit containing 4in. spool of Long Playing Tape.

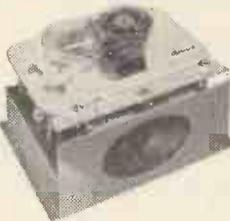
H.P. TERMS: Deposit £5 and 12 monthly payments of £1/16/8.

Alternatively we offer—Complete Kit of Parts to build the HF/G2A Amplifier with the ASSEMBLED AND TESTED GARRARD TAPE DECK for **£22.0.0**

H.P. Deposit: £4/8/- and 12 months of £1/12/3

The Amplifier, Model HF/G2A is available separately for:

- (a) Complete kit of parts **£11.0.0**
- (b) Assembled **£12.15.0**



MODEL HF/G2P-D

THE IDEAL "LINK" TO ADD FULL TAPE RECORDING FACILITIES TO HIGH QUALITY HOME INSTALLATIONS, RADIOGRAMS, etc. Comprises the HF/G2P Tape Pre-amplifier fitted to the Garrard Tape Deck, operates at 3 1/2 in./sec. speed, connects into the tape input or pick-up sockets of existing amplifier or Radio Chassis.

COMPLETE WORKING UNIT, containing 4in. spool of Long Play Tape. **£23.15.0**

Hire Purchase Terms: Deposit £4/15/- and 12 monthly payments of £1/14/10.

Alternatively we offer—Complete Kit of Parts to build the HF/G2P Pre-amplifier with the ASSEMBLED AND TESTED GARRARD DECK for **£20.15.0**

Deposit, £4/3/- and 12 months at £1/10/5

The Pre-amplifier, Model HF/G2P is available separately for:

- (a) Complete kit of parts **£9.10.0**
- (b) Assembled **£11.5.0**



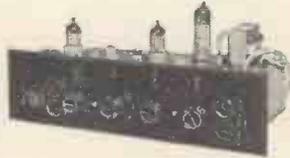
MODEL HF/G2E

Contains the Model HF/G2A-D UNIT (described opposite). A small robust recorder with outstanding performance. Truly portable, weighs only 22lbs. Twin Track operates on 3 1/2 in./sec. speed. Price **£29.15.0**

H.P. Terms. Deposit £6 and 12 months at £2/3/7.

MODEL HF/TR3 TAPE AMPLIFIER

(Mullard Type "A" design)
A very high quality Amplifier incorporating 3-speed treble equalisation, using the latest FERROXUCUBE POT CORE INDUCTOR. FOR COLLARO-TRUVOX-BRENELL WEARITE or MOTEK TAPE DECKS, has GILSEN Output Transformer. Includes separate Power Supply Unit.



£12.15.0 or ASSEMBLED..... **£16.10.0**

KIT OF PARTS H.P. £3/6/6 Deposit and 12 months at £1/4/2.

MULLARD TYPE "C" TAPE-PREAMPLIFIER ERASE UNIT

The "Hi-Fi" link to add full tape recording facilities to High Fidelity home installations. Incorporates FERROXUCUBE POT CORE PUSH-PULL OSCILLATOR and 3-speed treble equalisation by FERROXUCUBE POT CORE INDUCTOR. FOR WEARITE — COLLARO — TRUVOX — BRENELL or MOTEK TAPE DECKS. Includes separate Power Supply Unit.



or ASSEMBLED..... **£17.0.0**
KIT OF PARTS H.P. £3/8/- Deposit and 12 months at £1/4/11. (Excluding Power Unit £11/15/- and £14/10/- respectively).

FOR THE HOME CONSTRUCTOR SPECIAL "COMBINED ORDER" PRICES

- (a) The COLLARO "STUDIO" TAPE DECK and our Mullard Type "C" PRE-AMPLIFIER and Power Unit assembled and tested..... **£29.10.0**
- (b) As above but Type "C" PRE-AMPLIFIER supplied as complete Kit of Parts..... **£26.10.0**
- (c) The COLLARO Mk. IV TAPE DECK and the MULLARD Type "C" PRE-AMPLIFIER and Power Unit assembled and tested..... **£35.0.0**
H.P. Deposit £7 and 12 months £2/11/4.
- (d) As 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**
- (g) The BRENELL Mk. V Deck and the assembled Type "C" PRE-AMPLIFIER and Power Unit..... **£46.0.0**
- (h) As above, but the Type "C" supplied as complete Kit of Parts..... **£43.0.0**
- (i) The WEARITE 4A DECK with Type "C" assembled and tested..... **£56.0.0**
H.P. Deposit £11/4/- and 12 months £4/2/1.
- (a) COMPLETE KIT to build the HF/TR3 Amplifier, together with the COLLARO "STUDIO" DECK..... **£25.10.0**
- (b) As above but HF/TR3 ASSEMBLED and TESTED..... **£29.0.0**
H.P. TERMS: Deposit £5/16/0, 12 months of £2/2/6.
- (c) COMPLETE KIT to build the HF/TR3 together with the Mk. IV COLLARO "TRANSCRIBTOR" DECK (£1 extra if we are required to wire up Deck Banks)..... **£30.15.0**
- (d) As above but HF/TR3 ASSEMBLED and TESTED..... **£34.10.0**
H.P. Terms: Deposit £7, 12 months at £2/10/5. (£1 extra is we are to wire up Deck Switch Banks)
- (e) COMPLETE KIT to build the HF/TR3 together with the NEW TRUVOX Mk. VI TAPE DECK..... **£36.0.0**
- (f) As above but HF/TR3 ASSEMBLED and TESTED..... **£39.10.0**
H.P. Terms: Deposit £7/18/-, 12 months of £2/17/11.
- (g) COMPLETE KIT to build the HF/TR3 AMPLIFIER with the BRENELL Mk. V TAPE DECK..... **£41.10.0**
- (h) As above but HF/TR3 ASSEMBLED and TESTED..... **£45.0.0**
H.P. Terms: Deposit £9, 12 months of £3/6/-.
- (i) THE ASSEMBLED and TESTED HF/TR3 AMPLIFIER with the WEARITE MODEL 4A DECK, incorporates Wearite Head Lift Transformer, etc..... **£55.0.0**
H.P. TERMS: Deposit £11 12 months of £4/0/8. (Carriage and Insurance on each above is 10/- extra)

(Carriage and Insurance on above quotes 10/- extra)

ALL THE ABOVE CAN BE SUPPLIED IN A PORTABLE CASE FOR £5/10/0 extra, THUS FORMING A COMPLETE PORTABLE PRE-AMPLIFIER.

Attractive PORTABLE CASE is available to accommodate the TRUVOX or COLLARO TAPE DECKS and we offer it together with ROLA/CELESTION 10 x 6in. LOUDSPEAKER—ACOS CRYSTAL MICROPHONE—and 1,200ft. SPOOL E.M.I. TAPE—ALL FOR..... **£9.10.0**
(Carriage and Insurance 5/- extra)

STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4

Telephone: FLEET STREET 3812/3/4

FULLY DESCRIPTIVE LEAFLETS ON ALL OF ABOVE ARE AVAILABLE—BUT PLEASE ENCLOSE S.A.E. AND STATE WHICH LEAFLET IS REQUIRED.

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 Output Trans.)..... **£10.00**
 Alternatively we supply ASSEMBLED AND TESTED **£11.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra

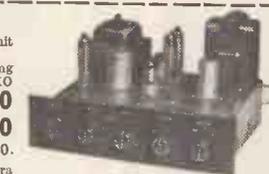
MULLARD'S PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER, but also perfectly suitable for other makes. Supplied strictly to MULLARD SPECIFICATION and incorporating:
 ● Equalisation for the latest R.I.A.A. characteristics.
 ● Input for Crystal Pick-ups and variable reluctance magnetic types.
 ● Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier.
 ● Sensitive Microphone Channel. ● Wide range BASS and TREBLE Controls.
 Price: COMPLETE KIT OF PARTS **£6.6.0**
 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-VALVE 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.
 Price for COMPLETE KIT OF PARTS **£7.10.0**
 (Plus 6/6 carriage and insurance).
 Alternatively supplied ASSEMBLED AND FULLY TESTED (Plus 6/6 carriage and insurance).... **£8.19.6**
 H.P. TERMS: Deposit £2 and 8 monthly payments of £1.



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 £1/16/8.
- (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 £1/16/8.
- (i) COMPLETE KIT OF PARTS to build Two "5-10" Main Amplifiers (Incorporating Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit..... **£31.0.0**
- (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 MULLARD 3-3 Main Amplifiers on one chassis. Operates with MULLARD STEREO PRE-AMPLIFIER. Output power 6 watts. Inputs for Crystal Pick-up and Radio Tuner.
 KIT OF PARTS..... **£10.0.0** or ASSEMBLED..... **£11.15.0**

COMPLETE STEREO AMPLIFIER

Meets the many requests for a low priced but good quality Stereophonic Amplifier. Output power is 4 watts and suitable for Crystal Pick-ups.
 KIT OF PARTS..... **£8.10.0** or ASSEMBLED..... **£10.10.0**

STEREO DUAL CHANNEL PRE-AMPLIFIER

This model incorporates two 2-valve Pre-Amplifiers (described above) combined into a Single Unit enabling it to be used for both STEREOPHONIC and MONAURAL operation. It is designed primarily to operate with our range of MULLARD MAIN AMPLIFIERS but will also operate equally well with any make of Amplifiers requiring an input of 250 mv.
 Price: COMPLETE KIT OF PARTS **£12.10.0** Alternatively ASSEMBLED AND TESTED **£15.0.0**
 H.P. Terms on assembled unit: £3 Deposit and 12 months of £1/2/-



THE MULLARD FOUR CHANNEL MIXING UNIT

Will be available late September both as COMPLETE KIT OF PARTS and an ASSEMBLED AND TESTED UNIT. It incorporates two input channels for Microphones, one for Crystal Pick-up and a fourth for Tape or Radio.
 FULLY DESCRIPTIVE LEAFLET and prices available late September.

Mk. II "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard Amplifiers.
 FOR THE CONSTRUCTOR..... **£10.10.0** or ASSEMBLED..... **£14.5.0**

SPECIAL CASH ONLY OFFER !!

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY **£8.7.6** (plus 7/6 carr. and ins.). The Amplifier consists of a 2-stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey Colour Resine—WE ALSO SUPPLY SEPARATELY—
 (a) The 2-stage (plus Rectifier) AMPLIFIER **£4 2 6**
 (b) The PORTABLE CARRYING CASE **£3 17 6** (Carriage and Insurance 4/- extra)
 (c) 6 1/2 in. P.M. SPEAKER **18 9**



"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY GOODMANS—WHARFEDALE—W.B. ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

THE "ADD-A-DECK" incorporating the NEW B.S.R.

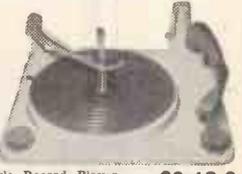
"MONARDECK" & MATCHED PRE-AMPLIFIER
 Carriage and Insurance 10/-.
 Deposit £3/12/- 12 mths. £1/6/2 **£17.17.0**
 Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER through which first-class results are obtained. It consists of a Twin Track Tape Deck, incorporating matched Pre-amplifier, and operates at 3 1/2 in./sec. speed. Supplied fully tested and completely assembled on an attractive wood plinth, and only requires connections to the mains supply and the Pick-up Sockets, for which purposes "floating" leads are incorporated.
 H.P. TERMS ARE AVAILABLE ON ALL EQUIPMENT OVER £9. FULLY DESCRIPTIVE LEAFLETS ARE AVAILABLE FOR ALL EQUIPMENT, BUT PLEASE SEND S.A.E.



!! 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. 9.6**
- The NEW B.S.R. Model UA12 is in stock. A 4" SPEED MIXER AUTOCHANGER **£8. 7.6**
- UA12 is also available incorporating the B.S.R. STEREO Pick-up, plays LP and 78 records. **£10.10.0**
- GARRARD RC210 4-speed Autochanger fitted with latest Crystal Pick-up **£10.10.0**
- The latest GARRARD TRANSCRIPTION MOTOR "301" with Stroboscopically marked turntable **£23.18.4**
- The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A. 12 Pick-up arm and G.C.S. Crystal Cartridge **£18.7.6**
- GARRARD Model TA/Mk. II Single Record Player fitted with high output Crystal Pick-up (detachable head) **£8.10.0**
 HIRE PURCHASE TERMS available on all units £8/19/6 and over Carriage and insurance on each above 5/- extra.



!! HOME CONSTRUCTORS !!

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" speakers give really first-class reproduction and are well recommended. Models are also available to accommodate high-quality Amplifiers, Pre-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.

LASKY'S RADIO



AMAZING NEW TAPE RECORDER BARGAIN OFFER

A complete Tape Recorder using Collaro Studio 3-speed Deck, 1½, 3½, 7½ i.p.s. Twin track, with pause control, rev. counter, latest type electronic recording indicator. Superimposing switch, volume and tone controls, 7x4 loudspeaker, 4 watts output. Takes 7in. spools. In contemporary design carrying case, 9½x16x16in. Brand new, fully assembled ready for use. Limited number.
LASKY'S 29 GNS. Including Acos mike and 1,200ft. Scotch Tape.
 PRICE 29 GNS. Carr. & ins. 25/-.

TAPE RECORDERS

Largest stocks in London.

- BRENELL, CLARION, COSSOR,
- ELIZABETHAN, ELEKTRON,
- FIDELITY, FI-CORD,
- FERGUSON, FERROGRAPH,
- GRUNDIG, HARTING,
- KORTING, MINIVOX,
- PHILIPS, REFLECTOGRAPH,
- SOUND, SIMON, STEELMAN,
- STUZZI, TANDBERG,
- TELEFUNKEN, TRUVOX,
- TRIX, STELLA, WALTER

TAPE RECORDER AMPLIFIER

for use with Collaro Studio Transcriber. Uses 3 valves, magic eye, contact cooled metal rectifier. Incorporates mike/gram/radio inputs, ext. l.s. jack, superimposing switch. Complete with gold/black knobs.
12 Gns. Post 3/6.

PLASTIC TAPE SPOOLS

3in.	5in.	5½in.	7in.	8½in.
2/9	2/9	2/9	2/9	5/6
7in. Metal Spools, 1/9 each				
Post extra.				

"INSTANT" BULK TAPE ERASER

and Head Demagnetiser. Erases a complete reel of magnetic Tape in few seconds. 27/6. Post free.

TAPE DECK OFFERS



B.S.R. "MONARDECK" single speed, 3½ i.p.s., uses 5in. spools.
Lasky's Price £8/19/6.
 Carr. & ins. Tape extra.

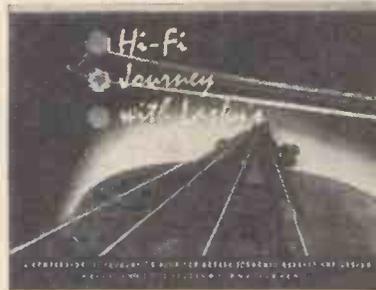


COLLARO STUDIO TAPE TRANSCRIBTOR. 3 motors, 3 speed, 1½, 3½, 7½ i.p.s., takes 7in. spools. Push-button controls. £12/19/6.
 Carr. & ins. 12/6. Tape extra.

COLLARO TAPE TRANSCRIBTOR Mk. IV, fitted digital counter. List £25.
Lasky's Price £17/16/6
 Carr. & ins. 21/- Tape extra.

LONDON'S LEADING Hi-Fi SPECIALISTS

Visit either of our addresses for selective Demonstrations of the very latest Hi-Fi Equipment.



- AMPLIFIERS
- F.M. TUNERS
- TAPE RECORDERS
- TRANSCRIPTION TURNTABLES
- SPEAKERS
- PICK-UPS
- CABINETS

Our Fabulous Hi-Fi Catalogue NOW AVAILABLE. SEND FOR A COPY TODAY

"Hi-Fi Journey with Lasky's" is the title of our superb new catalogue and it takes you all through the realm of high fidelity reproduction. Nothing like it has ever before been offered. Over 100 large pages, 11½x8½in. in photogravure and colour. It is a COMPARATOR-CATALOGUE to enable you to choose from all the latest and most advanced equipment. Price 3/6 part post 6d.
 Fully refunded on making your first hi-fi purchase.

SPECIAL OFFER OF TAPE

Famous make. P.V.C. base on latest type plastic spools. Brand new, boxed and guaranteed. 1,800ft. on 7in. spool, **32/6**



1,200ft. on 7in. spool..... 21/-
 1,200ft. on 5½in. spool..... 22/6
 850ft. on 5½in. spool..... 16/6

SCOTCH PLASTIC TAPE
 1,200ft. on 7in. spool..... 25/-
 Post: 1 spool, 1/6.
 Orders over 60/- post free.

GEVAERT L.P. TAPE
 1,700ft. on 7in. spool..... 35/-
 850ft. on 5in. spool..... 16/6
 210ft. on 3in. spool..... 5/11
 Post: 1 spool 1/6.
 Orders over 60/- post free.

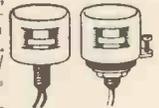
ALL MAKES OF TAPE. Long Play, Double Play and American "MYLAR."

TRANSCRIPTION MOTORS

GARRARD 4HF stereo and monaural, complete with two plug-in heads, £18/9/-.
 Carr. & Ins. 12/6.
 GARRARD 301 £22 7 3
 GARRARD 301 (Strobe) £23 18 4
 PHILIPS £10 10 0

HIGH FIDELITY TAPE RECORDER HEADS

Leading make, new and unused. Upper or lower track. RECO RD/PLAYBACK, high impedance. Double wound and will reproduce up to 12,000 c.p.s. at 7½ i.p.s. Azimuth adjustments. Output 5 millivolts at 1 Kc. at 7½ i.p.s. ERASE, low impedance. **39/6**
Lasky's Price, per pair,
 Post free. Worth double. Please specify upper or lower track.



Avantic

For 200-250 v. A.C. mains. Brand new in maker's cartons, fully guaranteed. Full details of any item post free.



SPA11 Stereo Amplifier and Pre-Amplifier, twin 10 watts output. 3-dimensional monaural reproduction by combining both channels. 3 inputs for each channel. Size 14½in. wide, 4in. high, 8½in. deep.
 List £29/8/-. **Lasky's Price 19 Gns.**
 Carr. & Ins. 7/6.



SP21/2 Stereo Pre-Amplifier Control Unit, twin channel. Designed primarily for use with two DL7-35 Power Amplifiers (as on right). 8 inputs for each channel. Freq. response 40 c/s.-15 Kc/s. List £28/10/-.
Lasky's Price £16/19/6
 Carr. & Ins. 7/6.



DL7-35 Power Amplifier. 54 watts peak output. Freq. response 5 c/s.-30 Kc/s ± 0dB. Two DL7-35 Amplifiers can be used in conjunction with SP21/2 Pre-Amplifier Control Unit for stereophonic reproduction. Size 14½in. long, 9in. wide, 8½in. high. List Price £31/10/-.
Lasky's Price £16/19/6
 Carr. & Ins. 12/6.

SPECIAL COMBINED OFFER

The above Unit and two DL7-35 Power Amplifiers offered at a special inclusive price of 47 Gns.
 Carr. extra.

BUILD THIS FINE 3-SPEED TRANSISTOR RECORD PLAYER

FOR £9.19.6 Carr. 7/6

6 volt operation. For all L.P. and standard records. Complete parcel comprises:—

AMPLIFIER. 300 milliwatts output, using two OC71 and two OC72 transistors. Fully assembled. 79/6. Knobs 3/6 extra.

LOUDSPEAKER. 30 ohms, 7x4in. elliptical. Speaker matched to amplifier. 25/-.

3-SPEED TURNTABLE with rubber mat and speed adjustment, complete with t.o. crystal cartridge and two sapphire styli. 79/6.

CARRYING CASE as illustrated, handsome two-tone finish, size 17in. deep, 14in. wide, 5½in. high. 49/6.

Batteries extra. All components available separately. Build this modern Record Player for ££s less than an equivalent ready-built player.



H.P. TERMS AVAILABLE
on certain goods.
Call or write stating your requirements.

LASKY'S RADIO

MICROPHONE BARGAINS

The "Diana." High impedance moving coil mike with unique magnetised table base. Response 30 15,000 c.p.s. Ideal for tape recordings. List 4 Gns.
Lasky's Price **55/-**
Post free.



ACOS type 33/1. Crystal hand or table Mike, 29/6. Post 1/6.

RIBBON MIKE on table stand. High impedance, famous make. £6/16/6. Post 3/6.

3-TRANSISTOR POCKET RADIO

The VANCOUVER employs 3 transistors plus germanium diode, on printed circuit size 3¼x4x½in. Tunable over medium and long waves. Built-in Ferrite rod aerial. Complete Kit of Parts, with circuit diagram, 39/6. Post 1/6. Circuit diagram only 1/6, post free.

BARGAINS IN 4-SPEED AUTO-CHANGERS

New and Unused in Maker's Cartons



- B.S.R. type UA8..... £6 19 6
 - B.S.R. UA8, stereo..... £7 19 6
 - B.S.R. UA12, stereo... £8 19 6
 - B.S.R. type UA14..... £7 19 6
 - COLLARO Conquest, wired for stereo, with monaural p.u. £7 19 6
 - As above, stereo..... £8 19 6
- Post on all above 5/-.

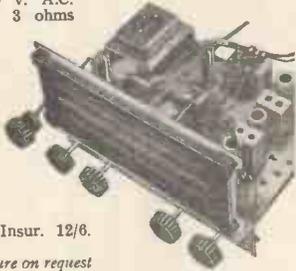
SPECIAL OFFER! PRINTED CIRCUIT GRAM AMPLIFIER

Uses two valves, ECL82 and EZ80 and separate mains transformer to minimise hum. Incorporates Elac 8x5in. loudspeaker with output transformer mounted. Concentric volume and tone controls. Size of printed circuit: 4 x 3 x 2½in. Lasky's Price **69/6** complete,

Post 2/6. Less Speaker, 55/-.

7-VALVE AM/FM RADIOGRAM CHASSIS

Famous make. For 200-250 v. A.C. Output 4 watts matched to 3 ohms speaker. 7 valves: ECC85, ECH81, EF89, EABC80, EL84, EZ80, EM81, magic eye tuning indicator. Covers medium, long and FM bands. Length 12in., height 7½in., front to back 8½in. Limited number only.



LISTED AT 22 GNS.

LASKY'S PRICE

£16.19.6 Carr. and Insur. 12/6.

Available on H.P. terms. Brochure on request

"LINEAR" AMPLIFIERS

"DIATONIC" 10-14 watts 12 Gns.
"CONCHORD" 30 watt 15 Gns.
L45 4.5 watt Amplifier 25/19/6
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.

P.M. SPEAKERS

ROUND
3½in. 4in. 5in. 6½in. 8in.
17/6 19/6 14/6 16/- 16/6

ELLIPTICAL
7x4 9x6 10x2½ 10x6 10x7
15/6 22/6 25/- 25/- 32/6

Post extra.

