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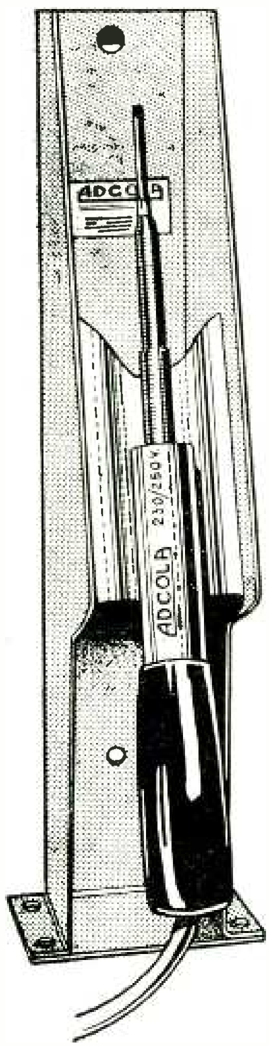

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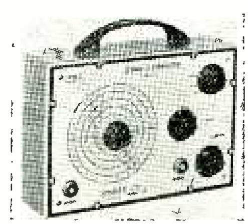

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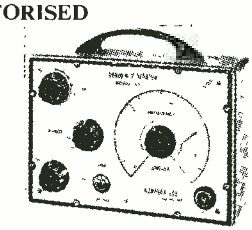

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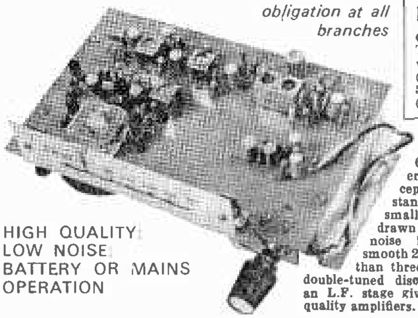

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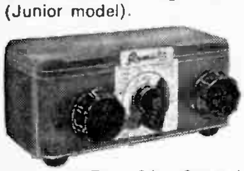

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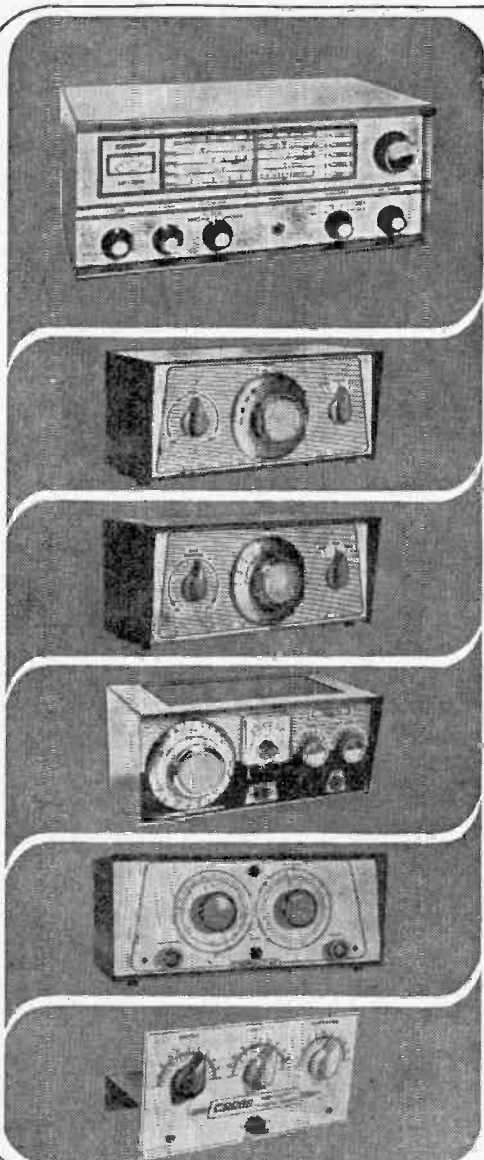