ANOTHER GREAT OFFER! FERGUSON F.M. TUNER

FM/1. Brand new and unused. Employs 3 valves and incorporates own power supply. Freq. range 87.6 to 100 Mc/s continuously. Metal case, hammer finish, size 10in. x 7½in. x 2½in., with smart escutcheon in cream. LIST PRICE 13 GNS.

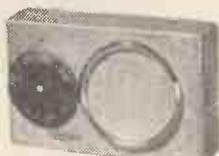
LASKY'S PRICE **£12.19.6**

Carr. & Ins. 12/6.

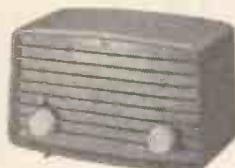
BUILD THIS COSSOR POCKET SUPERHET

The 4-transistor "Traveller's Friend," using OC44, two OC45, and OC72 transistors, two OC70 diodes, two AGC systems, 2½in. M.C. speaker, Ferrite slab aerial, etc., in leatherette case, size 6x3½x1½in. All components, printed circuit with full instructions. **£7.19.6** Post 2/6.

All components available separately.



LASKY'S MIDGET T.R.F.



CAN BE BUILT FOR **£4.19.6** Post & Pkg. 5/-

Handsome contemporary design case, overall size 8½in. wide, 4½in. deep, 6in. high, 2 latest double-purpose valves EBF89 and ECL80, contact cooled rectifier. For A.C. mains 200-250 v. med. and long wave, 5in. P.M. speaker. Plastic cabinet in cream, pastel green, pink, blue.

FULL DATA, instructions, circuit diagram, shopping list, 1/6.

The "Shira" TRANSISTOR SIX POCKET RADIO

Lasky's Price **£13.15.0**



Post 2/-.

Very small—only 4 x 2½ x 1½in., and slips easily into pocket or lady's handbag. Selectivity and tonal quality truly remarkable. Built on printed circuit with six transistors, 2in. m.c. speaker, Ferrite aerial, etc. Covers medium waveband. Operates on PP3 9 v. battery, obtainable everywhere. Cream and various colours. In carton, with additional plastic protective case, ready for use. PP3 9 v. Battery, 2/6 extra.
Optional extra: Earpiece, complete with jack, 19/6.

LASKY'S CAR RADIO CAN BE BUILT ABSOLUTELY COMPLETE

FOR **£12.10.0** Post 3/6.



- ★ 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 2/6 post free (returned if you order).

GARRARD

- Model 121. Mk. II..... £10 10 0
- 121, Mk. II STEREO £11 10 0
- 121, Mk. II, with monaural and Stereo heads £12 10 0
- RCC.88..... £12 19 6
- RC.88 STEREO..... £13 19 6

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Auto start and stop. Complete with pick-up and crystal cartridge.
GARRARD 4SP..... £6 19 6
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E.M.I. 4-sp., wired for STEREO and fitted Acos stereo T.O. cartridge..... £6 19 6
Post on all above 5/-.

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COLLARO JUNIOR 4-speed motor and separate pick-up with cartridge styli..... £3 15 0
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PICK-UP CARTRIDGES

ACOS HGP.59 or HGP.37 turnover crystal cartridge with L.P. and standard styli. List 39/7.
Lasky's Price **18/-** post free.

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Lasky's Price **29/6** post 1/-.

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We hold the largest selection of leading makes: ARMSTRONG, DULCI, EMPRES, etc. A.M. chassis (l., m., s.) from..... 7 Gns.
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A.M./F.M. STEREO from 22 Gns.

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LARGEST AND MOST COMPREHENSIVE STOCKS FOR ALL CONSTRUCTORS

20,000 VALVES IN STOCK
Mullard, Brimar, G.E.C., Mazda, Cossor, E.M.I., Philips, Pinnacle, Telefunken, etc. Send for our latest Valve List.

CABINETS
W/B PRELUDE, G. PLAN, NORDYK, CAPRIOL, etc., etc.

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, EM84, magic eye, EZ80 rect.
 - ★ Choice of speaker: 7x4, 8x5, 9x4, 6in., 8in., etc.
 - ★ Collaro Studio or B.S.R. Monardeck Tape Deck.
 - ★ Complete with Acos 39/1 Mike, Tape and Spool.

PRICES FROM

20 GNS. (B.S.R. deck)
25 GNS. (Collaro deck)
All components available separately
Full details and shopping list post free on request.



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"ALFA" MULTI-RANGE RADIO TEST METER. A.C. and D.C. 3,333 ohms per volt. Ohms ranges to 2 megs. Volts A.C. and D.C. up to 1,200. 300 microamps—300 mA. Decibels, 2 ranges—20 to +23 db; +20 to +37 db. Accuracy ±3%. Large full vision dial. Overall size: 5½ x 3½ x 1½ in.
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PRINTED CIRCUIT VERSION OF G.E.C. 912 "F.M. PLUS" TUNER FOR HOME CONSTRUCTION
Uses 5 valves, 2 germanium diodes and brand new T.C.C. condensers. The PRINTED CIRCUIT ensures that the I.F. and R.F. amplifiers are extremely stable at maximum gain and results are consistent on all tuners.
CAN BE BUILT FOR (including valves) 7 GNS.
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ALIGNMENT SERVICE available.

BUILD THE LABGEAR AUDIO OUTPUT METER

Two ranges: 25 milliwatts to 1 watt, 1 watt to 10 watts.
Accuracy 5% and matched for 3, 15 and 600 ohms. Ideal for constructors, hi-fi enthusiasts.
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SHORT WAVE CONVERTER FOR CAR RADIO

Smith's "Radiomobile" Converter offers short wave reception of your favourite stations. 6 or 12 v., positive or negative earth. Uses 6BE6 heptode freq. changer. Easily installed, may be used with any car radio. Chrome escutcheon, cream push buttons. Size 1½ x 7 x 5 in. All plugs and sockets included. Supplied with 3 removable coil units of your choice. Bandsread: 16, 19, 25, 31, 41, 49, 60, 90 metres.
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Seconds but in perfect working order and guaranteed.
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| 14in. rect. | £8 10 0 | 12/6 |
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Large selection, many by famous makers such as Cyldon, Brayhead, Plessey, Cossor, etc., all I.F.s. New and unused. Let us quote you for the model required. Examples:
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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/-**

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Type T81. Suitable for all audio applications. Each **3/6**
Post 6d.
One dozen 35/- post free.

Special prices quoted for large quantities.

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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/-.
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For use on A.C. mains, 100-250 v. Plug in anywhere and get the smoothest, closest, speediest shave ever! Vibratory action tones up face. Swiss make, cream finish. Limited number only. Worth 7 Gns.
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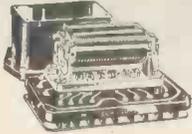
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SOLENOID OPERATED MAGNETIC RELAY.

Type 5CW/3945, 4 pole changeover, 10 A contacts 24 v. operation. Brand new 13/6. P. & P. 1/6.

NEW CARPENTER'S TYPE POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/-.



Carpenter's, similar to above, but type 5A48. Coils 1 x 3200 turns at 100 ohms and 1 x 2000 turns at 145 ohms, 22/6 each. P. & P. 1/-. Bases for same 2/6.

SIEMENS H.S. RELAY. Very latest type, sealed. H96E. 1,700 ohms plus 1,700 ohms, single C.O. contacts. Brand new with fixing clip. In maker's cartons. Price 16/6 each, plus 1/- P. & P.



Siemens sealed similar relay to above, but 2.2 ohms plus 2.2 ohms. Minus clips, 12/6 each. Plus 1/- P. & P.

SUPERIOR BRAND NEW RELAY. 7,000 ohms coil. Will pull in at 750 microamp. and out at 450 microamp. Change-over, platinum contacts. Vacuum sealed, will therefore not be affected by oil, moisture or water and never needs adjusting. Weight 2 1/2 oz. Price 18/6. P. & P. 1/-.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each. Operating current minimum 140 microamp., nominal 400 microamp, maximum 8 milliamp. One pole two way, or centre stable. Two way contact current 100 mA. at 50 V. A.C. or D.C. Size 1 1/4 x 3/8 x 3/16 in. Price 22/6 each.



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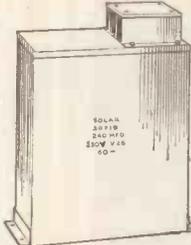
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AUTO TRANSFORMERS. Step up, step down, 110-200-220-240 v. Fully shrouded. New. 300 watt type £2/2/- each. P. & P. 2/6. 500 watt type £3/3/- each. P. & P. 3/9. 1,000 watt type £4/4/- each. P. & P. 6/6.



HIGHLY PRECISION MADE GEARED MOTOR BY DRAYTON REGULATOR CO., for 230 volt 50 cycles S.P. A.C. input, 37 rev. per min. Overall size 5 in. x 4 in. x 5 1/2 in. Ex brand new equipment, unused. Price £3/17/6. P. & P. 3/-.

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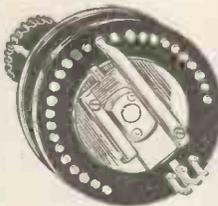
DIAL THERMOMETER. Made by Short & Mason. Calibrated 0-160 degrees Fahrenheit. 4 1/2 in. dial. 6 in. rim for flush mounting with 6 in. long rod protruding at the back. Brand new. Manufacturer's packing. Price 22/6. P. & P. 3/-.

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 SOUND POWER OPERATED EX-ADMIRALTY HEAD AND BREAST SETS. Two such sets connected up will provide perfect intercom., no batteries required. Will operate up to 1/2 mile. Original manufacturer's boxes. Price 17/6 each, plus P. & P. 2/-; or 32/6 per pair. P. & P. 3/-.



MUIRHEAD PRECISION. 1 bank, 1 pole, 25 position Stud Switch. Brand new. Price 12/6. P. & P. 1/-.

CERAMIC PRECISION SWITCH. 2 pole, 6 way, 4 banks. New in manufacturer's boxes. Price 10/6 each. P. & P. 1/6.

MINIATURE INSTRUMENT RECTIFIERS. Bridge Type 1 milliamp. Guaranteed perfect, 7/6 each.

S.T.C. RECTIFIER. 36 plates by 120 mm. Bridge connected. Maximum A.C. input 60 volt. D.C. output 15 amp. New, perfect. Price 60/- P. & P. 3/6.

8-day clockwork Time Switch. Contacts 2 1/2 amp., 230 volt, 24 hour phase, 1/2 hour divisions, allow setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 1/6.



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7 1/2 amp. D.C. M.I. 3 1/2 in. proj. rnd.	12/6
9 amp. D.C. Hot Wire W.R. 2 1/2 in. fl. rnd.	6/6
15 amp. D.C. M.C. 2 in. rnd.	10/6
30 amp. D.C. M.C. 2 in. fl. sq.	12/6
100 amp. A.C. M.I. 4 1/2 in. fl. rnd.	32/6
Voltmeters	
12 v. D.C. M.C. 2 1/2 in. proj. rnd.	8/6
20 v. D.C. M.C. 2 in. fl. sq.	9/6
25 v. D.C. M.C. 2 in. fl. rnd.	7/6
30 v. M.I. 3 in. proj. rnd.	10/6
40 v. M.C. 2 in. fl. sq.	9/6
300 v. A.C. M.C. 2 1/2 in. fl. rnd.	27/6
300 v. A.C. M.I. 2 1/2 in. fl. rnd.	22/-
400 v. A.C. M.I. 4 1/2 in. rnd.	35/-
Milliammeters	
1 mA. M.C. 2 1/2 in. fl. rnd.	25/-
50 mA. M.C. 2 in. fl. sq.	9/6
500 mA. M.C. 2 1/2 in. fl. rnd.	9/6
Microamp	
50 microamp., scaled 0-100, M.C. 2 1/2 in. fl. rnd.	42/6
15 microA. 2 1/2 in. square, side fitting scales	35/-
500 microA. M.C. 2 in. rnd.	16/6

Postage on all meters 1/- each.

Miniature latest type moving coil 0-5 milliammeter, 1 1/2 in. diameter, flush fitting complete with fixing clip. Price 17/6. P. & P. 1/-.



CRYSTAL CALIBRATOR No. 10. A crystal controlled 4-valve high-grade instrument in the same category as the famous B.C. 221.



Directly calibrated, does not require cross reference or charts — functions as follows: (1) A crystal controlled oscillator which provides fixed frequency signals of 500 KC to beyond 10 Meg. and up to 30 Meg. (2) A variable oscillator from 250 KC to 5 KC, this enables all intermediate frequencies between 250 Kc/s. and 30 Meg. to be produced and modulated. Supplied complete with 3 spare valves, all leads and maker's instruction book in carrying haversack. The complete outfit is brand new — repeat NEW. Price: £4/19/6. Carr. 3/-.

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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Ideal for all Intercom systems, house, office, building sites etc. Generator bell ringing, 2-line connection. Supplied complete with batteries and wooden carrying case, fully tested.



59/6 each per telephone, plus 3/6 P/P.

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.	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



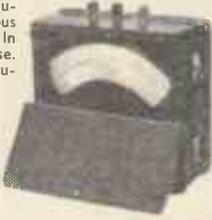
Ranges 1.5, 3, 7, 15, 30, 60, 300 and 450 amps. 8in. mirror scale. Meter housed in polished teak case. Supplied complete with all shunts and leather carrying case. £15 each. P/P. 7/6.

7.5 KVA AUTO TRANSFORMERS 115/230 VOLTS

Brand new and boxed Ex. U.S.A.
£15 each plus carriage.

PORTABLE PRECISION VOLTMETERS

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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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.



METER BARGAINS

25 microamp D.C. M/C flush rd. 2 1/2in.	69/6
25 microamp D.C. M/C. proj. rd. 2 1/2in.	59/6
50 microamp D.C. M/C. proj. rd. 2 1/2in.	49/6
100 microamp D.C. M/C flush rd. 3 1/2in.	62/6
500/0/500 microamp D.C. M/C proj rd 2 1/2in.	19/6
1 milliamp D.C. M/C flush sq 2in.	22/6
1 milliamp D.C. M/C flush rd 2 1/2in.	25/-
1 milliamp D.C. M/C flush rd 3 1/2in.	50/-
1 milliamp D.C. M/C flush sq 4in.	69/6
200 milliamp D.C. M/C. flush rd. 2 1/2in.	9/6
15 amp. D.C. M/C. Proj. rd. 2"	8/6
30 amp. D.C. M/C. flush rd. 2 1/2in.	9/6
15 volt D.C. M/C. flush rd. 1 1/2in.	10/6
120 volt D.C. M/C. flush rd. 3 1/2in.	32/6
300 volt A.C. M/L. flush rd. 2 1/2in.	25/-
300 volt A.C. M/C. rect. flush rd. 2 1/2in.	25/-
500 volt A.C. M/L. flush rd. 2 1/2in.	25/-

BRAND NEW MEDRESCO HEARING AIDS

Fully tested, complete with earpiece, all necessary leads and battery pouch. Incorporates three sub-miniature valves and sensitive crystal microphone. Price only 32/6 each, plus 1/- P. & P. Batteries 5/- extra.



COLLARO STUDIO TAPE TRANSCRIPTORS.

Brand new, fully guaranteed, 3 speeds, 1 1/2, 3 1/2, 7 1/2, 3 motors, digital counter etc. 200/250v. A.C. operation. Supplied complete with 7in. spool, instructions and fixings. Only £12/19/6 each. P/P. 5/- Tape not supplied.



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/-.



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.

PARMEKO TABLE TOP TRANSFORMERS

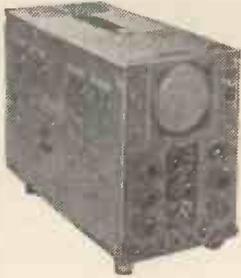
Input 230 v. 50 c/s. Output 620/550/375/0/375/550/620 volts 250 mA. Also 2.5 v 3 amp. windings. Size 6 1/2 x 6 1/2 x 5 1/2 in. Brand new only, 45/- each. P/P. 5/-.



FIELD TELEPHONES TYPE L.

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.





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/-.

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.	1,500 v.		10 K. ohm

Incorporated overload trip and special safety interlocking switches. Supplied in perfect condition with lead and battery at £7/10/- each. P/P. 3/6.

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 makers' spec. 1,000 c/s. Ranges: 100H, 100 mfd. 1 MEG. 100 Q. 200/250 v. A.C. operation. £35 each.

PADDED MOVING COIL HEADPHONES Good quality, complete with moving coil hand mike. Brand new. 12/6 per set. P. & P. 2/-.

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/-.

AMERICAN SUPER LIGHTWEIGHT HEADSETS. Res. 50 ohms. Brand new, 15/- P/P. 1/6.

SOUND-POWERED TELEPHONE HAND-SETS. No batteries required. 15/- each. P/P 1/6.

LEACH 12 VOLT AERIAL C/OVER RELAYS. Double pole, 7/6 each. P/P 9d.

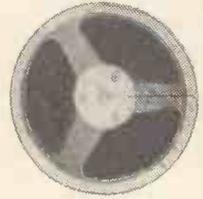
MUIRHEAD PRECISION STUD SWITCHES. 4 bank, 4 pole, 24 positions. New, boxed, 17/6 each. P/P. 1/3.

CR.100 SPARES KITS. Contains 15 valves; resistors, pots, condensers, output trans., etc. All brand new, 59/6 sec. P/P. 3/6.

24 AMP. VARIAC TRANSFORMERS. 230 v. input. Variable output 185 to 250 volts. Can be used reversely giving 230 volts out with variable input. £12/10/- P/P 10/-.

HIGH FIDELITY RECORDING TAPES.

P.V.C. Base. Brand new in makers' cartons, universal plastic spools. 5in. 600ft. Std. 12/-; 5 1/2 in. 1200ft. L.P. 19/6; 7in. 1200ft. Std. 19/6; 7in. 1800ft. L.P. 29/-; P/P. 1/-, 2 or more reels post paid. Spare spools, 5 1/2 in. 2/3; 7in. 3/6.



R.1155 RECEIVERS

Standard Model B with improved geared drive, perfect order, £8/19/6 each, 7/6 P/P. Trawler Band Model L or N, £12/19/6 each. P/P. 7/6. Combined Power Pack and Audio Output Stage suit either model, 85/- extra.

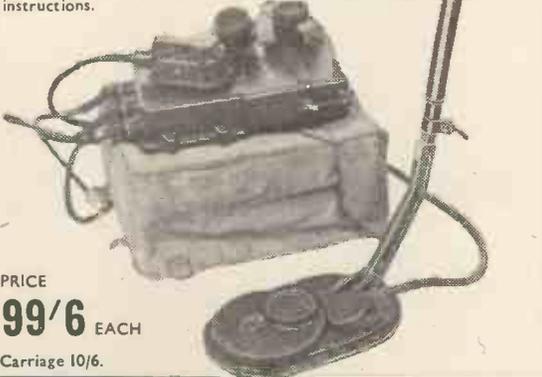
ROTARY CONVERTERS



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/-.

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.

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. 200/250 v. A.C. operation. 65/- each. FOR CALLERS ONLY.

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.



G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

CLYNE RADIO LTD.



18 TOTTENHAM COURT RD., LONDON, W.1

MUSEUM 5929/0095
 ALSO AT: 162 HOLLOWAY ROAD, LONDON, N.7
 NORTH 6295/6/7

99 CHEAPSIDE, E.C.2. MON 6860

All post orders and correspondence to 162 HOLLOWAY RD., LONDON, N.7

Open: Tottenham Court Rd., and
 Cheapside: 9 a.m. to 6 p.m. Mon.
 to Fri., Sat. 1 p.m. Holloway Road;
 9 a.m. to 6 p.m. daily. Thurs. 1
 p.m., Sat. 5.30 p.m.

If not stated, please add postage
 on orders under £1. Cash with
 order or C.O.D. (charges extra).

Our advantageous H.P. and Credit
 Sale Terms are available on any single
 item over £5. Your enquiries invited.
 Please print your name and address!!

CLYNE RADIO ELECTRONIC ORGAN

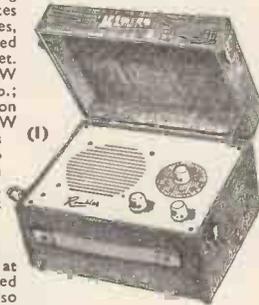


Readers will no doubt be
 pleased to know that our
 working model of this
 amazing organ for home
 construction, may now be
 heard and seen, at our Hi-
 Fi Showroom in Totten-
 ham Court Road, W.1.
 For the benefit of construc-
 tors all components, key-
 boards, chokes, etc., are
 available ready made. 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.

THE NEW LOOK RAMBLER PORTABLE

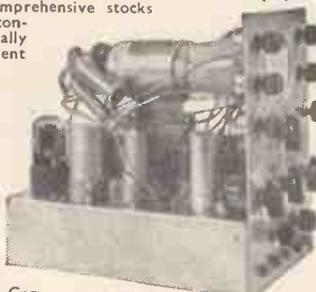
This wonderful little Medium and Long
 wave battery superhet incorporates
 1R5, 1T4, 1S5, 3V4 miniature valves,
 5in. speaker and frame aerial. Housed
 in smart two tone Red/Grey cabinet.
 All required components at the NEW
 LOW PRICE of £6/19/6, plus 2/6 p. & p.;
 or with the latest low consumption
 "96 range" valves at the NEW LOW
 PRICE of £7/7/0, plus p. & p. Uses
 all-dry batteries AD35 (1/6), B126
 (9/-). Full descriptive instruction
 book with itemised price list, diagrams,
 etc., available separately at 1/6d. post
 free.

(2) MAINS UNIT FOR ABOVE.
 Fits into battery compartment. A.C.
 200/250 v. All required components at
 ONLY 47/6 plus 1/6 p. & p. or assembled
 and tested at £3/5/- plus p. & p. (Also
 suitable for many other portables.)



CLYNE CATHODE RAY OSCILLOSCOPE for Home Construction

A recent addition to our comprehensive stocks
 of quality equipment for the con-
 structor. This is an exceptionally
 sound and robust instrument
 of the most versatile type,
 that will be a boon to the
 seriously minded amateur, ser-
 viceman or constructor. Spec-
 ifications: 8-Range Time Base,
 switched from 20 c/s to 160
 Kc/s. Y-Plate Amplifier has
 a sensitivity of 50 mV,
 and frequency response of
 20 c/s to 600 Kc/s with a
 gain of 150. A calibrating
 voltage of 6.3 v. 50 c/s
 is provided. Employs ECR30
 2 1/2 in. Cathode Ray Tube and 4
 valves; 2/ECF80, 1/EP91, 1/6X5. Con-
 trols: X-shift, Y-shift, Focus, Width, Brilliance. ON/OFF. Time Base
 Frequency (Fine), Time Base Frequency (Coarse). Sync Selector. Sync.
 Amplitude. Y-input Selector. X-input Selector. Amplifier Gain. Operates
 from 200/250 v. A.C. Mains. All required components for the construction of
 this wonderful instrument, including comprehensive assembly instruc-
 tions, available at a SPECIAL INCLUSIVE PRICE OF ONLY £12/19/6,
 plus 5/- carriage and packing. Attractive engraved Ivoryine Front panel,
 optional extra at only 10/6.



NEW LOOK ECONOMY FOUR

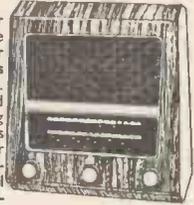


(3 & 4)

Our very popular three valve
 plus rectifier mains T.R.F. receiver
 is now available with a new De-
 Luxe cabinet with polished Walnut
 finish and Cream trimming (as
 illustrated). Brief Spec: Valve
 line-up 6K7, 6J7, 6V6, and contact
 cooled rectifier. Ready drilled
 chassis, good quality 5in. loud-
 speaker, Special Denco Coils
 Covers Medium and Long Wave-
 bands. Overall dimensions: 12in. x
 6in. x 5in. high A.C. 200/250 v.
 Simple construction with guaran-
 teed results. Easy to follow prac-
 tical and theoretical diagrams
 supplied. All necessary components,
 down to the last nut and bolt, are
 offered at a SPECIAL INCLUSIVE
 PRICE OF £5/10/-, plus
 5/- p. & p. Instruction book
 available separately 1/6, post free.
 Also available with plastic cabinet
 in IVORY or BROWN if preferred
 at ONLY £5/5/-, plus p. & p.

THE "SUPERIOR FOUR"

Our su-
 perior
 four-valve
 receiver
 A.C. mains
 200/250 v.
 M. and
 Long
 waves. As
 with our
 very suc-
 cessful
 "Econo-
 my Four" (6)



all required components are
 supplied. Valve line-up: 2 6S67,
 6 X5GT and 6 V6GT. Chassis
 ready drilled. Cabinet size 10in. x
 10in. wide. Maximum depth at
 base 5in. tapering to 3 1/2 in. at top.
 Sloping front. Very attractively
 finished in light walnut and peach.
 Each component brand new and
 tested prior to packing. Complete
 instruction booklet with practical
 and theoretical diagrams is pro-
 vided. Booklet available at 1/6
 post free. Our price complete
 £5/15/-. Please add 2/6 P. & C.
 If preferred, we can supply Cabinet
 Assembly only, comprising Cabinet
 and bracket wave-change switch;
 dial pointer, drum, pulleys, drive
 spindle, drive spring and knobs,
 at 45/-, plus 2/6 P. & C.

THE R.C. 3/4 WATT AMPLIFIER

Compare the advan-
 tages. Treble base
 AND middle
 controls. For
 crystal or
 magnetic
 pick-up.
 A.C.
 Mains
 200/250
 v. Valve
 line-up: 6V6-
 GT, 6S67 metal 6X5GT. Negative
 feedback. Built on stove enamelled
 steel chassis, measuring only 8in. x
 4in. x 1 1/2 in. Four engraved cream
 knobs are included in the price
 of the complete kit with all nec-
 essary practical and theoretical
 diagrams at £4/5/- only, plus 2/6
 p. & p. or Instruction Book fully
 illustrated for 1/- post free. This
 amplifier can be supplied assem-
 bled, tested, and ready for use at
 £5/5/- plus p. & p.

(14)
 SUPER 1 VALVE SHORT-WAVE
 RADIO
 World-
 wide
 coverage
 at most
 reason-
 able cost.
 Covers 40-100 metres with the coil supplied. Can
 be extended to cover 10-100 metres. Provision is
 also made for the addition of two extra valve stages. Employs
 the famous Acorn-type 954 valve. All necessary components can be supplied
 complete with full assembly instructions at ONLY 35/- plus 2/- p. & p. Send
 2/- for point-to-point wiring diagram and price list.



The CRY BABY ALARM

This highly
 efficient unit
 is simple to assemble, extremely
 sensitive and may be installed in a
 matter of minutes. Completely
 SAFE employing a double wound
 mains transformer. Attractively
 finished in Red and Grey (wash-
 able) "Lionide" with cream
 plastic escutcheon. Size only 7 1/2 in.
 x 3 1/2 in. x 6 1/2 in. Supplied in
 kit form complete with mike at
 ONLY 72/6 plus 2/6 P. & P. or
 assembled and tested 89/6 P. & P.
 2/6. Suitable mike flex available at
 3d. a yard. Instruction book and
 price list separately 1/- post free.
 A.C. 200-250 v.



VISIT OUR FULLY EQUIPPED
HI-FI SHOWROOM
 AT TOTTENHAM COURT ROAD FOR
 DEMONSTRATIONS OF THE LATEST
HI-FIDELITY EQUIPMENT
 BY ALL LEADING MANUFACTURERS

We stock equipment of Quality by all leading makers:
 i.e., Leak, Quad, Armstrong, Dulci, Ferrograph, Reflectograph, Vortexion,
 Linear, Wharfedale, Grundig, Goodmans, W.B., Rogers, Garrard, Lenco,
 B.T.H., Pamphonic, Simon, Brenell, Collaro, Telefunken, Fi-Cord, etc., etc.
 A full range of high quality cabinets to suit all purposes is on show, i.e.,
 "RECORD HOUSING", "W.B.", "A.D.", etc. Enquire about our
 interesting part-exchange scheme for personal callers. H.P. Available.

TO BUILD YOURSELF

ALL PARTS AVAILABLE SEPARATELY

WE ARE EXPERTS IN THIS FIELD AND CARRY THE MOST COMPREHENSIVE STOCKS IN THE COUNTRY.

	All required components at special inclusive price	P. & P.	Instruction Book and itemised price list available separately
(1) New Look "RAMBLER" all dry s'het portable. NEW LOW PRICE	£6 19 6	2/6	1/6
(2) "RAMBLER" Mains Unit (suits most portables)	£2 7 6	1/6	9d.
(3) "ECONOMY FOUR" T.R.F. Mains Receiver	£5 5 0	2/6	1/6
(4) "ECONOMY FOUR" with New Look Cabinet	£5 10 0	2/6	1/6
(5) "FAMILY FOUR" (our new T.R.F. Receiver)	£3 19 6	2/6	1/6
(6) "SUPERIOR FOUR" (four valve mains receiver)	£5 15 0	2/6	1/6
(7) Standard JASON F.M. Tuner FMT1	£6 15 0	2/6	2/-
(8) Fringe area JASON F.M. Tuner FMF	£7 15 0	2/6	2/-
(9) JASON "MERCURY 2" Switched F.M. Tuner plus ITA/B.B.C. Sound	£10 10 0	2/6	3/6
(10) OSRAM 912 Printed circuit F.M. Tuner. NEW LOW PRICE	£5 19 6	2/6	2/6
(11) JASON "ARGONAUT" AM/FM Chassis	£15 5 0	2/6	2/-
(12) JASON "ARGONAUT" AM/FM Tuner	£13 19 6	3/6	2/-
(13) F.M. Power Pack (suitable for most tuners)	£1 17 6	1/6	1/-
(14) R.C. 3/4 watt Amplifier (with Bass, Middle and Treble controls)	£4 5 0	2/6	1/-
(15) 2-amp. Battery Charger	£1 16 6	2/6	3d.
(16) R.C. Transistor/Crystal Receiver (phones extra)	£1 1 0	1/3	3d.
(17) R.C. Super Transistor/Crystal Rec. (ditto)	£1 7 6	1/3	3d.
(18) R.E.P. 1-valve Battery Receiver	£2 2 0	2/-	9d.
(19) "CRY-BABY" ALARM (Baby Alarm)	£3 12 6	2/6	1/-
(20) MULLARD 510 Amplifier (printed circuit) Ultra Linear Version	£9 9 0	3/6	1/6
(21) MULLARD 510 as above plus input selector and spare power supplies	£11 10 0	3/6	2/6
(22) "DE-LUXE" Printed Circuit Superhet	£7 19 6	3/6	1/6
(23) "DE-LUXE" with New Look Cabinet	£8 4 6	3/6	1/6
(24) JASON J.T.V. 2 Tuner	£13 19 6	3/6	2/6
(25) RADIO JACK	19 6	1/6	6d.
(26) MULLARD TYPE "C" Tape pre-amp.	£12 9 6	3/6	2/6
(27) JASON Will Wobblator	£14 19 0	3/6	3/6
(28) JASON Valve Voltmeter EM10 (23 ranges)	£18 10 0	3/6	2/6
(29) NEW JASON F.M. TUNER FMT2 with built-in power supplies and cabinet	£8 19 6	3/6	2/6
(30) NEW JASON FRINGE F.M. TUNER FMT3, as above	£10 19 6	3/6	2/6
(31) PULLIN Series 90 TEST METER	£5 19 6	2/6	1/6
(32) R.C. Super Personal Portable 1-valve (phone extra)	£1 15 0	2/6	2/-
(33) R.C. Super Personal Portable 2-valve (phone extra)	£2 1 0	2/6	2/-
(34) R.C. TRANSETTE 2-Transistor Personal Portable	£3 9 6	2/-	2/-
(35) JASON EVEREST 6-Transistor 2-wave Portable	£13 19 9	3/6	3/6
(36) JASON EVEREST 7-Transistor 2-wave Portable	£15 18 9	3/6	3/6
(37) CLYNE Cathode Ray Oscilloscope	£12 19 6	5/-	10/-
(38) Compact Multi-range Test Meter	£2 19 6	1/6	1/6
(39) CAR RADIO, Printed Circuit, 5-valve S'het. NEW LOW PRICE	£11 19 6	3/6	2/6
(40) JASON Audio Generator AG10	£14 5 0	3/6	2/6
(41) JASON Oscilloscope OG10	£22 10 0	5/-	3/6
(42) Super SHORT WAVE RADIO, 1 valve	£1 15 0	2/-	2/-
(43) "WAVEMASTER" 7-Transistor Luxury Portable	£10 19 6	3/6	2/6
(44) "GOLD STAR" De-luxe 1-valve Portable	£1 17 6	2/6	1/6

Instruction Books which contain full descriptions, easy-to-follow practical wiring diagrams theoretical diagrams itemised price lists, etc., are free of charge with all parcels but may be purchased separately as shown above.

PLEASE NOTE:—A selection of the above items are described more fully in this advertisement!!

THE "WAVEMASTER" 7-TRANSISTOR LUXURY PORTABLE

400 MILLIWATTS OUTPUT

To build yourself Medium and Long Waves—Push-Pull Superhet A.V.C. Perfect Car Radio reception. Size 10in. x 6½in. x 4½in. at base tapering to 4in. at top.

Very attractive two-tone grey Vynlide covered cabinet with black and gold printed escutcheon plate, cream and gold knobs, handle and cabinet fittings. ★ Weight—complete with long-life 7½ volt battery—4½lb. ★ Mazda high-grade transistors throughout. ★ High-Flux 7in. x 4in. Elliptical Speaker. ★ Slow motion tuning. ★ Co-axial socket at rear for direct connection to Car Radio Aerial. ★ Improved reception by use of seven-section plated telescopic aerial disappearing into Cabinet when closed, 34in. above Cabinet when fully extended.

Construction simplified by Bakelite chassis board with the following components already mounted: I.F. Transformers (3). Oscillator Coil, Trimmer Bank, Output Transformer, Interstage Transformer, Aerial Brackets and Earth Bar. **SPECIAL INCLUSIVE PRICE** for all required components, full assembly instructions—nothing more to buy—is £10/19/6 plus 3/6 P. & P. Alignment service available. Full assembly instructions and individually priced parts list, all of which are available separately, 2/6, post free.



(43)

TWO-TRANSISTOR PERSONAL PORTABLE. This is an amazing little receiver with built-in aerial and small enough to be held in the palm of the hand. Medium wave reception at wonderful volume. Supplied with drilled chassis and colour coded components. Easily assembled with the aid of the easy-to-follow assembly instructions provided. Total cost of all necessary components, including transistors, Deaf-aid type earpiece, wiring wire and even solder. **ONLY 69/6** plus 1/6 P. & P., or complete with single standard High Resistance earphone at **ONLY 62/6**. Plus 1/6 P. & P. Parts price list and Easy Lay-out Plans 2/- post free.



(34)

PRINTED CIRCUIT CAR RADIO (for Home Construction).

We are proud to be able to offer this New type Car Radio employing up-to-the-minute circuitry, special 12 volt valves and transistorised output stage. The highest degree of sensitivity is assured by the incorporation of Permeability Tuning and a tuned R.F. Stage. Covers Medium and Long Wavebands. **NO VIBRATOR PACK IS REQUIRED.** This is a really compact receiver that will fit any car. Comprehensive assembly instructions are provided with all necessary components, including valves and transistor at a Special New Low inclusive Price of Only £11/19/6 plus 3/6 P. & P. Instruction booklet with itemised price list, full description dimensions, etc., available separately at 3/6 post free.



(39)

"FAMILY FOUR" (5)

Our supersensitive T.R.F. Receiver for home construction. Covers Long and Medium Wavebands, is housed in very smart plastic table cabinet in Brown or Black. For A.C. mains 200/250 v. Comprehensive assembly instructions provided, including practical and theoretical diagrams, which are easy to follow and will enable you to complete this receiver which will be the envy of your friends. **ALL NECESSARY COMPONENTS ARE BEING OFFERED FOR LIMITED PERIOD ONLY AT THE REMARKABLE PRICE OF ONLY 79/6**, plus 2/6 P. & P. Instruction book available separately if you wish to study before purchase at 1/6 post free.



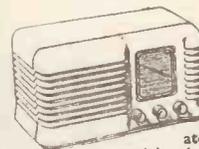
SUPER PERSONAL PORTABLE. (32) & (33)

A wonderful little set that you can take anywhere. Ideal for camping, picnics, etc. Detachable aerial rod supplied. Covers Medium waveband 200-500 metres. Can be built in approx. 1 hour. All necessary components available at the following **SPECIAL INCLUSIVE PRICES:** 1-valve version **ONLY 35/-** plus 2/- P. & P. Super 2-valve version **ONLY 41/-**. Plus 2/- P. & P. Send for point-to-point wiring diagram and parts price list 2/- post free. Extra for use with the above DLR5 balanced armature headphones, 7/6 pair.



THE CLYNE RADIO "DE LUXE" PRINTED CIRCUIT SUPERHET

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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 3½ x 8½in. Only 59/6 plus 2/6 P. & P. SPECIAL CELESTION 8 x 6in. elliptical high flux loudspeaker 30/- plus 1/- P. & P. to fit.

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Note. If the above three items are purchased together they will be supplied at the special inclusive price of £72/6 plus 6/6 P. & P.

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A small three-valve PORTABLE RECORD-PLAYER AMPLIFIER mounted on baffle 12 x 7in., with High Flux 6½in. Loudspeaker. Valve line-up ECC83, EL84, EZ80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high impedance pick-up. Ready to use, £5/12/6. P. & P. 3/6.
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LATEST COLLARO STUDIO TAPE TRANSCRIBER. 3 motors, 3 speeds, 1½, 3½, 7½ i.p.s., takes 7in. spools. Push-button controls, £12/19/6 plus 5/- P. & P. Usual H.P. facilities.

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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.

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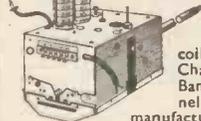
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Valve line-up: 6K8G, 6K7G, 6Q7C 6F6G, 6X5G and 6 volt 4-pin non-synchronous vibrator. 8in. P.M. Speaker, 4 watts output, P.U. socket Ext. L.S. socket, etc. Tone control. Fitted in polished wood cabinet, size 21½in. x 10½in. x 10½in. These cabinets are slightly soiled owing to storage, but each is guaranteed unused, in serviceable condition, tested prior to despatch. Price £5/19/6 only plus P. & P. 7/6, plus 27/6 for A.C. Mains Conversion Components if required. **OUTSTANDING BUY!**

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(By famous manufacturer). Brand new, NOT surplus or ex-equipment. 35 Mc/s. I.F. PCF 84 valves. Complete with



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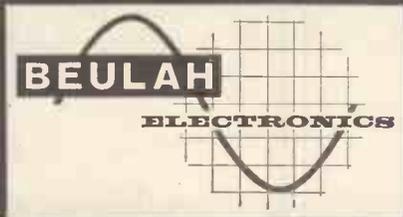


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Internationally famous.



Performance and professional appearance equal to many higher priced instruments. Gold-plated printed-circuit. High Input impedance (11 megohms). The V-7A measures A.C. volts (0-1.5, 5, 15, 50, 150, 500, 1,500) R.M.S. and A.C. volts (0-4, 14, 40, 140, 400, 1,400 and 4,000) pk.-to-pk. D.C. volts (0-1.5, 5, 15, 50, 150, 500, 1,500). Ohms (with 10 ohms centre) X1, X10, X100, X1,000, X10K, X100K, and X1 megohm.

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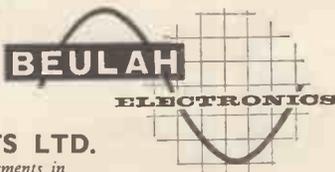
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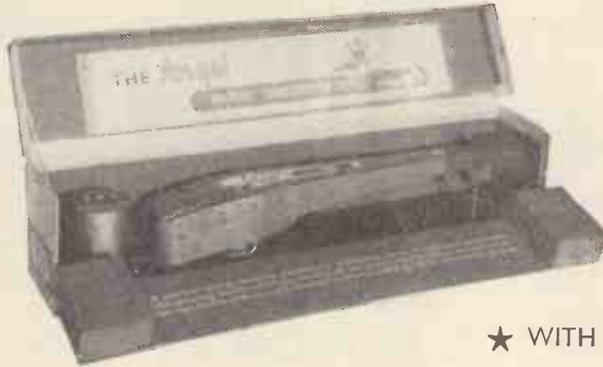
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SPECIFICATION

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—16,800 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

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PLUS P. & P. 5/-.

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500 MICROAMMETER

A 4½" Panel mounting 500 Microammeter marked in ohms and ideal for building into a multi-range meter.

PRICE **£2.10.0**
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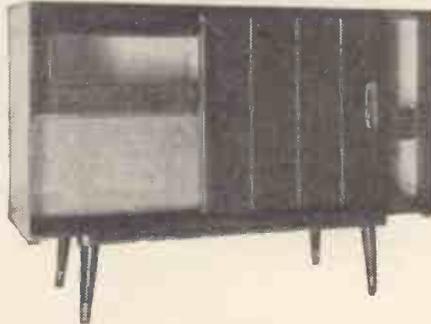
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12/6 TAX PAID
 Plus P. & P. 1/6.



Another scoop to the first 20 customers, this wonderful cabinet at £12/12/-. P. & P. £1.



Dimensions: Length 40", width 16", depth 21" without legs.

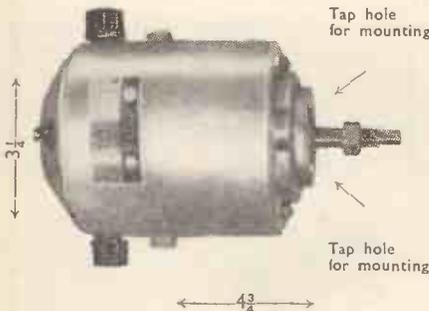
SUPER SCOOP

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.

A few only left of the cabinet previously advertised at £18.10. P. & P. 25/-.



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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.
29/6 P. & P. 2/3.

NEW and boxed	VALVES	90-day guarantee		
1R5	8/6 6L6G	10/6 EA50	1/6 EV51	12/6
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1T4	8/6 6Q7G	10/6 EB91	8/6 HABC80	12/6
2X2	2/6 6SA7M	10/6 EBC33	8/6 HVE2A	7/6
384	8/6 6BJ7M	10/6 EBC41	10/6 MU14	10/6
3V4	8/6 6BN7	8/6 EBF90	10/6 P61	6/6
5U4	8/6 6V6G	7/6 ECC84	12/6 PCC84	12/6
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6AM8	8/6 12A6	8/6 ECL90	12/6 PCL82	11/6
6BE6	7/6 12AT7	10/6 ECL82	12/6 PEN25	6/6
6BB6	10/6 12AU7	9/6 EFS9	7/6 PL82	10/6
6BW6	10/6 12AX7	9/6 EF41	10/6 PY80	8/6
6D6	7/6 12BA6	9/6 EF50	5/6 PY81	10/6
6F0G	7/6 12BE6	9/6 EF80	10/6 PY82	8/6
6HG7	3/6 12K7	8/6 EFB8	14/6 SP61	5/6
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6J6	7/6 35L6	9/6 EL32	5/6 UCH42	10/6
6J7G	8/6 35Z4	9/6 EL41	10/6 UF41	10/6
6K6GT	6/6 80	10/6 EF 84	10/6 UL41	10/6
6K7G	5/6 807	6/6 EZ40	8/6 UY41	8/6
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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.

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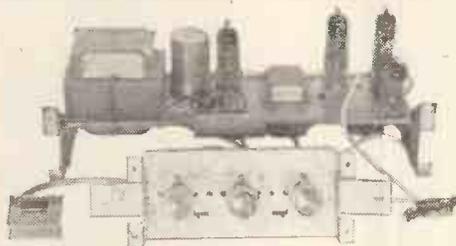
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8 WATT Push Pull MONAURAL AMPLIFIER

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. £4.19.6

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*All brand new. *Note special prices. *All permanent magnet 3 ohms Impedance. Units by Plessey, Goodmans, Lectrona, etc.

	Each
2½in. Celestion	18/-
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P. & P. 2/-.

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GC2	16/6

All Types Available.

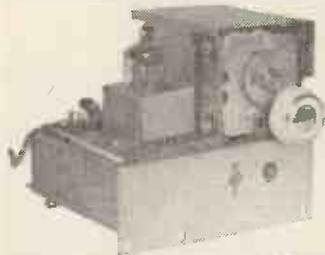
A few only left of this cabinet. Product of a well-known manufacturer. Don't miss this wonderful offer.

Length 40in.
Width 17½in.
Height 19½in.

OUR PRICE
£9.15.0

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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" Goodmans unit. Cabinet 8" x 6" x 2". Complete, including lead. P. & P. 2/-.

18/6



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WIRE. Twin padded, grey, with maroon tracer Mains Lead—usually 10d. per yard.—Our Price 15/- per 100 yd. coil. P. & P. 3/-.

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WE SEND THE BEST OF BRITAIN'S HI-FI EVERYWHERE

EVERYTHING FOR RADIO, RECORD & TAPE

- PROMPT DESPATCH SERVICE
- HOME AND EXPORT ENQUIRIES WELCOMED AT ALL TIMES
- 110 VOLT ITEMS AVAILABLE

★ RECORDERS

Vortexion W.V.A.	£93 13 0	\$267
Vortexion W.V.B.	£110 3 0	\$315
Brenell Mk. V	84 gns.	\$192
Brenell 3 Star Stereo	89 gns.	\$267
Simon SP4	95 gns.	\$285
Cossor 1601 4 Tr.	37 gns.	\$111
Cossor 1602 4 Tr. 3 spd.	59 gns.	\$127
Simon Minstrelle	39 gns.	\$117
Ferroglyph 4AN	81 gns.	\$243
Ferroglyph 4AH	86 gns.	\$258
Ferroglyph 808	105 gns.	\$315
Grundig TK60 Stereo	128 gns.	\$384
Grundig TK55 Stereo	92 gns.	\$276
Grundig TK20 with Mic.	52 gns.	\$156
Grundig TK30	72 gns.	\$216
Minivox	37 gns.	\$111
Philips 4 Track	59 gns.	\$177
Philips 4 Track Stereo	92 gns.	\$276
Philips 4 Track	37 gns.	\$111
Reflectograph 'B' 4 Tr.	105 gns.	\$315
Stuzzi Transistor	69 gns.	\$207
Steelman Battery	55 gns.	\$165

★ DECKS

Wearite 4A	£36 15 0	\$105
Wearite 4B	£41 10 0	\$119
Brenell	28 gns.	\$84
Brenell Stereo Deck	£33 16 0	\$101
Brenell Pre-Amp. and Amp.	24 gns.	\$72

Microphones by Lustraphone, Reslo, Acos, Simon Sound, Geloso, etc.

★ TAPES BY ALL LEADING MAKERS

★ SPEAKER SYSTEMS

Quad Electrostatic	£52 0 0	\$149
Wharfedale SFB/3	£39 10 0	\$113
Wharfedale Coaxial 12	£25 0 0	\$156
Wharfedale Golden 10	£8 14 11	\$18
Tannoy 12in. Monitor	£30 15 0	\$87
Tannoy 15in. Monitor	£37 10 0	\$108
WB. 1016	£7 12 3	\$16
Goodmans AL120	£29 10 0	\$84
Goodmans AL100	£23 10 0	\$67
Goodmans Triaxiom	£25 0 0	\$71
Goodmans 300	£11 5 9	\$32
Goodmans 400	£16 17 0	\$46
Kelly Ribbon Mk. II	£10 10 0	\$30
B. J. Tweeter complete	£5 5 0	\$11

★ MOTORS AND PICK-UPS

Decca Stereo PU	£21 0 0	\$154
Lenco GL60 Trans. Unit	£28 19 2	\$62
Lenco GL58/R, Stereo P.U.	£29 3 10	\$62
Garrard 301	£22 7 3	\$54
Garrard 4HF/Stereo P.U.	£19 17 7	\$41
Garrard TA/Mk. II	£9 15 8	\$22
Connoisseur Motor Type 'B'	£27 16 1	\$63
Connoisseur, 2 sp. Motor	£16 3 1	\$36
Goldring 700	£9 14 9	\$21
Ronette DC284	£4 3 5	\$9

★ AMPLIFIERS & TUNERS

Quad 22-Control Unit	£25 0 0	\$76
Quad II Amplifier	£22 10 0	\$64
Leak Stereo 20 Amp.	£30 9 0	\$87
Leak Point One Pre-Amp.	£21 0 0	\$60

Rogers Junior Stereo	£28 10 0	\$81
Rogers Master Stereo Unit	£35 0 0	\$100
Quad FM Tuner	29 gns.	\$60
Chapman AM/FM	£29 8 0	\$60

Enquiries for new items by firms mentioned in this advertisement invited.

BINSON "ECHOREC"

distributed exclusively by Modern Electrics Ltd., (see W.W. Feb. page 92), this is a device for superimposing controlled echo on to any audio signal. It achieves within the size of a compact, fully portable instrument, effects normally requiring large echo chambers and associated equipment. Three working channels, echo interval is variable, swell and other effects are obtainable.

ABRIDGED DESCRIPTION

- Three inputs and outputs.
- Push-button channel selection for 1, 2 or 3 channels.
- Controls for echo intervals, volume of echo, swell effect, volume level on input channels, etc.
- Complete with fitted carrying case, leads, plugs, A.C. mains.

Professional Discounts

140 gns. \$420 Leaflet on request. Trade enquiries invited.

MODERN ELECTRICS (RETAIL) LTD.

We carry extensive and up-to-date stocks of equipment, components and accessories by Britain's leading makers. Enquiries dealt with by return.

164 CHARING CROSS ROAD, LONDON, W.C.2

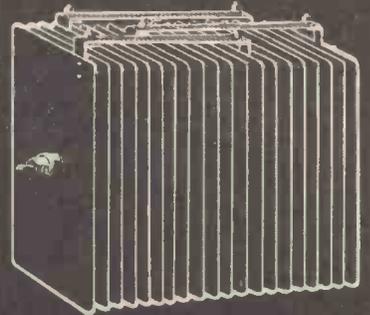
(3 shops from Tottenham Court Road Station Underground)

Tel.: TEM 7587 & COV 1703

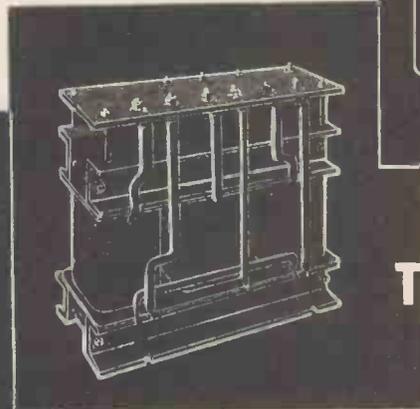
Cables: MODCHAR2X, LONDON

AUTOMAT

RECTIFIERS



TRANSFORMERS



D C EQUIPMENT

AUTOMAT Moorside Swinton Manchester Tel: Swinton 4242-3-4

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 units primaries:

2 volt	12/6 each
4 volt	12/6 each
6.3 volt	12/6 each
30 0.5 ohm	12/6 each
13.3 volt	12/6 each

OUR LATEST SUPERIOR PRODUCT, Type A2.
High Quality. Low capacity, 10/15 pf. 16/6 each
Optional boost 25%, 50%, 75%.

Type B. Mains input. Low capacity. Multi Output 2, 6.3, 10 and 15 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes 21".

RESISTORS. All preferred values. 20% 10 ohms to 10 meg. 1 w., 4d.; 1/2 w., 4d.; 1 w., 6d.; 1 1/2 w., 8d. 2 w. 1/-

HIGH STABILITY. 1 w., 1/-, 2/- Preferred values 100 to 10 meg., Ditto 5% 9d., 100 to 5 meg.

WIRE-WOUND RESISTORS { 1/6
10 watt 25 ohms-10,000 ohms. { 2/-
15 watt

15,000 ohms - 50,000 ohms 5 w., 1/9; 10 w., 2/8

WIRE-WOUND POTS, 3 w. Standard size Pots, long Spindle High Grade. All values 25 ohms to 25K. 3/- ea., 30 K. 50 K. 4/-

Ditto, 1 w. Carbon Track W/W EXTRA SPEAKER 30 to 2 MEG. 3/-

O/P TRANSFORMERS. Heavy duty 50 mA. 4/8. Multi-ratio push-pull 7/6. Miniature 3V4, etc. 4/6. Bygrade Push-pull 10 watts, 15/6. Push-pull 20w. 6k or 8k 30/4. **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. 2 1/2 a. Dkt. 350-550 22/6

MINIATURE 220 v. 20 mA. 6.3 v. 1 a. 10/6

MIDGET, 220 v. 45 mA. 3 v. 2 a. 15/6

SMALL, 210-0-210 50 mA. 6.3 v. 2 a. 17/6

STANDARD, 250-0-250 65 mA. 6.3 v. 3.5 a. 17/6

HEATER TRANS. 6.3 v. 1 a. 7/6; 3 amp. 10/6

GENERAL PURPOSE LOW VOLTAGE Output 3, 4, 5, 6, 8, 10, 12, 15, 16, 24 and 30 v at 2 A. 22/6

ALADDIN FORMERS and cores 1/4 in. 8d.; 1/2 in. 10d. 0.3in. FORMERS 5997 or 8 and Carr TV1 or 2. 1/4 in. sq. x 2 1/2 in. sq. x 1 1/2 in. 2/- with cores 2/-

SLOW MOTION DRIVES. Epicyclic ratio 6:1, 2/3.

SOLOIN. Midget Soid-rim, Iron, 220/40 v. 25 w. 24/-

REMPLOY INSTRUMENT RON. 220/40 v. 25 w. 17/6

MAINS DROPPERS. 3 x 1 1/4 in. Adj. Sliders, 3 amp. 1,000 ohms 4/3. 2 amp. 4/3. 1 amp. 2,000 ohms 5/-

LINE CORD. 3 and 60 ohms per foot, 2 amp., 100 ohms per foot 2 way, 6d.

CRYSTAL MIKE INSERT by Acos 6/6
Precision engineered. Size only 4x1 1/2 in.

ACOS CRYSTAL STICK MIKE 39-1. Bargain 35/-

MIKE TRANS. 50:1, 3/9 ea.; 100:1 Potted 10/6.

LOUDSPEAKERS P.M. 3 OHM. 6in. Rols. 17/6. 6in. x 4in. Rola. 18/-. 7in. x 4in. Rola. 21/-. 10in. x 6in. Rola 27/6. 8in. Plesey. 19/6

6in. Rols. 18/6. 8in. Rols. 21/-. 10in. Rola. 30/-

ELF TWEETERS. 6in. 12/6. 12in. Plesey. 30/-

12in. Baker 15 wt. 3 ohm, and 15 ohm models. 80/-

12in. Baker foam suspension 15 w. 15 ohm, 28/-

12in. 15 ohm Plesey 10 wt., 45/- E.M.I. 14 x 8" 45/-

I.F. TRANSFORMERS 7/6 pair
465 kc/s. slug tuning miniature can 2 1/4 x 1 1/4 in. High Q and good bandwidth. By Pvc Radio, Data sheet supplied.

Wearite M800 I.F. Miniature 465 kc/s., 12/6 pair.

Weymouth I.F. Standard size 465 kc/s., 12/6 pair.

CRYSTAL DIODE G.E.C., 2/- OEX34, 4/-, 40 Circuits. 3/-

H.R. HEADPHONES. 3,000 ohms, brand new, 15/- pair

SWITCH CLEANERS Fluid squirt sprout, 4/3 tin.

TWIN GANG CONDENSERS. 365 pf. Miniature 1 1/4 in. x 1 1/4 in. 10/-. 0005 Standard with trimmers. 9/-; less trimmers 8/- Midget 7/6; Single 50 pf. 2/6; 100 pf. 150 pf. 7/- Solid dielectric 100, 300, 500 pf. 3/6

VALVE HOLDERS. Pat. int. Oct. 44. EF50, PA50 6d. B12A, CRT 1/3, Eng. and Amer. 4, 5, 6, 7 pin. 1/-

MOLDDEDDED Mazda or Int. Oct. 6d. B7G, B8A, B8Q B9A 9d. B7D with can. 1/6; B12A, 1/3. B9A with can. 1/6; CERAMIC EF50, B7G B8A, Oct. 1/-; B7G, B9A Glass. 1/-

SPEAKER PREP. Gold cloth 7 1/2 in. x 2 1/2 in. 5/- 25in. x 3 1/2 in. 10/- Tysan 5 1/4 in. wide. 10/- ft. 27in. wide. 5/- ft. samples, 8/6

WAVECHANGE SWITCHES
2 v. 2-way on 3 p. 2-way; short episode 2/6
5 p. 3-way 2 wifer, on 3 p. 11-w. 3 wifer long episode 6/6
2 p. 4-way or 4 p. 2-way, or 1 p. 3-way four spindle 3/6
3 p. 4-way or 1 p. 12-way, long spindle 3/6
Wave change "MAKIES" 1 wifer. 8/6; 2 wifer. 12/6; 3 wifer 16/-; 4 wifer 19/6; 5 wifer 23/-; 6 wifer 26/6

TOGGLE SWITCHES. 8 p. 2/- D.P. 3/6; D.P.D.T. 4/-

MORSE KEYS, good quality, 2/6

MINIATURE ELECTROLYTICS (15 v.) 1, 2, 4, 5, 8, 25 50 mfd., 100 mfd. 3/- each.

THE HI-GAIN BAND 3 PRE-AMP
Cascode circuit using Valve ECC84, 17db gain. Kit 29/6 less power; or 49/6 with power pack. Plans only 6d.
Also Band 1 version same prices. (PCC84 Valve if preferred)

RGS "REGENT" 4 VALVE

"96" RANGE VALVES
KIT PRICE
£6. 6. 0.
Carr. 4/-



Leaflet S.A.E

PRINTED CIRCUIT BATTERY PORTABLE KIT

Medium and long wave. Powerful output from 6in. high Flux Speaker. T.C.C. Printed circuit and condensers. All components of finest quality clearly identified for assembly with full instructions. Osmor Ferrite Aerial and Coils, Rexine covered attache case type cabinet. Size 12in. x 8in. x 4in. Batteries used B126 (L5512) and AD35 (L5040), 10/- extra. Details and instructions 9d. (free with kit). Mains Unit ready made for above 3/6. Same size as batteries sold separately

1960 RADIOGRAM CHASSIS



THREE WAVEBANDS S.W. 16 m. - 50 m. L.W. 200 m. - 500 m. L.W. 800 m. - 2,000 m.

FIVE VALVES LATEST BULLARD ECH91, EF89, EB281, ELS4, E280

12-month Guarantee. A.C. 200/250 v. 4-way switch Short-Medium-Long-Gramp. A.V.C. and Negative Feedback, 4.2 watts. Chassis 1 3/4 in. x 5 1/2 in. x 2 1/4 in. Glass Dial Size 10 x 4 1/2 in. horizontal or vertical. Two Pilot Lamps. Four Knobs. Walnut or Ivory. Aligned and calibrated. Chassis finished from mains.

BRAND NEW £9. 10. 0. Carr. 4/6

TERMS: Deposit 25/5- and 5 monthly payments of 21/-
MATCHED SPEAKERS 6in. 17/6; 10in. 25/-; 12in. 30/-

RECORD PLAYER BARGAINS



4 Speed Autochangers, B.S.R., U.A.8 £6 15 0
Collaro Conquest £7 19 6
Garrard Model 210 £10 10 0
4 speed Single Players, EMI £6 19 6
Garrard TA Mk. II £8 8 0
Garrard 4 HF Transcription £17 19 6
All post free

TELETRON POCKET RADIO KIT
Transidyne Superhet Six 6" x 4" x 1 1/2"
T.C.C. Printed Circuit, internal Ferrite aerial, Rola loudspeaker push pull output. All parts, cabinet, 6 Edison transistors, GEX34 diode. Details 9d. **£9.9.0**

VOLUME CONTROLS 80 ohm Gable Coaxial
Midget size:
Long spindle. Guaranteed 1 Year. All values. 5 K. ohms up to 2 Meg. No switch D.P. 5w 3/- Linear or Log Tracks. 4/9

Some air spaced, 1/4 in. dia. Ideal for 60 ohm. 6d. Loss cut 50%. Post 1d. per yard extra. **FRINGE QUALITY** Altkas Acad. 1/- yd

COAXIAL PLUGS 1/- **LEAD SOCKETS** 2/-
PANEL SOCKETS 1/- **OUTLET BOXES** 2/-
BALANCED TWIN FEEDER per yd. 6d., 80 pf. 4/0
TWIN SCREENED BALANCED FEEDER 1/6 yd., 90 ohm

ALUMINUM CHASSIS. 8 s.w. v. Flat, undrilled with 4 sides, riveted corners and lattice fixing holes with 2 1/2 in. sides 7 x 4 in. 4/6; 9 x 7 in. 5/9; 11 x 7 in. 6/9; 13 x 9 in. 8/6; 14 x 12 in. 10/6; 16 x 14 in. 12/6 and 18 x 16 x 3 in. 16/6.

BLACK CRACKLE PAINT. An drying 3/- tin.
V.C. CONN. WIRE, coloured, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-
COLORED SOLDER RADIOGRADE, 4d. yd. 1lb. 2/6.
FAROLIN 1/16in. x 8in. x 10in. 1/6. Oil RAPS 5/-

P.V.C. PLASTIC RECORDING TAPE

Long Play 7in. reel 1,400ft.	32/6	ALL Spare Plastic Reels 3/- ea
5in. reel 1,200ft.	22/6	7in. Reels 2/- ea
5in. reel, 850ft.	19/6	
3in. reel, 225ft.	7/6	
Standard 7in. Reel, 1,200ft.	21/-	
5in. reel, 850ft.	17/6	
5in. reel, 800ft.	15/-	
"Instant" Bull. Tape Eraser and Head Defuser	2/- ea	
00/250 v. A.C. 27/6. Leaflet, S.A.E.		

RECTIFIERS, RM1, 5/-; RM2, 6/-; RM3, 8/-; RM4, 16/-; RM5, 20/-; FUS1, 27/6; 14A8E, 17/6; 14A100, 21/-

MINIATURE CONTACT COILED RECTIFIERS. 250 v. 60 mA., 7/6; 80 mA., 8/6; 85 mA., 9/6; 90 mA., 21/-; 300 mA., 27/6; Full Wave 250 v. 120 mA. 15/-

COILS. Wearite "P" type 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.

TELETRON. L and M. T.R.F. with reaction, 3/6.

FERRITE ROD AERIALS. M.W. 9/9; M. & L. 12/6. A.R.F. COILS. A/H.F. 7/- pair. R.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET. 26/-, H.F. coil aerial coil, Oscillator coil, two I.F. transformer: 10.7 Mc/s., Detector transformer and better chokes. Circuits and component book using four 6AM9, 2/6. Complete kit FMT1 with Jason Calibrated dial and 4 valves. 26/5/- With new Jason Cabinet, FMT2, 30/- extra.

CONDENSERS. New Stock. 001 mfd. 7kV T.C.C. 5/6; 20 v. 9/6; 1 mfd. 7kV. 9/6. 100pf. to 500 pf. Mica. 6d. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25, 1/6; 0.5, 1/8; 0.1/350 v., 9d.; 0.1/1,000 v., 1/9; 0.1 mfd. 2,000 v., 3/6; 0.001 mfd., 2,000 v., 1/8.

CERAMIC COND. 500 v. 0.3 pf. to 0.01 mfd. 9d.

SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 800 pf. to 3,000 pf., 1/3.

CLOSE TOLERANCE (1 ± pf. to 1.5 pf. to 47 pf., 1/6. DITTO 1 1/2 pf. to 815 pf., 1/8; 1,000 pf. to 2,000 pf., 2/-.

TRIMMERS. Ceramic, 50, 50, 70 pf., 9d. 100 pf., 150 pf. 1/3. 250 pf., 1/8. 500 pf. 750 pf., 1/8. Philips, 1/- ea.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR	TUBULAR	CAN TYPES
1/350 v. 2/3	50/350 v. 5/6	8/100 v. 4/-
2/350 v. 2/3	100/25 v. 3/6	16/500 v. 4/-
4/450 v. 2/3	250/25 v. 3/-	32/350 v. 4/-
8/450 v. 2/3	500/12 v. 3/6	100/270 v. 5/-
8/500 v. 2/9	8+8/450 v. 4/6	250/25 v. 4/6
16/450 v. 3/6	8+8/500 v. 5/-	500/60 v. 5/-
15/500 v. 4/6	8+18/450 v. 4/-	8+16/600 v. 7/-
32/450 v. 5/6	8+16/500 v. 5/6	32+32/450 v. 6/6
25/25 v. 1/9	16+16/450 v. 5/6	50+60/350 v. 7/-
50/25 v. 2/-	16+16/500 v. 5/6	64+120/350 v. 11/6
50/50 v. 2/-	32+32/350 v. 4/6	100+200/275 v. 12/6

FULL WAVE BRIDGE/SELENIUM RECTIFIERS. 25 v. 12 v. 1 1/2 amp. 8/9; 2 a., 11/3; 4 a., 17/6; 6 a., 22/6.

CHARGER TRANSFORMERS. Tapped input 200/250 v for charging at 2, 6 or 12 v., 1 1/4 a., 15/6; 2 a., 17/6; 4 a., 22/6. Charger circuit free. AMPMETERS, 4 a., and 5 a., 13/6.

NEW and boxed VALVES 90 day-guarantee

1R6.	7/6	6L6G	10/6	E60	1/6	EY51	5/6
1R5	7/6	6BTM	6/6	EAC90	3/6	EY600	10/6
1T4	5/-	6U7G	7/6	EB91	8/-	6ABX80	12/6
2X2	3/6	6NA7M	6/-	EB38	5/6	6BZ2A	6/6
3V4	7/6	6SN7M	6/6	EM41	8/-	6MU4	9/-
384	7/6	68N7	6/6	EBF80	10/-	6F1	3/6
3Z4	7/6	6Y6G	6/6	ECC84	9/6	PC84	9/6
5Y3	7/6	6X4	7/6	ECH80	8/6	PCF80	9/6
6A4	8/6	6X5	8/6	ECH42	10/-	PL82	11/6
6AM6	5/-	12A6.	7/6	EL180	10/6	PE25.	6/6
6BE6	7/6	12AT7	8/-	ECL82	10/6	EL32	10/6
6BH6	9/6	12AU7	8/-	EF39	5/6	PY80	7/6
6BW6	9/6	12AX7	8/-	ECC83	9/6	PY81	7/6
6DB5	8/-	12BA6	8/6	EF60	5/6	PY81	7/6
6FG6	7/6	12BE8	8/6	EF80	8/-	8P1	3/6
6HG6T	3/6	12K7.	6/6	EF86	14/6	UBC41	9/6
6J5	5/6	12Q7.	6/6	EL92	5/6	UBC42.	9/6
6J6	5/6	12SL6	9/6	EL32	5/6	UF41	9/6
6J7G	6/6	12SK7.	7/6	EL41	9/6	UL41	9/6
6K7G	6/6	80	8/6	EL41	9/6	UL41	9/6
6K7G	5/-	807	5/6	EZ40	7/6	U22	8/-
6KR6	7/6	944.	1/6	EZ80	7/6	U32	7/6

RADIO COMPONENT SPECIALISTS

48 HOUR MAIL ORDER
337 WHITEHORSE RD.
WEST CROYDON

Get Finest Value from IRONGATE—England's Leading Equipment Wholesalers Bulk Buying means LOWEST PRICES. All Equipment is in TIP-TOP condition



LATEST miniature

EXPORT ONLY

WALKIE TALKIE

"88" sets—just released by Ministry of Supply. Produced to exacting specifications by leading manufacturers E. K. Cole & Co. This Transmitter/Receiver weighs only 5½lb. (approx.) and measures 3½in. x 5½in. x 9½in. It is a 4 frequency channel set, heavy type crystal controlled, 40-42



Mc/s., and operates from a Standard Dry Battery—HT/LT. 94/1. 3 v. (i.e. Ruben Mallory Type 1). 14 of the current series of B7G valves are employed: 1-3A4, 6-1L4, 4-1T4, 1-1S5, 2-1A3. Each set is fully tested and in good condition.

Only **£10** each.

Special quotations for quantities up to 3000 sets. "22" SETS ALSO—300 available only. New condition £10 each.

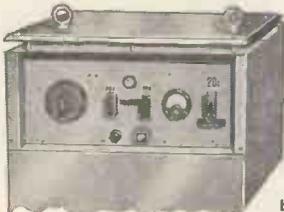
SUPPLIED COMPLETE WITH CRYSTALS. Accessories can be supplied to order at extra cost.

1,000,000 YARDS!!
SCREENED WIRE FLEX
FOR ONLY 3d. per yd.



For Immediate Delivery—priced far below cost.
Specification: Close braided 14/0048in. Covered .024 p.v.c. Tinned Copper. Assorted colours.
Applications: Microphone leads, pick-up leads, etc.
ON MAKER'S REELS.
220 yd. REELS (min. quantity) 55/- P. & P. 5/-
TEN REELS £25. Carr. Paid.

HEAVY DUTY
20 AMP. L.T. SUPPLY UNIT



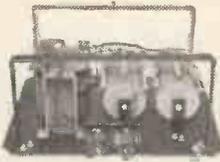
Normal cost over £100

by **S.T.C.**

Essential equipment for Electronic Engineering, research laboratories, schools. Ideal for battery charging, etc. Guaranteed for 20 amps. Output: D.C. Variable up to 20 amps. and 24 v. or trickle charge 125/350/700 ampere hours. Input: A.C. 100/250 volts 45/65 cycles. Size: 16 x 24 x 32in. high.

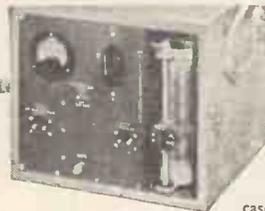
In attractive **£22-10-0** Grey Cabinet. Ex. Warehouse.

(Circ. diag. and instr. loaned for 10/- deposit).



G.E.C. L.T. SUPPLY UNIT
OUTPUT: 24 volts 10 amps D.C.
INPUT: 200/250 volts A.C.
New in original case **£13. 10. 0**
Carr. 9/6.

ROTARY CONVERTORS.



Input: 12 v. D.C.
Output: 230 v. A.C. 150 watts 50 cycles

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/-.

WORLD FAMOUS TELEPHONES
"F" TYPE
IN ATTRACTIVE CASE



The best portable telephone ever made. With a range of up to 5 miles is ideal

for FACTORIES, BUILDING SITES, FARMS, CIVIL ENGINEERING PROJECTS, OUTSIDE BROADCAST UNITS AND OFFICES. 2 perfect sets (**SUPERIOR QUALITY**) in individual carrying cases, complete with long life batteries, bells, magneto and 100ft. telephone cable.

£7.10.0 per pair. Carr. 7/-.

Originally cost £40

TELE "F" HIGH POWER, as above, but complete, with amplifier, **£6.10.0** Carr. 12/6. Each

D3 STRANDED TELEPHONE CABLE. New Mile Drum 85/- Carr. 17/6. **ENGLAND'S LARGEST STOCKS OF TELEPHONE EQUIPMENT**

CONSTANT VOLTAGE TRANSFORMERS

FERRANTI 7½-KVA MOVING COIL
Stabilized output voltage in the range 200-250 v. Plug-board tappings. The selected output voltage is constant with +1% at all loads 0 to 30/37½ amps. when the supply voltage is varying over the range +8% to -12%
★ Frequency compensated 45-55 and 54-66 c/s.
★ Excellent output wave-form.
★ Can be used as a variable transformer.
★ Unused. Complete with spares and instruction book at a fraction of the normal cost, only £65.
★ A.C. MAINS STABILIZER.



AUTO TRANSFORMERS

3KVA Air Cooled (100% under-rated). GUARANTEED 230/250 tapped, 12 amps. 6 KVA 105/120 tapped, 28.5 amps. Made by well-known manufacturer and housed in strong metal case. Weight: 2 cwt. Brand new, in original maker's case.

PRICE **£15. 0. 0** Carr. 25/-.



SUPER POWER AMPLIFIER

MADE TO STRICT GOVT. SPEC. Complete system with 4 speakers.

For outdoors—and entire premises indoors will take up to 20 speakers.

Output: 30 to 60 watts. Valves: Four 6L6, parallel push-pull. Input: 200-250 volts A.C. Leads, hand mic., plugs, spares included. Robust wooden transit case 17½ x 15½ x 12in. Save over £100! **TODAY'S BEST PRICE—£40 carr. paid.** EXTRA SPEAKERS 22/-, carr. paid.

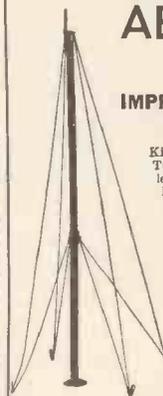
P.A. SYSTEM (EX GOVT.)

Complete with amplifier unit, 4 speakers, microphone, headphones and all spares packed in wooden cases, 6 or 12 volts D.C. handling capacity 8 watts. Ideal for cars, boats, factories, etc. 15 gns. Carr. 30/-.

AERIAL MASTS

IMPROVED TYPE 50 MK.II

36ft HIGH



Kits comprise—six 2½in. dia. Tubular Steel Sections of 6ft. length, top-section and base Pickets, Guys and Fittings. YOU can purchase this normally expensive MAST for a fraction of its cost. Please add £1 for (returnable) wooden carrying case. The MAST is particularly suitable to take aerials for Tx., Rx. F.M. and TV. (especially COMMERCIAL) and has many other uses. Extra 6ft. sections can be supplied at 17/6 per section. Carr. 15/6. **£8.10.0 only**

U.S.A. Type 45ft. TELECOM AERIAL MAST. (7 sections, 6ft. 8in. x 2½in., guys, etc.) This entirely complete set in carrying case 12½ Gns. Carr. 17/6. Or 2 sets for £25. Carr. extra. British Manufacture only.

ARMY TYPE 32FT. MASTS similar to above but 10 lin. screw-sections, suitable for permanent lightweight installation. Kit in canvas bag, £3/15/- Carr. 7/6.

Limited Quantity
36ft. TELESCOPE MASTS

Finest quality brass. Non-rusting. Base diameter 2½in. Complete with hand-winding winch for easy, rapid extension; and cable-wire bracing stays. One of the best masts ever produced. **£35** each Carr. £1/10. Winds down to 9ft.

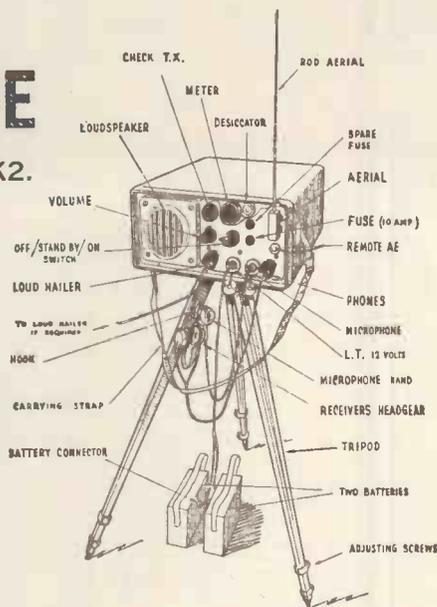
Irongate
(M.O.) COMPANY

Dept. (W10), 2, IRONGATE WHARF ROAD, PRAED STREET, LONDON W.2

PADDINGTON 2231/2/3

Portable/Mobile V.H.F RADIO TELEPHONE

TYPE W.S B44 MK2.



EXPORT ONLY

CRYSTAL CONTROLLED 60-95mc/s.

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

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

Special quotation for quantities up to 500 sets.

50 MICRO AMP MOVING COIL METERS

Brand New & Boxed—Large Stocks available

Made on Government Contract by Famous British Maker

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

A RANGE OF METER BOXES

Useful for all kinds of testgear, a quality job in welded steel, finished in grey hammer stoved enamel. Standard panel size 4½" x 7½", available in depths 2", 3", 4" and 6".

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



Complete with data

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

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

SPECIAL PRICES FOR 100 LOTS

TEST GEAR COMPONENTS (LONDON) LTD

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

AUTUMN BARGAINS FROM DUKE & CO.

(LONDON) LTD.,
621/3 Romford Road,
Manor Park, E.12.
ILF 6001/3



LIST PRICE
29 gns.
NOW ONLY
18 gns.

COMPLETE TAPE RECORDER UNREPEATABLE VALUE

Famous manufacturer. Huge purchase allows us to offer at this amazing price. Beautifully styled, rexine covered cabinets. Colours: Red, Grey, Black. Storage space for 4 tapes, mike and lead. Incorporating the latest B.S.R. Deck. LOOK AT THESE EXPENSIVE FEATURES. Controls: Record/Playback switch and rewind with interlocking device to prevent accidental erasure. Tone and volume controls. Superimpose and electronic eye. Ample power output 3.5 watts. Small overall size 14½in. x 14½in. x 7½in. Lightweight, only 21lb. Playing time 1½ hours. 5½in. standard tape. Terms: carr. and ins. 12/6. Microphone 27/6 extra. Tapes 19/9. Carr. & ins. 12/6



DE LUXE TAPE RECORDER CABINET
ONLY 29/9

Beautifully Made Tape Recording Cabinet. Size 13in. x 10½in. x 7in. Covered in two-tone coloured rexine cloth. Stylish design. Carrying handle with detachable lid and lock and key. Easily adapted to Record Player Cabinet. Exceptional value at this very low price. P. & P. 4/6.

★ AMPLIFIERS ★ ALL PORTABLE 12 MONTHS' GUARANTEE

MK. D.1 59/6
Brand new. Latest design with printed circuit. Dimensions 7 x 2½ x 5in. A.C. only. Mains isolated 3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. P. & P. 2/6.

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 bass control. Knobs 3/6 extra. P. & P. 3/6.

MK. D.5 39/6
Simple circuit employing ECL80 triode pentode output valve giving 2-3 watts output. A.C. only. Mains isolated. Single control for volume and on/off switch with knob. P. & P. 3/6.

TAPE RECORDER AMPLIFIER 87/19/6
Compact, well designed 5-valve amplifier. Output 3.5 watts. Valve line up—ECC83. Double triode first audio amplifiers. ECL82 Triode pentode further audio amplifier and output valve. 6BW6 Bias and erase oscillator, EM84 record level, indicator. EZ80 H.T. rectifier. Input for mike, radio and gram. Controls: record playback volume and on/off playback tone. Dia. 8½ x 3 x 4½in. Ins. and carr. 4/6. Terms. Knobs 2/6 per set. Beautiful perspex dial plate, 3/6. Completed with sockets for mike. Radio and superimpose switch.

12 months' guarantee.

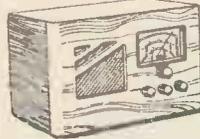
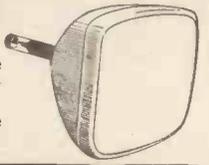
Carr. & Ins. 15/6

REPLACEMENT, REBUILT T.V. TUBES

21 in. TUBE ... £8.10.0 **£2** allowed on old tube
17 in. TUBE ... £7.10.0

12, 14, 15 in. TUBES **£1** allowed on old tube
£5.10.0

TERMS AVAILABLE OVER 20 WEEKS



HOME RADIO 79/6 A.C. or UNIVERSAL MAINS

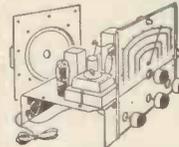
5 valve octal superhet. 3 waveband receiver. In attractive polished cabinet. Dimensions 9½in. x 18½in. x 11½in. Carr. and ins. 4/6.

AUTUMN SALE! BARGAIN! 17" T.V.s COMPLETE 19 gns.

Cash, or terms over 20 weeks. (NO interest charged). Initial payment £10/7 and 19 weekly payments of 19/11. Carr. & ins. 30/-.

ITV/BBC. Beautifully styled polished cabinets. These are table models with the option of contemporary legs fitted (2 gns. extra). 17in. rectangular tube guaranteed for 12 months. Valves and chassis guaranteed for 3 months. (Chassis salvaged but reconditioned). Where possible personal collection is advised.

SEND for FREE CATALOGUE ★ Full details of easy terms ★



SUPER CHASSIS 79/6 3/11

Cash Price. Per Week. Five valve superhet chassis including 8in. P.M. Speaker and Valves. Four control knobs (tone, volume, tuning, w/change, switch). Four wavebands with position for gram. P.U. and extension speaker. A.C. Ins. and carr. 5/6.

RECORD PLAYER CABINET MODEL R.P.2. CASH PRICE: 59/6

Made by a famous manufacturer. In polka dot cloth with clipped lid and carrying handle. 6in. x 14½in. x 8½in. deep. Carr. and Ins. 4/6. Will take B.S.R. Monarch 4-speed Autochanger. 7in. x 4in. elliptical speaker and our Mk. D.2 Portable Amplifier.



LIVERPOOL ST. TO MANOR PARK ONLY **10 minutes**

RECORD PLAYER CABINET R.P.8 79/9 cash OR 5/4 initial payment



Balance at 3/11 a week for 19 weeks. This contemporary cabinet in two tone grey rexine is ideal for the modern home. Added attraction is the cream plastic speaker fret. Press button lid; lock. Fittings for screw in legs. Internal measurements 14½ x 18 x 8½in. deep. Takes a Garrard 121 Mk. 2 or B.S.R. U12; 9½ x 4½in. elliptical speaker; our Mk. D.2 portable amplifier. Carr. and ins. 5/6.

RECORD PLAYER CABINET R.P.9 only 19/6

Exceptional offer. A lightweight portable record player cabinet by a famous manufacturer. Size 14½ x 11½ x 6in. Colours cream and rust. Complete with moulded deck board of attractive design. Takes a B.S.R. TU9 single player, 2 control amplifier and a 5in. round speaker. P. & P. 4/6.

B.S.R. Monarch, 4-speed Autochanger, 86/19/6.
Collaro Conquest, 4-speed Autochanger, 86/19/6
Collaro Conquest, Stereo Autochanger, 9 gns.
Ronnette Hi-Fi Crystal Cartridge, 17/9.

EXTENSION SPEAKERS only 19/9



8in. P.M. speakers fitted into polished oak cabinets. Standard matching to any receiver (2.5 ohms), complete, switch and flex included. Relay that radio programme anywhere! Post and packing 3/9.

ELLIPTICAL SPEAKERS 15/9 7 x 4in. and 8 x 3in. P. & P. 2/9.

P.M. SPEAKERS
8in. Output transformers fitted. P & P. on 1, 2/6; on 2, 3/6. **9/6**

SCANNING COILS
90 deg. 38 mm. Low imp. Postage 1/3. **7/9**

FOCUS MAGNETS
Brand new. Complete with shift control. Post 1/3. **5/9**

SOUND/VISION STRIP
I.F.'s 10.5 or 16-19.5 mc/s. Circuit inc. Post 2/6. **2/9**

GERMANIUM CRYSTALS. 9d. each or 6/- doz.
Complete with L.P. and Standard Stylus. Post 9d.

CO-AX CABLE.
1/6 postage on 20 yds. 45/- per 100 yds. P. & P. 3/6. **6d.** yard.

SOLO SOLDERING TOOL 12/6

110 v. 6 v. or 12 v. (special adaptor for 200/250 v., 10/- extra). Automatic solder feed including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use Post 3/6.



DUKE & CO (LONDON) LTD

621/3 ROMFORD ROAD,
MANOR PARK, LONDON,
E.12. ILFord 6001/3

COMPLETE RECORD PLAYER

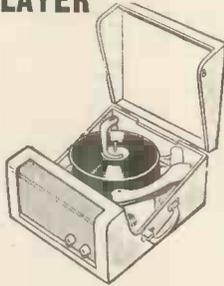
Model R.P.1. 10 Gns.

The finest value yet in four speed portable players. Excellent volume and tone controls. Impeccably finished in smart two tone colour scheme. Width 14½in. Depth 14½in. Height 6½in. Weight 13½ lbs. Insurance and carriage 9/6, or Initial payment 20/- (incl. carr.) and 19 weekly payments of 10/6.

COMPLETE RECORD PLAYER

Model R.P.20.
ONLY 14 Gns.

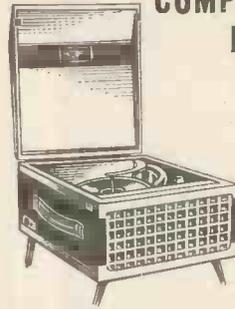
An elegant record player in Grey polka dot. Contains four speed auto changer and a modern amplifier. Sturdy carrying handle and fittings. Width 16in. Depth 14½ins. Height 8½in. Insurance and carriage 12/6, or Initial payment 12/6 (incl. carr.) and 19 weekly payments of 14/6.



COMPLETE PORTABLE PLAYER

Model P.L.5. ONLY 8 Gns.

A petite portable player. Robust case with smart two tone colour scheme. Sturdy carrying handle and fittings. Contains four speed single player unit and 8in. x 3in. elliptical speaker. Width 12in. Depth 10½in. Height 6in. Plays 7in., 10in. and 12in. records. Insurance and carriage 9/6, or Initial payment 19/2 (incl. carr.) and 19 weekly payments of 8/4.



COMPLETE CONTEMPORARY RECORD PLAYER Model R.P.80. 18 Gns.

This contemporary record player is beautifully suited for the modern home, in two tone grey with attractive cream plastic speaker fret, push button lid with lock. Fittings for screw in legs. Contains UA12 auto changer, 9½in. x 4½in. elliptical speaker, 2 control 4 watt amplifier. Size 14½in. x 18in. x 8½in. Carriage and Insurance 12/6, or Initial payments 39/- (incl. carr.) and 19 weekly payments of 18/6.

TIME BASE 2/9. Containing scanning coils, line trans. etc. Less valves. Drawings available with order. Postage 2/6.

MASKS 12in. 1/9. Round. Soiled, needs washing. Postage 1/6.

MASKS 15in. 1/9. New. Colours—Gold or White. Postage 1/6.

MASKS 17in. 7/9. Grey plastic. Good quality. Postage 2/-.

TWIN GANG CONDENSERS 1/9. Salvage guaranteed. Standard size 2 gang .0003 (300 pf) also standard size 2 and 3 gang .0005 (500 pf). All tested and guaranteed. Postage 1/3.

RECTIFIERS 2/9. 250v. 100 m.a. Full or half wave. Salvage guaranteed. Postage 1/3. Insulating tape, 1/6 per Roll. Finest quality. Large roll in sealed container. 75ft. x ¼in. wide. It's a BARGAIN at this price. Will last a lifetime. Postage 1/6.



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. Size 18in. x 14in. x 8½in. high. This stereophonic player COMPLETE, retails at 35 Gns. in the shops today. Insurance and carriage 5/6 or Initial payment 11/1 (incl. carr.) and 19 weekly payments of 4/11.

CAR AERIALS, 6/9. Whip antennae. 50ins. long, collapsing to 11ins. Not telescopic. One hole fixing. Post and Packing 1/-.

I.T.A. 23/6. For all I.T.A. channels. For outdoor or loft. 3 elements. Postage 2/6.

I.T.A. 18/6. Indoor type. Folded dipole with 12ft. co-ax cable fitted. Aluminium. Postage 2/-.

B.B.C. 15/6. Indoor type. Folded dipole with 12ft. co-ax cable fitted. Gold finish. Postage 1/9.

INDOOR COMBINED 27/-. Folded dipole with 12ft. co-ax cable fitted. Gold finish. Postage 2/-.

COMBINED 35/6. Loft type. Single dipole B.B.C. with 3 elements I.T.A. Swivel bracket for universal fixing. Insurance and carriage 3/-.

PRESENTATION CASES.

Covered in hard wearing washable leatherette of various colours, and beautifully made. Hinged top for easy access to records and numbered index for easy reference. Plated clip fasteners. Carry all those expensive records safely to parties and record sessions.

10in. Case, holding 20 Records—18/6. Postage 2/6.

12in. Case, holding 20 Records—22/6. Postage 2/6.

ELECTRIC CONVECTOR HEATERS 99/6

By famous manufacturer. Costs only 1½d. an hour or 3d. on high heat. 1 kilowatt or 2 switched (1-2 units). Illuminated grill. Bronze finish. 200-250 volts AC/DC. Size: 26in. x 18in. x 7½in. We purchased the entire stock, but these cannot last. It will be cold again, why pay three times this price? order now and don't be disappointed later. Insurance and carriage 10/6, or Initial payment 15/5 (incl. carr.) and 19 weekly payments of 6/1.

PHOTOGRAPHIC SLIDE CASES 15/6.

Covered in tan rexine. Made to take 90 of those expensive coloured transparencies in separated partitions. This is the answer to that aggravating search for that particular slide.

CHASSIS FOR SPARES ONLY 9/6.

56 resistances incl. 7 variable controls. 54 condensers, inc. electrolytics, coils, 7 I.F. and R.F. transformers. Main, output, line and frame. Metal rectifier 300v. at 250 m.a. Fuse panel, scanning coils, focus magnet, plugs, sockets, switch, chassis screws, tape strips etc. I.F. strip can be separated. Power pack can be used without dismantling. These chassis have been used, but were working when stored. 6-page circuit showing positions of each component available with order. Carriage 7/6.

5in. P.M. SPEAKERS 12/6. Round. 3Ω speech coil. Flux density 8,500 gauss. Post and packing 2/3.

DON'T FORGET TO SEND FOR YOUR FREE CATALOGUE.

TRANSFORMERS. MAINS TRANSFORMERS, 6/6. Primary 200-250 volt. Secondary 300-0-300 @ 80 m.a. 6.3 at 3 amp. 5v. @ 2 amp. Postage and packing 2/9.

HEATER TRANSFORMERS, 7/9. 12 volt at 1½ amp. 0-200-250 volt primary. Postage 1/9.

HEATER TRANSFORMERS, 3/9. 2-1 ratio auto transformer. 2v. at 1.4 amp. primary. 4 volt secondary. Post and packing 1/9.

EY51 7KV ISOLATION TRANSFORMERS, 5/9. 1-1 ratio. Suitable for 6.3 tube as isolation transformer. Post and packing 1/9.

OUTPUT TRANSFORMERS, 1/3. Salvage guaranteed. Standard size. 2-5 ohms. Matching pentode or tetrode O.P. valve. Post and packing 1/9. 20 for £1. Carriage 5/6.

CHASSIS, 1/-. 6 or 8 valves. Latest type, midjet valve design for A.M. or F.M. Brand new. Cadmium plated. Size: 12½in. x 7½in. x 2½in. Post and packing 1/9. 4 for 3/6, Postage 3/-, 12 for 7/6, Carriage 5/-.

IDEAL FOR SPARES

1D6	6H6	9D2	78	AR6	EB34	KT241	QP21	VR35
3D6	6SA7	11D3	210VPT	ARP36	EF36	LP220	SP41	VT61A
4D1	6SH7	12BE6	1203A	CV73	EF37	ML4	SP61	VT510
6AC7	7B6	12SC7	2050	CV188	EF60	NGT2	T41	VW48
6B7	7B7	12Y4	2151	D1	GTIC	PM202	TT11	W21
6B8	8D2	18	7103	EA50	KT24	PP225/6	VR21	

VALVES

AND MANY OTHERS

SALVAGED GUARANTEED

2D21	6F13	6SG7	12SK7	EAF42	HL41DD
6BA6	6F14	7C6	12SR7	EBC41	HL42DD
6C4	6F15	7S7	1625	EF42	KT33C
6D6	6J5	7Y4	CV1144	EF91	KT33C
6F1	6K7	10F1	DF66	EF92	KT81
6F12	6LD20	12SH7	DH81	EL32	KTW61



FOR VALVES, TUBES AND COMPONENTS—BY RETURN POST SERVICE

AC/P 7/6	ECC81 8/-	MSP4/7 7/6	SP4/7 10/6	UY85 7/-	4D1 3/-	6J7G 6/6	9D2 3/6	27SU 19/11
AC6PEN 6/6	ECC82 7/6	MSP41 6/-	TP25 10/-	VP13C 3/6	5R4GY 9/6	6K7G 4/-	10C1 17/3	30C1 10/6
ATP4 3/6	ECC83 9/-	MX40 12/6	U10 9/6	VP133 15/-	5U4G 6/6	6K7M 6/9	10C2 17/6	30F5 10/6
AZI 10/-	ECC84 10/-	N37 19/11	U14 8/6	VR22(PM2A) 5V4 11/6	5V4 11/6	6K8G 6/6	10D2 12/-	30FL1 10/6
AZ31 10/-	ECC85 9/6	N78 19/11	U16 12/6	VP23 6/6	5Y3G 8/-	6K6GT 7/9	10F1 12/6	30L1 10/6
AZ41 13/11	ECC86 12/-	N147 14/6	U22 8/-	VP23 3/6	5Y3GT 7/6	6K7GT 5/9	10F3 23/3	30L1 19/11
B36 10/-	ECC87 10/6	N339 33/2	U25 15/-	VP41 8/6	5Z4G 9/-	6K8GT 10/1	10F9 15/3	30L15 23/3
CBL31 23/3	ECC88 9/6	OZ4 5/6	U26 10/6	VR105/30 8/-	5Z4M 10/6	6K25 10/1	10F18 15/3	30P4 15/-
CCH35 23/3	ECC89 10/6	P61 3/6	U37 26/6	VR116 4/-	6A7 10/-	6L6G 10/6	10L1 15/11	30P12 12/6
CL4 12/6	ECC90 10/6	PABC80 13/11	U45 15/-	VR150/30 7/6	6ABG 9/-	6L6M 9/6	10LD11 12/-	30P16 9/6
CL33 19/3	ECC91 9/6	PCC84 8/6	U50 8/-	VI20A 3/6	6AC7 4/-	6L7G 7/6	10M2 23/3	30P16 9/6
CY31 16/7	ECC92 10/6	PCC85 11/6	U76 8/-	VU39 (MU12) 8/6	6AG5 5/6	6L8 11/6	10P13 15/-	30PL1 12/6
CY1 18/7	ECC93 10/6	PCC88 23/11	U81 8/-	U81 8/-	6AK5 5/-	6L18 13/6	10P14 19/3	30PL13 21/11
CV73 4/-	ECC94 10/6	PCC89 19/11	U82 8/-	VU111 2/6	6AL5 4/-	6L19 13/6	12A6 5/-	35L6GT 10/-
C36A 6/6	ECC95 10/6	PCF80 8/9	U101 8/-	W21 10/-	6AM5 7/6	6LD20 15/11	12AH8 12/-	35L6GT 10/-
D42 4/6	ECC96 10/6	PCF81 11/6	U339 16/7	W76 7/6	6AM6 4/-	6M1 17/3	12AT6 9/6	25Y5 9/9
DAF96 8/-	ECC97 10/6	PCF82 16/7	U403 16/7	W77 8/6	6AQ5 7/6	6N1 19/3	12AT7 7/6	35W4 7/6
DF96 8/-	ECC98 10/6	PCF84 16/7	U404 11/4	W101 8/-	6AT6 8/6	6P26 19/11	12A06 8/-	35Z4GT 8/-
DH163 7/6	ECC99 10/6	PCF85 11/6	U403 11/4	W101 8/-	6AT6 8/6	6P26 19/11	12A07 8/-	42 8/-
DH1101 8/6	ECC100 10/6	PCL82 11/6	U404 11/4	W101 8/-	6AT6 8/6	6P26 19/11	12A08 8/-	35Z3GT 16/7
DK96 8/-	ECC101 10/6	PCL83 13/6	U801 29/10	W21 10/-	6AU6 10/6	6P26 19/11	12A09 8/-	35Z4GT 8/-
DL63 9/-	ECC102 10/6	PCL84 13/6	U801 29/10	W61 6/-	6BBG 4/-	6P28 26/6	12A10 8/-	42 8/-
DL82 10/6	ECC103 10/6	PL38 26/6	UAF42 9/6	W61 (M) 8/-	6BA6 7/6	6Q7G 7/6	12A11 8/-	35Z3 16/7
DM70 7/6	ECC104 10/6	PL84 12/7	UB41 9/6	X22 12/6	6BE6 7/6	6Q7GT 9/6	12A12 8/-	35Z5GT 9/-
DM41 12/6	ECC105 10/6	PL83 9/6	UBC41 8/6	X41M 12/6	6BH6 9/-	6SA7GT 8/-	12C8 7/6	50C5 11/6
EA50 1/6	ECC106 10/6	PL84 12/7	UBC81 11/4	X101M 8/-	6BJ6 9/-	6S7 12/6	12H6 3/6	50CD6G 29/10
EA50 1/6	ECC107 10/6	PL84 12/7	UBF80 9/6	Y63 7/6	6BR7 12/6	6SH7 4/6	12J5GT 10/6	50L6GT 8/6
EA50 1/6	ECC108 10/6	PL84 12/7	UBF89 13/11	Z21 (4 pin) 8/6	6BW6 9/-	6S17 8/6	12K7GT 10/6	50L6GT 8/6
EA50 1/6	ECC109 10/6	PL84 12/7	UBL21 23/3	Z309 7/6	6BW7 7/-	6SK7 6/-	12K8GT 13/6	75 10/6
EA50 1/6	ECC110 10/6	PL84 12/7	UC92 12/6	Z359 7/6	6C4 4/6	6SL7GT 8/-	12K8M 13/6	77 6/-
EA50 1/6	ECC111 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C5GT 6/6	6SN7GT 7/6	12K8M 13/6	77 6/-
EA50 1/6	ECC112 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC113 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC114 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC115 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC116 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC117 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC118 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC119 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC120 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC121 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC122 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC123 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC124 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC125 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC126 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC127 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC128 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC129 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC130 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC131 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC132 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC133 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC134 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC135 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC136 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC137 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC138 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC139 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC140 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC141 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC142 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC143 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC144 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC145 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC146 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC147 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC148 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC149 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC150 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC151 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC152 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC153 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC154 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC155 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC156 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC157 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC158 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC159 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC160 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC161 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC162 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC163 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC164 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC165 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC166 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC167 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC168 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC169 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC170 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC171 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC172 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC173 10/6	PL84 12/7	UC92 12/6	I3 3/6	6C6 5/6	6S97 9/3	12K8M 13/6	77 6/-
EA50 1/6	ECC174 10/6	PL84 12/7	UC92 12/6	I3 3/6	6			

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including Cabinet, Battery, Transistors, Car Radio, AVC and all necessary items.

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(3-Transistor Pocket Radio)



- ★ 5-stage Reflex Circuit.
- ★ No Aerial or Earth required.
- ★ Min. Volume Control.
- ★ 3 Ediswan Transistors.
- ★ Medium Wave Tuning.
- ★ Size 4½ x 3 x 1½in.
- ★ Personal phone included.

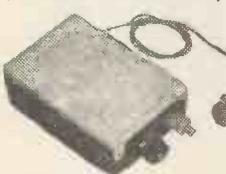
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TOTAL 87/6 P.P. 1/6. BOOKLET FREE

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(2-Transistor Pocket Radio)



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- ★ Very sensitive. No aerial or earth required.
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- ★ Personal phone included.

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CRYSTAL CONTROLLED OSCILLATORS: 10 Kc/s., 100 Kc/s. and 1 Mc/s. Output up to 20 Mc/s. On/OFF MODULATOR. With handbook. Unused. ONLY 79/6. P.P. 2/6.

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Complete with 5 valves. In new condition. These Sets are sold without Guarantee, but are serviceable (7 to 9 Mc/s), 22/6. P.P. 2/6. Handphones 7/6 pair, Junction Box 2/6, Throat Mike 3/6, Aerial Rod 2/6.

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Complete with speaker sockets, calibrated dials, etc

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Grade 1 industrial process timer with 3 inch dial covering $\frac{1}{2}$ to 10 minutes in one tenth divisions. Driven by a 16 volt 50 c/s synchronous clock. A metal rectifier provides D.C. to pull in a relay that engages the drive until the time set on the dial elapses. As it reaches zero heavy duty contacts snap shut to close the external circuit (at the same time other contacts break to arrest the clock). Switching off the power trips the relay and the spring loaded dial returns to the time set ready for the next cycle. Whole totally enclosed in a heavy cast wall mounting case, stove enamelled black, size $6\frac{1}{2} \times 7 \times 4$ inches. Brand new in original packings **55/-** post paid.



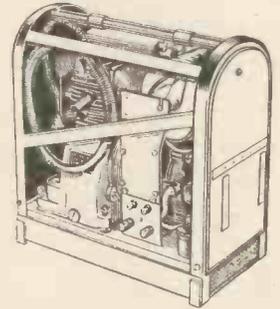
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Type T.S.2, first grade precision time switches as supplied to G.P.O. Comprises absolutely silent self starting 250 volt 50 c/s synchronous clock mechanism totally enclosed in heavy gauge brass case. Central drive takes detachable dial that revolves to operate sensitive on and off trips for external mains operated circuit. Self contained clock is easily detachable from rear mounting panel (self starting down to 80 v. and keeps running down to 15 v.).

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Preliminary announcement—write for full details. Self contained 80 watt unit delivery 12 to 18 volts. Size only 15 x 8 inches, weight 46 lb.



As new

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carriage

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TORCH IGNITER PUMP.



the motor develops 1/6th h.p. at 13,000 r.p.m., pumping about a gallon a minute at 30 p.s.i. (adjustable by pressure relief valve) Performance marginally less on 12 volts. Inlet and outlet unions. $\frac{1}{2}$ in. B.S.P. Brand new.

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Plessey FP3 Mk. 4, totally enclosed, flame proof, compound wound motor driving a self-lubricating, positive displacement, sliding blade Kerosene pump through a 4 to 1 reduction gearbox. Running on 24 volts D.C. (designed for 16-29 v.)

200 AMPERE D.C. GENERATORS.

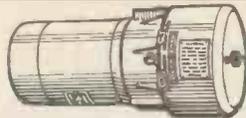
Normally driven from tractor power take-off or the like to give a 29 v. output sufficient to weld $\frac{1}{16}$ in. plate.

£6 carr. paid.

AMERICAN COWL GILL MOTORS.

Smaller and neater than British counterpart. Split-field, reversible. 12-24 volts.

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AMERICAN 400 CYCLES INVERTER.



Very neat unit indeed, only 2 $\frac{1}{2}$ dia. by 4 in. long on 1 $\frac{1}{2}$ in. high pedestal base containing suppressor. Ball bearings. 24 volt D.C., input for 26 volt single phase output. Instrument quality — as used with Bendix Magnesy compass system.

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New, weather protected, sealed twin 500 ohm solenoids driving striker between twin 6 in. dia. plated gongs.

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VARIABLE SPEED HYDRAULIC GEARBOX.

This specially made oil-filled casing houses a hydraulic torque conversion unit originally precision made by Westinghouse from high quality materials for the U.S. Government at an acquisition cost exceeding £150 each. Highly suitable for lathe head drive, workshop variable speed power take-off, etc.

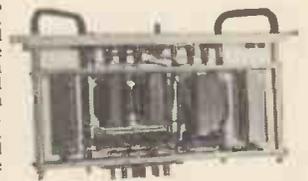
Basically the unit is a back-to-back mounted, oil submerged, variable displacement hydraulic pump (input shaft) feeding a reversible hydraulic motor (output shaft) so that variation of output speed from zero up to 6% below input speed while a changeover valve in the supply lines to the motor provides instantaneous reverse at any speed. Recommended input speed 500-1,000 r.p.m., maximum power 1 $\frac{1}{2}$ h.p. Both shafts $\frac{1}{2}$ in. dia. with Woodruff key. Tested and fully guaranteed, supplied complete with technical data and performance curves for the remarkable price of £16 only, carriage paid.

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Set of 5 brand new 25 SN7's **£1** post free.

Admiralty Type 107 Rectifier Unit in totally enclosed rack mounting case. A.C. input 100, 110, 200, 210 up to 250 volts. D.C. output +50/0/-50 V. and 20 V. A.C. for pilot light. Spare A.C. outlets 80-0-80. Twin 9 Henry smoothing chokes and twin 8 uf paper capacitors with 15 k. bleeders. Two 550 mA. mains fuses and three 250 mA. output fuses. Full wave metal rectifier. Circuit diagram inside case. Size 19 in. long by 3 $\frac{1}{2}$ in. high. Neat solid job, ready made to fit and forget. **£1** carriage paid.

BIAS RELAY POWER PACK for £1.



SPECIAL

strictly limited offer of

"READ-OUT" DECADE COUNTER TUBES

Type G10/241 Nomotron ("read out") tubes—latest type cold cathode, gas-filled, single pulse, uni-directional decade counter which displays count in actual numeral on tube face. Operating range 0-20 Kc/s.; cathode output 40 volts, 3.7 mA. Applications include: tachometers, counting and batching, frequency and time measurement, direct operation of electro-magnetic relays, sequential monitoring of up to 10 different waveforms, etc. **32/6** post paid. Brand new with base and instructions.

LATEST DELIVERY
SMALL QUANTITY BRAND NEW
CLASS D WAVEMETERS

Complete with reference xtal. **£5** carriage paid.

SPECIAL VALVES

CV.4038. 4054 (Radioactive). 4069 VX 8142 and 8190.

Details and prices on application.

NICKEL CADMIUM BATTERIES. £6 carr. paid.
Five heavy duty 1.2 v. cells gives 6 v. for 75 amp.-hours. Fully charged in 15 $\frac{1}{2}$ x 12 x 6 in. wooden crate.

SELENIUM RECTIFIERS. 16/- post paid
New, full wave, 12 volt, 4 amp. 4 $\frac{1}{2}$ in. dia. Type B.56.

Premier RADIO

23 TOTTENHAM COURT RD., LONDON, W.1. Tel. MUSEum 3451/2 and at 309 EDGWARE RD., LONDON, W.2. Tel. PAD. 6963

Visit our large and comprehensive HI-FI showrooms



THE EASY SIX
6-Transistor Battery Portable
MAY BE BUILT FOR **£9.15.0** plus 3/- p. p.
Ever Ready PP7 Battery Extra 3/3
STAR FEATURES: ★ Six 1st grade Mullard Transistors ★ Internal Ferrite Rod Aerial ★ Provision for Car Radio Aerial ★ 5in. Loud-speaker ★ Printed circuit, with component positions indicated ★ Pre-assembled Dial Assembly ★ 500 milliwatts, Push Pull output ★ Pull medium and long waveband coverage ★ Attractive two-tone Blue/Cream Vynide covered Cabinet, dimensions 8½in. x 6½in. x 3in. ★ Full point-to-point instructions supplied ★ Weight 3 lb with battery.

Assemble it yourself and **SAVE £ £ £'s**

COMPACT GRAM. AMPLIFIER
2-valve printed circuit type for use on A.C. or D.C. 200/250 v. mains incorporating modern miniature valves. Output 2 watts. overall dimensions 6½ x 2 x 3½in.
Price 59/6, plus P. & P. 2/6.
Amplifier Cabinet, £2/19/6, plus 5/- P. & P.
7 x 4in. Elliptical Speaker, £1/1/6, plus 1/6 P. & P.
Latest-type Collaro Conquest 4-spd. Changer, £7/19/6, plus 5/- P. & P.
If all the above items are purchased at the same time they can be supplied at £13/15/-, plus 10/- P. & P.



DRAMATIC PRICE REDUCTIONS

AVANTIC DL735 Power Amplifier. Specifications: power output 54 watts peak; L.S. impedance 4, 8 or 16 ohms, power inputs 105-250 v. Valve line-up GZ34, 2-EL34, ECC83, EF86. Dimensions 14½ x 9 x 8½in. Original price 30 gns. P. & P. 12/6. **OUR PRICE £24.**

AVANTIC SP21. Stereophonic Pre-amp Control Unit. Brief specifications, 6 inputs for each channel, bass, treble, volume control, on/off stereo/3D/reverse stereo switch, stereo phase switch, low pass filter. Power requirements 6.3 v. at 1.3 A., A.C., 350 v. at 5 mA. D.C. Dimensions 14½ x 9 x 4in. Original price £28/10/-. P. & P. 7/6. **OUR PRICE 18 Gns.**

AVANTIC SP111 Stereophonic Amplifier. Technical details: power output (each channel) 10 watts peak, L.S. impedance, 4, 8 and 16 ohms 6-position input selector, bass, treble, volume on/off controls, stereo reverse switch, phase reverse switch, stereo balance control, P.U. balance control. Dimensions 14½ x 8½ x 4in. Original price 28 Gns. P. & P. 7/6. **OUR PRICE 19 Gns.**

AVANTIC PL621 20-watt monaural Amplifier, frequency response 10 c/s-30 Kc/s 1dB. L.S. Impedance, 4, 8, or 16 ohms. Dimensions 14in. x 8½in. x 7½in. Original price 29 Gns. P. & P. 7/6. **OUR PRICE 19 Gns.**

All this equipment is Brand New and in manufacturers' original sealed cartons. Full descriptive literature available.

MULLARD TYPE 5-10 AMPLIFIER

By Well Known Manufacturer

PRICE **£13.19.6** plus 5/- p. & p.

SEND FOR FULL TECHNICAL DETAILS

A SIX TRANSISTOR POCKET RECEIVER

complete with Earpiece and Plastic case.

£14. 14. 6 Battery extra 2/6. Plus 2/- P. & P.

This amazing Receiver is so small that it will fit snugly into a shirt pocket or ladies' handbag, size being only 4 x 2½ x 1½in. Ferrite Rod Aerial is used, full station selectivity on medium waveband.



THE Petite PORTABLE

MAY BE BUILT FOR **£7.7.0** p. & p. 3/-

Batteries extra. H.T. 10/- (Type B126) or equivalent.

L/T 1/6 (Type AD 35) or equivalent.

● High Q frame aerials. ● High sensitivity on both wavebands.

- Medium and long wave superhet circuit.
- Instruction book 1/6.
- Size only 8 x 8 x 4½in.
- Weight including batteries 5½lb. ● 4 valves of the economy type.

PREMIER BATTERY ELIMINATOR.

Housed in two containers which are to replace AD 35 and B126 batteries. KIT 37/6 plus 2/- post and packing. Only suitable for use with DK 96 Series valves.

THE MODEL FMA/1 FERGUSON FM TUNER

13 gns plus 3/- p. & p.

This Tuner has been designed for use with Radio Receivers or Hi-Fi equipment. The Unit is completely self-contained being self-powered and housed in a hammered metal finished steel case, measurements 10 x 7½ x 2½in. Brief technical specifications: Frequency coverage 87.6-100 Mc/s. (continuously). Valve line-up: 2—EF80, ECF80, 2 germanium diodes and metal rectifier, for operation on A.C. mains 200/250 v. 40-60 cycles.



DRAMATIC PRICE REDUCTIONS

SUPERHET may be built for **£7. 7. 0** plus 3/- p. & p.

T.R.F. may be built for **£5. 10. 0** plus 3/- p. & p.

These two receivers use the latest type circuitry and are fitted into attractive cabinets 12 x 6½ x 5½in., in either walnut or ivory Bakelite or wood 1/- extra. Individual instruction books 1/- each, post free.



THE "CLARION"

Transistorised miniature battery-operated TAPE RECORDER

- ★ Completely transistorised circuit.
 - ★ Constant governed speed of 3½ L.P.S.
 - ★ Recordings interchangeable with other recorders.
 - ★ Remarkable reproduction on both speech and music.
- Price complete with Microphone and tape— **25 GNS.** plus 5/- P. & P.

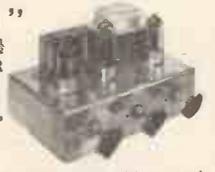
THE "MID-FI"

A NEW DESIGN 4½ WATT AMPLIFIER KIT

MAY BE BUILT FOR **95/-**

Plus 3/- p. & p.

A new circuit for the home constructor requiring a good-quality medium-powered Amplifier for reproduction of Records or F.M. Broadcasts. Technical Specifications: separate bass and treble controls. Valve line-up EF86, EL84, E280. Voltage adjustment for A.C. mains from 200/250 volt, 3 or 15 ohms impedance. Negative feedback. Size 7 x 5 x 2½in., overall height 5in. Silver-hammered finished Chassis.



THE VICEROY QUALITY CRYSTAL MICROPHONE.

A good-quality crystal Microphone for the discerning enthusiast, finished in polished steel with Muting Switch and detachable lead. Price 3 gns. P. P. 1/6

R.S.C. HI-FI TAPE RECORDER KIT

Build a high quality recorder
in the £70 class for only
Can be assembled in 1/2 hour.

25 1/2 GNS.
Carr. 17/6.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR, THE LINEAR LT45X HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7x4in. LOUDSPEAKER, Reel of Best Quality TAPE. Spare Tape Spool, a Portable Cabinet, size approx. 16x13x9in., finished in two-tone rexine, and connection diagram for wiring amplifier to transcriptor.

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 £5/15/- and 12 monthly payments of 42/-. 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 (specially suitable for use with any of our Amplifiers). A Triode Heptode Feeder 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 its 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.

RE-ENTRANT LOUD-SPEAKERS For factory or outdoor use.
Tannoy 7.5 ohms 8 watts 25/9.

Parmeko horn type, highly efficient. Handles up to 10 watts. 15 ohm and 200 ohm matching 59/6.

R.G.A. 20 watt rating, 3 ohm, 15 ohm, and 200 ohm matching 6 gu.

ACOS HI-FI CRYSTAL 'MIKES'

Mic 40 hand or Desk type

27/9 (Listed) 45/-

39-1 Stick type

39/6 (5 Gns.) Limited number.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5 1/4 x 4 1/2 in. approx. Completely replaces batteries supply 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 46/9.

Type BM2. Size 8 x 6 1/2 x 2 1/2 in. Supplies 120 v. 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed, THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND H.T. 2 v. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator.

Complete kit with diagrams and instructions. 49/9 or ready for use 59/6.



BUILD A PORTABLE BATTERY OPERATED RECORD PLAYER FOR ONLY 26/19/6. Portable Cabinet, Garrard 45 r.p.m. motor and pick-up unit, all parts for transistor amplifier, and circuit diagrams. Parts sold separately.

B.S.R. MONARDECKS. As fitted to most tape recorders in the £26/£30 class. With a suitable amplifier and speaker really excellent recordings can be made at 3 1/2 in. per sec. 9 GNS. Carr. 5/-.

THE SKY FOUR T.R.F. RECEIVER



A design of a 3 valve 200-250 v. A.C. mains 1 and M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet. Illustrated or walnut veneered type. It employs valves 6K7, 6SP1, 6F6 and is specially

designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-Point wiring diagram, instructions and parts list 1/9. This receiver can be built for a maximum of 24/19/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

EXTENSION SPEAKERS. Handsome walnut veneered cabinets. All standard 2-3 ohms. 6in. 29/9; 8in. 35/9.

R.S.C. A12 STEREO AMPLIFIER KIT

4 GNS.

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.

R.S.C. STEREO/HIGH QUALITY AMPLIFIER KIT. Valves EZ81, ECC83, ECC83, ECL84, EL84. Separate Bass and treble controls, giving "cut" and "boost" sensitivity 50 m.v. 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch, ganged volume, ganged treble, ganged bass, and balance. Outputs for 3 ohm speakers. Carr. 7/9. 8 Gns.

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	250 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. 1 a. 3/11	250 v. 80 mA. 6/11
6/12 v. 2 a. 6/11	250 v. 250 mA. 12/9
6/12 v. 3 a. 9/9	
6/12 v. 4 a. 12/3	Contact Cooled
6/12 v. 5 a. 14/6	250 v. 80 mA. 6/11
6/12 v. 6 a. 15/6	250 v. 75 mA. 9/11
6/12 v. 10 a. 25/9	F.W. (Bridge)
6/12 v. 15 a. 35/9	

JUNCTION TRANSISTORS. R.F. Type 11/6, Audio type, 5/9. Power type Goltop V1510P 2 watts, 17/9. OGT1 10/1, OGT2 16/9. XB102 10/-, XB104 10/-, XA101, XG101, OC44, XA102 17/6, and many other types.

RECORDING HEADS. Baird Record Playback and Erase. (Housed in one container.) 9/6 pr.

COLLARO STUDIO TAPE TRANSCRIPTORS

Incorporating 3 motors. Provision for extra head for stereo.
Speeds 1 1/2, 3 1/2, 7 1/2 ins. per sec. 15 Gns.

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.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and Treble controls. For A.C. mains input of 200-250 v. 80 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves. Size only 6 x 5 x 6 1/2 in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only £5/19/6 Or Deposit 22/- and 5 monthly payments of 22/- Send S.A.E. for leaflet.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts, 15-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.

Battery Chargers and Kits for 200-230-250 v. 50 c/s. A.C. Mains

ASSEMBLED CHARGERS

6 v. 1 a.	19/9
6 v. 2 a.	29/9
6/12 v. 1 a.	29/9
6/12 v. 2 a.	38/9

Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. & pkg. 3/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.	
0-9-15 v. 1 1/2 a.	12/9
0-9-15 v. 2 1/2 a.	15/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9

BATTERY CHARGER KITS

Consisting of Mains Transformer F.W. Bridge, Metal Rectifier well ventilated steel case. Fuses, fuse-holders, grommets, panels and circuit. Carr. 2/9 extra.
6 v. or 12 v. 1 amp. 24/5
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. 8/8

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 39/9. 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.

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, change direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number, 33/9.

REFANCO TWINNET TRANSISTOR PORTABLE RADIO DESIGN. Constructive Envelope and parts list 1/3. Built in Ferrite Aerial, 7in. x 4in. speaker, Long and Medium waves. Size approx. 7 x 4 x 3in. Total cost of all parts 5 GNS.

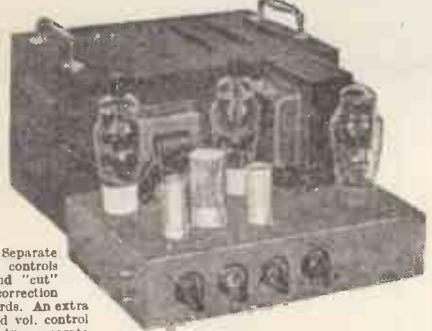
POWER PACK KITS. Only 18/11. Fully smoothed H.T. output of 250 v. 60 mA., and L.T. supply of 6.3 v. 1.5 amp. Consisting of Double Wound Mains Transformer 230/250 v. 50 c.p.s. A.C. primary. Selenium Rectifier, Smoothing Choke, Double Electrolytic Condenser. Aluminium Chassis and Circuit.

P.M. SPEAKERS. 2-3 ohm 2 1/2 in. Ferrido 21/9. 6in. Goodman 17/9. 7 x 4 in. R.A. Elliptical 19/6. 8in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 25/9. 8 x 8 in. Elac. with high flux magnet 25/9. 10in. R.A. 28/9. 10 x 8 in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. B.A. 3 or 15 ohms. 10 watts, 12,000 lines, 59/6.

TWEETERS, 4in. Plessey, 8 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 inputs such as "mike" and gram, etc., 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. Or Factory built with 12 months' guarantee £13/19/6. **TERMS ONLY 11 Gns.** ON ASSEMBLED UNITS. DEPOSIT 2/9 and 12 monthly payments of 2/9. Carr. 10/- Cover as illustrated 18/9 extra. Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ± 3 D.B. 30-20,000 c/s. Tone Controls ± 12 D.B. at 50 c/s. ± 12 D.B. to -6 D.B. at 12,000 c/s. hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12x9x9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Outputs for 3 and 15 ohm speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc.** We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. **EXPORT ENQUIRIES INVITED.**

FULL RANGE OF LINEAR HIGH FIDELITY AMPLIFIERS ALWAYS IN STOCK. GL3A MINIATURE 3 WATT GRAM AMPLIFIER

For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11x21x2 1/2 in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 5/9/6.

R.S.C. A7-34 4 WATT QUALITY AMPLIFIER. Spec. exactly as A5 below with exception of output voltage. Complete kit of parts, diagrams and instructions £3/15/-, carr. 3/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 A. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 90 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £2/15/- or assembled ready for use 25/- extra, plus 3/6 carriage. Or Deposit 2/- and five monthly payments of 2/- for assembled unit.

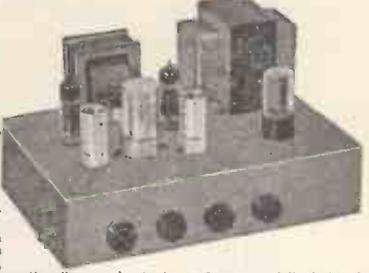


R.S.C. TRANSFORMERS. Fully Guaranteed. Interleaved & Impregnated. WE CAN QUOTE FOR SPECIAL OR STANDARD TYPES IN ANY QUANTITY. OUR FACTORY HAS SUPPLIED LEADING EQUIPMENT MANUFACTURERS AND GOV'T. DEPTS. FOR 15 YEARS.

MANS TRANSFORMERS. Primaries 200-250-250 v. 50 c/s.		OUTPUT TRANSFORMERS	
FULLY SHROUDED UPRIGHT MOUNTING.		Midget Battery Pentode	
250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6	661 for 35A, etc.	3/8
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9	Small Pentode 5,000 Ω to 3 Ω	3/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9	Standard Pentode 5,000 Ω to 3 Ω	5/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9	Standard Pentode 8,000 Ω to 3 Ω	5/9
300-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9	Push-pull 8 watts 6V6 to 3 ohms	8/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9	Push-pull 8 watts EL84 to 15 ohms	8/9
TOP SHROUDED DROP-THROUGH TYPE		Push-pull 10-12 watt 6V6 to 3 Ω or 15 Ω	16/9
250-0-250 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9	Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω	17/9
300-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9	Push-pull EL84 to 3 or 15 ohms	17/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9	Push-pull Ultra Linear for Mullard 810	27/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9	Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc., for 3 or 15 ohms	27/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a. suitable for Mullard 510 Amplifier	29/9	Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15 Ω	47/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9	MICROPHONE TRANSFORMERS	
300-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9	120 Ω High quality, clamped	6/9
ELIMINATOR TRANSFORMERS.		120 Ω High quality Mu metal screened	8/9
120 v. 4 mA., 5-0-5 v. 1 a.	14/9	SMOOTHING CHOKES	
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11	250 mA., 5 H., 100 Ω	11/9
FILAMENT TRANSFORMERS		80 mA., 10 H., 350 Ω	5/6
6.3 v. 1.5 a.	5/9	60 mA., 10 H., 400 Ω	4/11
6.3 v. 3 a.	7/6	150 mA., 7-10 H., 250 Ω	11/9
0-4-6.3 v. 2 a.	7/6	100 mA., 10 H., 200 Ω	8/9
AUTO (Step Up/Step Down) TRANSFORMERS		1 amp. 0.5 Ω I.T. type	6/6
50-50 watts 110-120 v./230-250 v.	11/9	PARMeko MAINS TRANSFORMERS. Fully shrouded.	
150 watts 110-120 v./200-230-250 v.	27/9	450-0-450 v. 120 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9
		500-0-500 v. 120 mA., 6.3 v. 4 a., 5 v. 3 a.	31/9

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram, as in A.10 High sensitivity. Includes 5 valves: ECC83, ECC83, EL84, EL84, 5Y3. High quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. **INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut."** Frequency response ± 3 D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. **ONLY 23 millivolts INPUT required for FULL OUTPUT.** Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. **OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 A.** For supply of a RADIO FEEDER UNIT. Size approx. 12.9x7in. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring. Carr. diagrams supplied. (Or factory built 45/- extra). **ONLY 8 Gns.** 10/- If required louvred metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT 18/9, and 12 monthly payments of 18/9.** Send 8 A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones, etc., with cash and credit terms.

R.S.C. PORTABLE GUITAR AMPLIFIERS



JUNIOR 5 WATT. High Quality Output. Separate Bass and Treble "cut" and "boost" controls. Sensitivity 15 mv. High Flux 8in. 1/2 speaker. Input sockets for Radio/Tape or Gram Pick-up and Mike /Instrument Pick-up. Handsome strongly made cabinet (size approx. 14 1/4 x 7 1/4). Finished in satin walnut and fitted carrying handle. **£8/19/6** Carr. 7/6. Or Deposit £1 and nine monthly payments £1. Send 8 A.E. for leaflet.

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STAR GALAXY 4-SPEED MIXER AUTO-CHANGERS. Brand New, cartoned. Turnover sapphire styl. Many exclusive features. Unique design motor virtually free from rumble. For 200/250 v. A.C. mains. Limited number tested and guaranteed. £5/19/6. Carr. 4/6.

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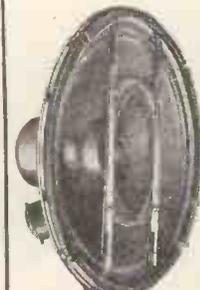
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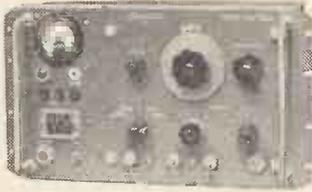
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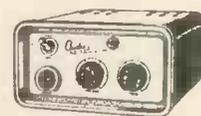
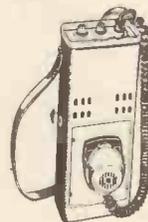
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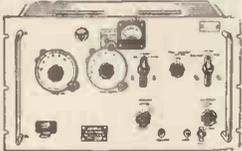
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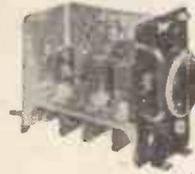
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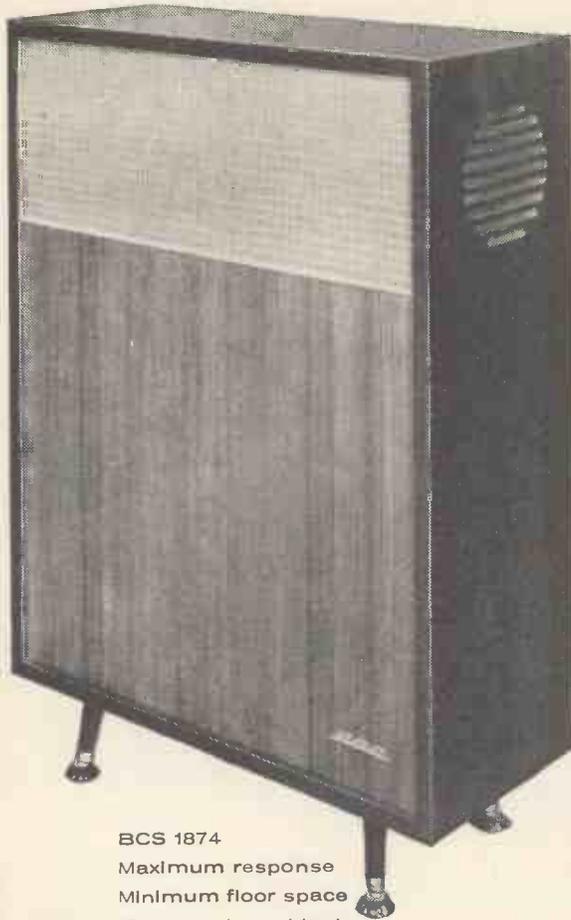
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1.5 V.	75 V.	150 mA.	750 mA.
3 V.	150 V.	300 mA.	1.5 Amps.
15 V.	300 V.	1.5 Amps.	7.5 Amps.
30 V.	600 V.	3 Amps.	15 Amps.
150 V.	750 V.	15 Amps.	
300 V.	1.5 KV.	30 Amps.	
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1.5 KV.			0-1000 ohms
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- 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.
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- No. 11. Pri. 200-240 v. Sec. 6.3 v. C.T. 3.25 A. 30 v. 1.2 A. 17/6, p.p. 4/-.
- No. 12. Pri. 220-240 v. Sec. 4.5 v. 2 A. 17/6, carr. 3/6.
- No. 13. Pri. 230 v. Sec. 50 v. 2 A., 6.3 v. 5 A., 6.3 v. 2 A., 6.3 v. 1 A., 6.3 v. 0.6 A., 5 v. 5.6 A., 5 v. 3 A. Brand new, 39/6, carr. 5/-.
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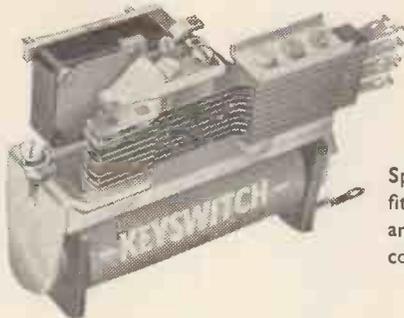
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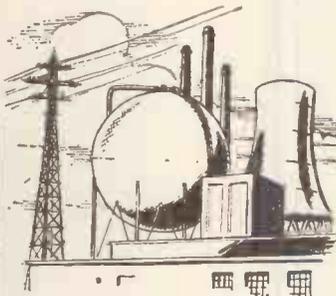
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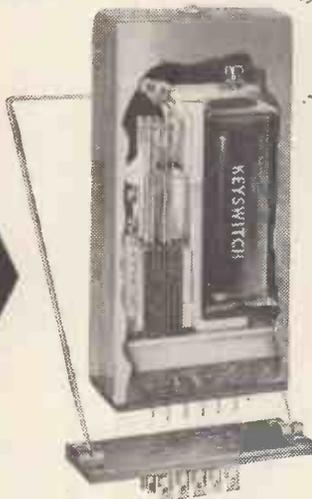
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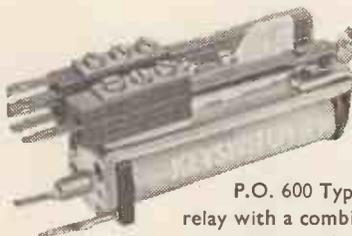
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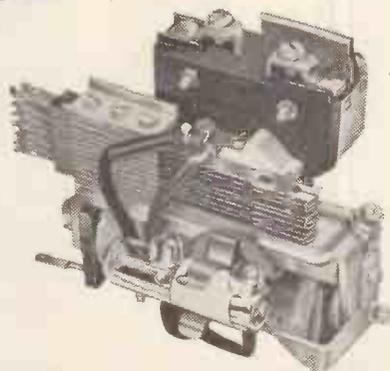
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Small, non-inductive, insulated, high-grade Capacitors
150 v. Wkg., .16 Mfd. 5% 10d., .22 Mfd. 10% 9d., 2 Mfd. 10% 1/10. 250 v. Wkg., .068 Mfd. 9d., 1 Mfd. 1/1. 22 Mfd. 2% 1/4. 1 Mfd. 10% 1/7. 500 v. Wkg., .080 pF., 1,000 pF., 1,500 pF., 2,200 pF., 7d. each. 3,300 pF. 8d. 5,000 pF., 6,800 pF., .01 Mfd. 9d. each. 8,200 pF., 1/-, .022 Mfd., .03 Mfd. 10d. each. .447 Mfd. 2% .05 Mfd. 11d. each. 1 Mfd. 11d. 25 Mfd. 1/7. 5 Mfd. 1/3. 750 v. Wkg., 470 pF., 10%, 820 pF., 1,500 pF., 2,000 pF. 8d. each. 5,000 pF., 6,800 pF. 9d. each. .022 Mfd. 10d. 1,000 v. Wkg., 1,500 pF. 9d. 6,800 pF. 10d. .01 Mfd., 1,500 v. 1/-, .12 Mfd. .15 Mfd. 1/1 each.

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4 pin UK, 7d. 5 pin Brit. Pax. 2d. 7 pin Brit. Pax. 3d. 7 pin Brit. Amp. 4d. Int. Octal Pax. 3d. Mazda Octal Pax. 3d. Loctal Amp. 6d. B7G Pax. 6d. B7G P.T.F.E. 8d. B7G Cer. with saddle and valve retaining spring 1/-. B8A Pax. 4d. B8A Amp. 6d. B8A Cer. 8d. B8A Pax. 6d. B8A Cer. 10d. B8A Cer. with saddle and valve retaining spring 1/-. B9A ceramic with skirt 1/-. B9A printed circuit 10d. B7G Valve Cans 6d. EY86 High voltage holders 1/8.

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Set of 3 I.F. Transformers 470 Kc/s plus Oscillator coil.

As specified for Mazda Circuits 23/6 complete.

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WTC oscillator Coils for Jackson or Passy Gang 4/6

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FULLY MOULDED TRACK POTS DIAMETER ½in.

SHORT SPINDLES 2/6 EACH

100Ω, 250Ω, 400Ω, 500Ω, 1K, 2K, 2.5K, 5K, 10K, 25K., 50K., 100K., 200K., 500K., 1M.

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As above with switch for I.V. pre-selection 11/-.

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Knurled knob and 6BA firing holes. Diam. 1in. 100Ω 5K., 10K., 20K., 50K., 100K., 200K., 250K., 500K., 1.5M. 2M. 1/3 each. 25K., wirewound 1/6.

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Size 1½in. dia. 2in. spindles. Price 2/11 each.
1 pole 10 way. 1 pole 12 way. 2 pole 2 way. 2 pole 3 way. 2 pole 4 way. 2 pole 5 way. 2 pole 6 way. 3 pole 3 way. 3 pole 4 way. 4 pole 5 way.

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Audio Output Types. 6,000Ω to 3Ω 3/6. 10,000Ω to 3Ω 3/9.

Universal CET Boosters with tapped primaries 2 v. 6.3 v.

13 v., 25% boost all taps, 10/6. Filament transformers, centre tapped, 6.3 v. output, 1.5 amps. 5/8; 3 amps. 9/6.

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Ferox Line O/P transformers, 16 Kv. U25 10/6. Frame

O/P transformers to match 4/6. Scanning Coils to match

10/6. 90° types 12/6. Panel containing 6 preset pots 5/-

Smoothing Chokes: 2 Hy. 250 mA. 3/11. 1.9 Hy. 250 mA

2/11. 1.3 Hy. 250 mA. 2/6.

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1/8 ea. 39 Meg. I.F.T. (link) 2/- ea. Masks 14in., 17in. and

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★ GARRARD BA 1 Gram Unit, 59/6. Carr. 2/6.



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All current 4-speed models. Brand new and boxed.

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Cabinet Price

£3.30

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Contemporary style, rexine covered cabinet in mottled red and white polka dot. Size 18½ x 13½ x ht. 8½in., fitted with all accessories including buffer board and anodised metal fret. Space available for all modern amplifiers and auto-changers, etc. Uncut record player mounting board 14 x 18in. supplied.

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Twin stage ECL32 with vol. and neg. feedback Tone control. AC 200/250 v. with knobs, etc., ready wired to fit above cabinet. £2/17/6. P. & P. 1/- 6in. Spkr. & trans., 22/- P. & P. 1/6.

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SPECIAL PRICE PER SET

1R5, 174, 1R5, or 3S4 or 3V4, 25/-
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Designer-approved kits of parts for these quality and highly popular tuners available as follows:—

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New improved types, low capacity, small size and tag terminated, A.C. 200/250 v. Secondaries NH, +25%, +50% BOOST for 2 v., 4 v., 6.3 v., 10.5 v., 12 v. or 13 v. tubes. 12/6 each. P. & P. 1/6.

COAX 80 ohm CABLE

Now only 6d. a yard.
High grade low loss Cellular Air Spaced Polythene—½in. diam.—Famous mfr.

BARGAIN PRICES—SPECIAL LENGTHS.

20 yds. 9/- P. & P. 1/6
40 yds. 17/6 P. & P. 2/-
60 yds. 25/- P. & P. 3/-
Coax Plugs, 1/-; Coax Sockets, 1/-;
Compers, 1/3; Cable End Sockets, 1/6
Outlet Boxes, 4/6.

RE-GUNNED TV TUBES

NEW REDUCED PRICES
... and now 12 months guarantee!

All tubes rebuilt with new heater, cathode and gun assembly—reconditioned virtually as new.

12in. £5, 14in. £5/10/-, 17in. £6, etc.

10/- part exchange allowance on old tube

Carr. and ins. 10/- Comprehensive stocks—quick delivery.

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RESISTORS—PULL RANGE 10 ohms—10 megohms 20%, ½ w. and ½ w. 3d., ½ w. 5d. (Midjet 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/W POTS. T/V type. 25 ohms—50 K ohms 3/-, 50K—2 Meg. (Carbon 3/-).

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12in. Pessey 15 ohms with 6/4in. Tweeter and Cross Over Filter, 97/6.

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25/25 v. 50/12 v. 1/9 8+8/450 v. 4/6
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16+16/450 v. 5/6 60+250/275 v. 12/8
32+32/450 v. 6/6 100+200/275 v. 12/6

Comprehensive range in stock.

VOLUME CONTROLS—5K—2 Megohms. ALL LONG SPINDLES, MIDJET TYPE, 1½in. diam. Guar. yr. LOG or LIN. Ratios less Sw. 3/-, D.P. Sw., 4/6. Twin gang stereo controls less Sw., 6/6. D.P. Sw. 8/-.

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve Line-up: ECC85, ECC81, EF89, EAB080, EL84, EM81, EZ80.

Three Waveband and Switched Gram positions. Med. 200-500 m. Long 1,000-2,000 m. VEE/FM 88-95 Mc/s. Phillippe 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 8½in. Vertical pointer. Horizontal station names. Gold 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. Indoor FM aerial 3/6 extra. Three ohm P.M. speaker only required. Recommended quality speakers. 10in. Rola (Heavy Duty)..... 30/-
8in. Goodmans special cone..... 21/6

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EMI 1st grade. Brand new sealed boxes.

Standard		Long Play	
3in., 175ft.	7/-	250ft.	9/-
5in., 600ft.	19/-	350ft.	25/-
8½in., 950ft.	25/-	1,200ft.	31/6
7in., 1,200ft.	31/6	1,800ft.	45/-

SPECIAL PURCHASE. Famous manufacturers, 1st grade tape, in sealed white boxes.

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5in., 600ft.	15/-	850ft.	19/6
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7in., 1,200ft.	21/-	1,800ft.	32/6

Plastic Tape Reels, special offer. Manufacturers' surplus. 3in. 2/9, 5in. 3/-, 8½in. 3/3, 7in. 3/6.

2 WAVEBAND CAR RADIO KIT Recommended Buy

12v. operation Med. & Long Waves

Modern development of the famous Brimar Hybrid vibratorless car radio circuit. Five latest type Brimar low voltage valves and power transistor. R.F. stage and permeability pre-aligned Cydon Tuner Unit provide 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.

Complete Kit
Bargain Price
P&P
£12.19.6 3/6.



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inbuilt L.S. bandspread, 5 valves, £35/10/-.

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A.C./D.C. on battery, Medium and S.W., also D.F. band for yachts, etc, £78/15/-.
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11 valves, bandspread, special filter and many refinements.
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*Proceedings of the Second
International Conference Paris 1959*

Medical Electronics

*Edited by C.N. Smyth M.A., B.Sc. ENG., B.CH., M.I.E.E. and published
for the International Federation for Medical Electronics*

Electronic techniques, are becoming increasingly important in the medical sphere, because they provide extremely sensitive and versatile means of measuring or examining physiological effects which often cannot be detected by other methods. The growing importance of medical electronics was first recognized on a world scale when the First International Conference was held in Paris in 1958. This was an exploratory meeting, which led to the organization of the full-scale Second International Conference on Medical Electronics, held at the UNESCO building in Paris in 1959. This book is a record of the proceedings.

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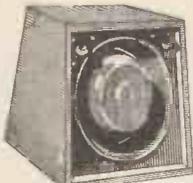
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PL6-21 AMPLIFIER AND PRE-AMP. Combined unit. Compactly designed and fully enclosed. Ideal for shelf mounting for monaural reproduction. 30 watt peak power. Intermod distortion 1% at 10w., output impedance 4, 8 and 16 ohms. Radio, tape, p/up, etc. inputs. Separate bass and treble controls. High and low pass filter. **Our price £19/19/0.** Carriage and packing 7/6.

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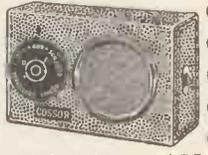
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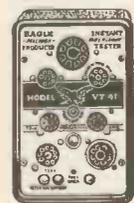
(4) Ferranti 9in. Tube, round white fluorescence, 4 v. heater, max. anode voltage 7 kV. **OUR PRICE £2/5/-.** Crating and carr. 11/6.



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FULL 12 MONTHS' GUARANTEE INCLUDING VALVES AND TUBE

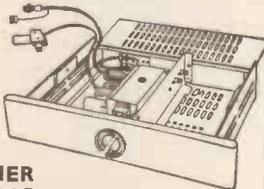
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32/6 Plus 3/6 P. & P.

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To suit the above, 200-250 v. 6/- Plus 1/6 P. & P.

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4-speed plays 10 records 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Easy manual play position, colour brown. Dimensions: 12 1/2in. x 10 1/2in. Space required above baseboard 4 1/2in., below baseboard 2 1/2in. Fitted with Ful-Fi turnover crystal head. £8/19/6. Plus 5/- P. & P.

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With built-in line and width control. 14 KV. Scan coil, 90° deflection, on ferrite yokes. Frame O.P. transformer 500 pf. 18 KV. smoothing condenser. Can be used for 14in., 17in. or 21in. tubes.

Complete with circuit diagram. 29/6 Plus 4/- P. & P.
As above, but for 625 lines £2.10 Plus 4/- P. & P.

FOCUS MAGNET suitable for the above (state tube), 10/-, 2/6 P. & P.

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All with tapped primaries 200-250 volts.

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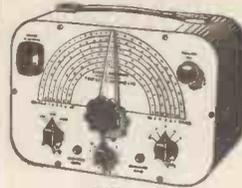
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Incorporating 45 r.p.m. "Start" motor "Acos" crystal pick-up, 3 transistor push-pull amplifier complete with transistors. Output 500 milliwatts, 49/6 plus 3/6 P. & P.

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Covering 100 Kc/s.—100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. x 6 1/2in. x 5 1/2in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F., output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%. Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 6/- extra.

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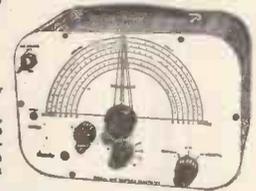
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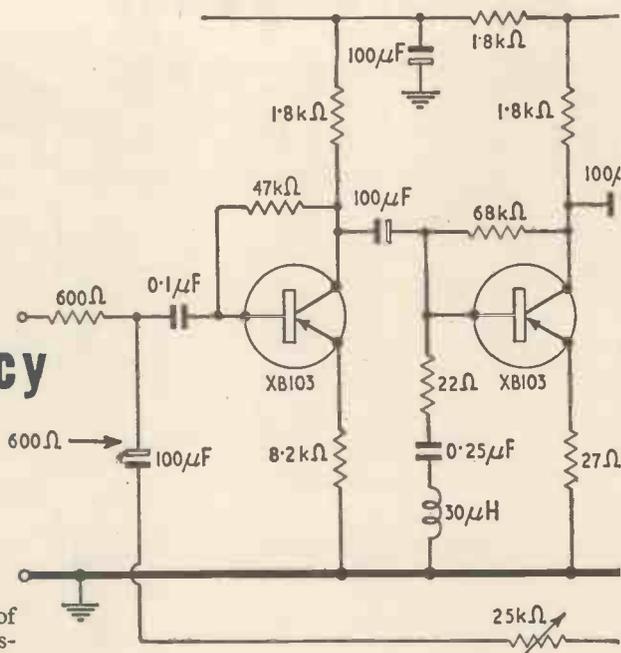
Transistors in Audio - and Carrier - Frequency Amplifiers

Appearing in the current August issue of *Electronic Technology* is an article which discusses the characteristics of common-emitter amplifiers in relation to the specific requirements of communication systems.

Practical methods of stabilizing both the bias point and the gain of a single stage are considered, together with the gain and bandwidth achievable with the common-emitter connection. A two-stage feedback circuit is analyzed in detail, the behaviour being illustrated by means of flow graphs.

Finally, consideration is given to the problem involved in applying large amounts of feedback over several stages and of obtaining the desired input and output impedances. A practical design is given of a 25-dB amplifier suitable for five telephone channels and a further illustrative example is also given in the design of a typical channel amplifier.

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 SEPTEMBER ISSUE INCLUDE:

PIEZOMAGNETIC FERRITES

This article surveys modern piezomagnetic ferrite materials and their applications in mechanical bandpass filters and high-power ultrasonics.

RECORDING ATMOSPHERIC RADIO NOISE

The detailed study of atmospheric radio noise normally requires complex equipment and skilled personnel, both of which present a limitation to the gathering of information. This article describes an investigation which has been made of the technique for tape-recording the noise at field stations, using simple equipment, with a view to the recordings then being sent to a central organisation for analysis.



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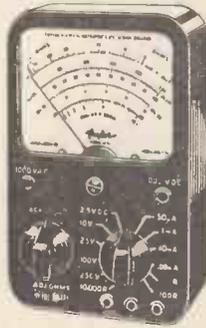
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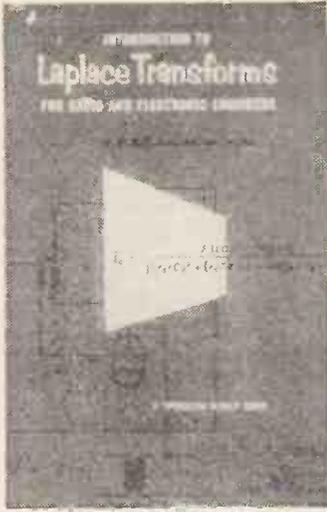
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Made by DELCO

TYPE 1 27/6. P. & P. 3/6.
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Type 1. Dual voltage 12 or 24 v., Input 265 v., 120 mA. output: 500 v., 26 mA. output.
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D.C. Input 27 v. Output 285 v. at 75 mA., 37/6. D.C. Input 12 v. Output 250 v. at 50 mA. 47/6. Postage and Packing on each, 3/6.

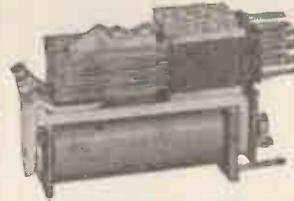


LARGE STOCKS ALWAYS AVAILABLE

POST OFFICE RELAYS TYPE 3,000

BUILT UP TO YOUR REQUIREMENTS

Type 600 also available



COMPONENT PARTS ALL PLATED

Yokes, 4/- each. Top plates, 3d. each. Fixing Screws (with insulators), 2d. each.
 Armatures, 1/3 each. Bottom Plates, 3d. Buffer Blocks, 6d. each.
 Adjustable, 1/9 each. Armature Screws, adjustable, 4d. each.
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BUILD UPS CONTACTS

	Silver	Platinum		Up to	100 Ohms	3/-	5/-
1. C/O	1/3	4/-	"	500	"	4/-	6/-
2. C/O	2/6	9/-	"	1,000	"	5/-	7/-
3. C/O	3/6	12/-	"	5,000	"	6/6	8/6
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Other build ups to order; all types of relays built to your specification.

*Slugged coils extra.

COIL VALUES

	Single	Twin		1,000+1,000 ohms	10/6
250+25p	ohms Twin Coils	6/6	"	1,700+1,700	17/6
850+850	"	8/6	"	"	"

SIEMENS HIGH SPEED C/O RELAYS

250+25p ohms Twin Coils 6/6
 850+850 " " 8/6
 1,000+1,000 ohms Twin Coils 10/6
 1,700+1,700 " " 17/6

G.E.C. MINIATURE SEALED RELAYS

No.	Ohms	Build Ups	Voltage	Price
Z530001	40	4 C/O	6 v.	17 6
Z530005	2	2 C/O	1.3 v.	12 6
Z530008	670	2 C/O	24 v.	19 6
Z530010	40	2 C/O 2K	7 v.	17 6
Z530014	2	1 C/O	1.3 v.	10 6
Z530015	40	1 C/O	6 v.	12 6
Z530016	180	1 C/O	12 v.	19 6
Z530018	2,500	1 C/O	48 v.	£1 2 6
Z530019	2	2 C/O 2K	1.3 v.	14 6
Z530020	2	4 C/O	1.3 v.	16 6
Z530021	2	2M	1.3 v.	10 6
Z530022	2	1M 1B	1.3 v.	12 6
Z530023	2	2B 2M	1.3 v.	12 6
Z530024	40	2M	6 v.	12 6
Z530025	40	1M 1B	6 v.	12 6
Z530026	40	2B 2M	6 v.	15 0
Z530027	180	2M	12 v.	17 6
Z530028	180	1M 1B	12 v.	17 6
Z530030	670	2M	24 v.	17 6
Z530031	670	1M 1B	24 v.	17 6
Z530034	2,500	1M 1B	48 v.	£1 2 6
Z530480	670	2B 2M	24 v.	19 6
Z530430	5,000	2 C/O	48 v.	£1 9 6
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S.T.C. MINIATURE SEALED RELAY

4184GD	700	2C	24	19 6
4190HC	170	2C	12	17 6

1/6 Post & Packing on all relays. Send for lists

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Good Condition.

50/- each. P. & P. 5/-
 or £4/10/0 pair.

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TYPE 900763-501

CLASS MODIFICATION
 Primary 10,400 ohms.
 Secondary 4,300 ohms.

NEW, BOXED, £3/10/- carriage extra.

HEAVY DUTY SLIDING RESISTORS

Supplied in two types

250 watts to carry 25 amps. Resistance 0.4 ohms, worm drive, also 125 watts, 12 amps. Resistance 1 ohm, slider. Suitable for charging board, etc. Size 9 x 4 x 6in. hgh. Brand new. Boxed.

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2C26C 1/O.	4/6
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HEADPHONES. D.L.R.2 and D.L.R.5. Brand New. Low resistance. Balanced armatures. 6/6 pair. P. & P. 1/6. Single earpieces 3/6.

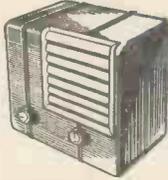
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Ex-Rental. Tested and in good working order. Ideal Guitar Amplifier. Complete with valves.

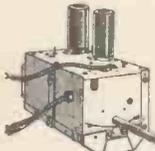


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BRAND NEW. Modernise and add pounds to the value of your electric cooker. Ideal for automatic cooking, or any heat or current control. Complete with handsome electric clock. 200/250V. 30 Amp. Full fitting instructions. Plus 2/6 P. & P.



OUR PRICE **£3.17.6**

Battery operated PORTABLE GRAM

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As above but with Transistor Amplifier, 45 r.p.m., crystal pick-up, 5in. high-flux speaker, record-carrying space, handsome cabinet. Plus 2/6 P. & P.

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(Size: 6 1/2in. x 4 1/2in. x 1 1/2in.) As the Transigen Three but with Push-Pull XC101's output. Uses five EDISWAN Transistors. New improved 3in. speaker. Complete kit £6/10/- P.P. 2/6. Easy build practical wiring diagrams free with kit. Dorset customer writes: "Makes fine car radio."



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Entirely self contained. R.F. stage with EDISWAN coils free upon request. On test (50 miles from London) tuned in the Home, Light and in the evening Radio Luxembourg, A.F.N. and many others. Attractive pale blue polystyrene case with red grille. Dynamic min. earpiece. Complete kit with easy build diagrams and battery, 79/6. P.P. 2/6.

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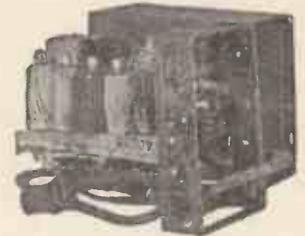
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1. COMPUTER ENGINEER Applicants (age 21-30) should be of H.N.C. (Electronics) standard or have a sound background in general electronics with emphasis on pulse circuitry. A knowledge of computer or calculator techniques would be an advantage but is not essential. Computer Engineers selected for the IBM 700 series machines must be prepared to spend a training period of 5/6 months in France or the United States. For the IBM 650 and RAMAC systems, training given in the United Kingdom or Germany. Excellent starting salaries are offered based on qualifications and experience.

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Personnel Manager, IBM United Kingdom Limited,

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ENGINEER to be responsible for the climatic testing of components and equipment. The post involves liaison duties with associated project teams. A H.N.C. in Electrical Engineering, together with experience in the basic techniques of measurement applicable to electronic components is an essential qualification for this post. Experience of environmental testing, particularly with regard to G.W. work would be a decided advantage. Ref. Sa/2/4

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**Personnel Manager,
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THE DE HAVILLAND ENGINE COMPANY LIMITED

Industrial Products Division

A vacancy exists for an

ELECTRICAL TECHNICAL ASSISTANT

with practical experience on the preparation of wiring diagrams, printed circuitry transistor amplifiers, and Buxton requirements. Applicants with electrical training up to at least O.N.C. standards and experience in any of the services could be suitable candidates for this vacancy.

Written applications should be sent to:

**The Personnel Officer (Ref: SC 995),
The de Havilland Engine Company Limited,
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UNITED KINGDOM ATOMIC ENERGY AUTHORITY THE RADIOCHEMICAL CENTRE AMERSHAM, BUCKS

requires

**INSTRUMENT FOREMAN
and TECHNICIAN**

**POST I Instrument Foreman
(Ref.: 1716/45)**

To be responsible for the INSTALLATION, CALIBRATION, and MAINTENANCE of a wide range of ELECTRONIC INSTRUMENTS.

Applicants should have served a recognised apprenticeship or have had equivalent training and preferably hold a National Certificate. Experience of PULSE, HIGH VOLTAGE and ELECTROMETER CIRCUIT TECHNIQUES essential, and supervisory experience an advantage.

**SALARY: £925 (at 30 or over) —
£1,105 p.a.**

**POST II Instrument Technician
(Ref.: 1717/45)**

To assist in the installation, maintenance and particularly in the calibration of electronic instruments. Applicants should have served a recognised apprenticeship or have had equivalent training, and have wide experience of pulse, high voltage and electrometer circuit techniques.

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Assisted housing and superannuation schemes.

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Vacancies exist in the Admiralty Surface Weapons Establishment Extension at Royal Naval Stores Depot, Copenacre, Hawthorn, Wilts., for Electricians (Radio) and Electrical Fitters. Applicants for the former position should have at least five years' experience in the trade and for the latter must have completed a recognised apprenticeship.

2. The Establishment is located 8 miles from Bath. The work is interesting and varied, in modern test rooms and workshops, and is mainly concerned with the testing and modification of naval radio and radar equipment.

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Hartree House, 151A-159A Queensway, London, W.2

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We require men who are prepared to travel continuously in this country and abroad.

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to be responsible to the Chief Engineer for quality control at all stages of manufacture and test of Electronic Products.

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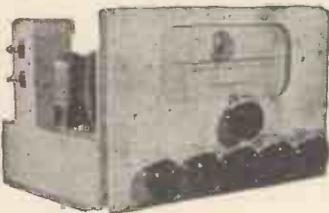
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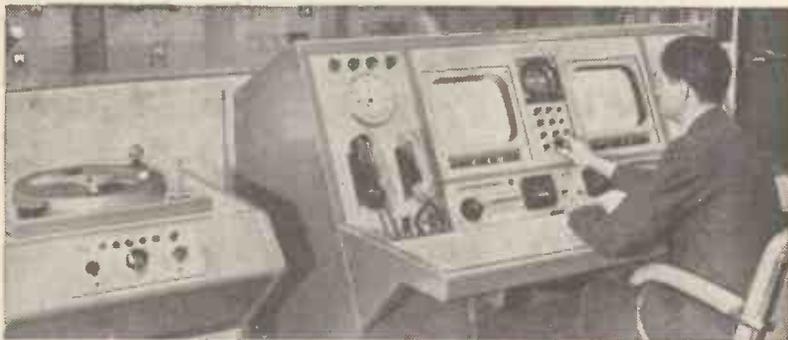
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URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Gerrard 2504. [9171]

WANTED, good quality communication RYS tape recorders, test equipment, domestic radios, record players, amplifiers, valves, components, etc., estab. 18 years.—Call, send or phone Ger. 4638, Miller's Radio, 38a, Newport Court, Leicester Square, W.C.2. [9173]

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PART-TIME electronic engineers for L.P. disc cutting, mobile work, technical advising, wanted in London; details of experience.—Box 1057. [0134]

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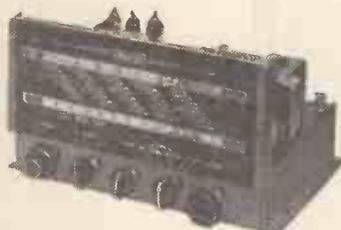
TECHNICAL writer required for compiling radio and television service manuals; must have good theoretical and practical knowledge of radio and television receivers and the ability to write good English.—Apply to Personnel Department, Murphy Radio, Ltd., Welwyn Garden City. [9210

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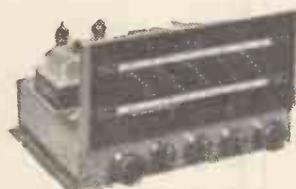
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THE RESEARCH LABORATORIES of the General Electric Co., Ltd., North Wembley, Middlesex, have a vacancy for a Radio Mechanic to work on the assembly and wiring of electronic apparatus to schematic diagrams. Candidates should have had at least three years experience in this field.—Please apply in writing to the Staff Manager (Ref. WO/229T), giving particulars of experience and age. [0317]

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the London permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details, to Personnel Officer, Rediffon, Ltd., Broomhill Rd., S.W.18. [0252]

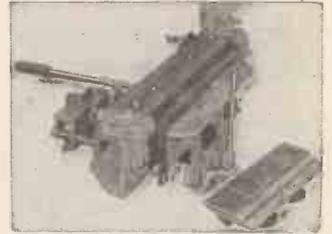
SIMULATOR engineer at B.E.A. Training Unit, Heston, to maintain, overhaul and carry out minor development work on electronic flight simulators; applicants should have completed an apprenticeship, possess O.N.C. (Electrical) or equivalent and be experienced in the maintenance of electronic equipment; a knowledge of the principles of flight and aircraft systems desirable; salary £16/9/6-£19/6/6 plus shift pay.—Write: Box 102, B.E.A. Bealine House, Ruislip, Middlesex. [9203]

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WRITE giving full details of qualifications and experience to the Personnel Manager, Ericsson Telephones, Limited, Beeston, Nottingham, quoting Ref. DA/1. [0160]

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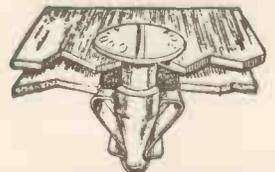


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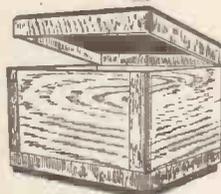
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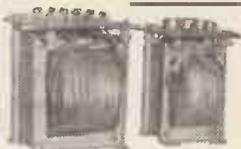


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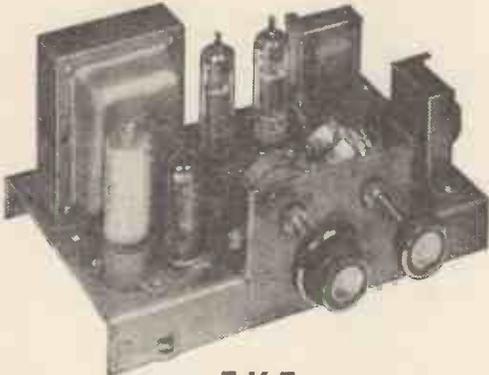
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