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6BW6	7/6
6BW7	8/6
6C4	3/-
6C5G	4/-
6C6	3/9
6C8G	6/-
6CD6G	22/6
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6F13	5/-
6F14	12/6
6F23	11/-
6G6	2/6
6H6	1/3
6J5M	6/6
6J5G	2/6
6J5GT	4/6
6J6	3/-
6J7M	8/6
6J7G	4/9
6J7GT	8/6
6K6GT	5/-
6K7M	5/-
6K7G	1/3
6K7GT	4/6
6K8M	8/6
6K8G	3/-
6K8GT	8/3
6K25	20/-
6L1	9/6
6L6G	7/-
6L18	7/6
6Q7G	5/6
6Q7GT	9/-
6SA7	7/-
6SC7	6/6
6SG7	4/-
6SH7	2/6
6SJ7	5/-
6SK7GT	4/9
6SL7GT	4/9
6SN7GT	4/-
6SQ7	8/-
6U4GT	12/-
6U5G	7/6
6V6M	8/-
6V6G	3/6
6V6GT	7/-
6X4	3/6
6X5G	4/9
6X5GT	7/6
7B6	11/-
7B7	7/-
7C5	10/-
7C6	6/-
7D5	8/-
7H7	5/-
7R7	19/6
7S7	17/9
7Y4	7/6
9BW6	8/-
10C1	9/-
10C2	12/-
10F1	14/-
10F3	12/-
10F9	9/9
10F18	9/-
10L1	10/-
10LD11	10/-
10P13	14/-
11E3	27/6
12AT6	4/6
12AT7	3/9
12AU6	5/9
12AU7	4/9
12AX7	5/9
12BA6	6/-
12BE6	5/3
12C8GT	7/6
12E1	19/6
12J5GT	2/3
12J7GT	7/3
12K7GT	3/-
12K8GT	8/-
12Q7GT	3/-
12SA7	6/6
12SG7	3/6
12SH7	2/9
12SJ7	3/9
12SK7	2/9
12SR7	5/-
14H7	9/-
19AQ5	7/6
20D1	10/-
20F2	11/-
20L1	15/-
20P4	17/-
20P5	16/-
25A6	6/6
25L6GT	4/6
25Y5	6/-
25Z4	6/3
25Z5	7/-
25Z6	11/-
28D7	5/-
30C1	6/6
30C15	11/6
30C17	12/-
30F5	13/-
30FL1	13/6
30L15	12/6
30L17	12/-
30P12	10/-
30P19	14/-
30PL1	14/-
30PL13	14/-
30PL14	14/-
35A5	17/-
35L6	5/9
35W4	4/6
35Z3	10/-
35Z4GT	3/9
35Z5	5/6
37	5/-
42	4/6
50B5	6/6
50C5	5/9
50CD6G	32/6
50L6GT	6/-
75	5/-
78	4/6
80	5/-
85A2	8/6
150B2	14/6
150C4	12/6
801	5/-
807	7/9
813	80/-
866	10/-
954	4/-
1625	5/-
4022AR	15/-
5763	10/6
7193	1/6
7475	2/6
ATP4	1/9
ATP5	7/-
ATP7	4/6
AU2	30/-
AU5	6/-
AZ1	8/9
AZ31	7/9
CBL31	15/-
CCH35	21/-
CL33	19/6
CY31	10/-
DAC32	7/6
DAF91	3/3
DAF96	6/-
DCC90	8/-
DF33	8/-
DF70	5/-
DF91	2/6
DF92	2/6
DF96	6/-
DH77	3/6
DK32	7/9
DK91	5/-
DK92	8/-
DK96	6/6
DL66	15/-
DL92	4/9
DL93	3/6
DL94	5/9
DL95	6/6
DL96	6/-
DM70	5/-
DY86	6/6
DY87	7/9
E88CC	12/-
EA50	2/-
EABC80	5/9
EAF42	7/6
EB41	4/6
EB91	3/-
EBC33	7/-
EBC41	8/3
EBC90	3/9
EBF80	6/6
EBF83	7/-
EBF89	6/6
EBL1	17/6
EBL21	10/6
EBL31	27/6
ECC81	3/9
ECC82	4/9
ECC83	5/9
ECC84	5/6
ECC85	5/-
ECC88	7/-
ECF80	7/-
ECF82	7/-
ECH21	19/-
ECH35	11/-
ECH42	9/-
ECH81	5/3
ECH83	7/-
ECL80	6/6
ECL82	6/6
ECL83	9/-
ECL86	8/9
EF9	20/-
EF36	3/-
EF37A	7/6
EF39	6/-
EF41	8/6
EF50	2/-
EF80	5/-
EF85	6/6
EF86	6/3
EF89	5/6
EF91	3/3
EF92	2/6
EF98	9/-
EF183	6/6
EF184	6/6
EL32	3/-
EL33	17/6
EL34	9/6
EL41	8/6
EL42	7/6
EL84	4/6
EL90	5/6
EL95	6/-
ELL80	20/-
EM80	7/-
EM81	7/-
EM84	7/-
ESU150	27/6
EY51	7/-
EY86	6/6
EZ35	4/9
EZ40	7/-
EZ41	8/-
EZ80	5/-
EZ81	5/-
GZ30	8/6
GZ32	9/6
GZ34	10/-
KT36	22/6
KT61	17/6
KT66	20/-
KT81	10/-
KT88	27/6
KTW61	4/3
KTZ41	8/-
ML4	17/6
ML6	12/6
MSP4	12/6
MU14	4/-
MX40	12/6
N37	10/-
N78	15/-
N108	15/-
NGT1	3/-
NGT7	25/-
OZ4	4/-
PC86	9/-
PC88	9/-
PC97	7/6
PCC84	5/6
PCC89	10/-
PCC189	10/-
PCF80	6/6
PCF82	6/-
PCF84	8/-
PCF86	8/-
PCF801	9/9
PCF802	9/9
PCF805	10/9
PCF806	12/-
PCF808	11/6
PCL82	7/-
PCL83	8/6
PCL84	7/3
PCL85	8/6
PCL86	8/6
PENA4	20/-
PENB4	20/-
PEN45	6/-
PEN46	2/9
PL36	9/-
PL81	7/6
PL82	6/6
PL83	6/-
PL84	6/6
PL500	14/6
PX4	18/6
PY33	8/6
PY81	6/-
PY82	5/6
PY83	6/-
PY800	7/-
PY801	7/-
R2	4/-
R19	7/-
RG5/500	59/-
S130	25/-
SP4	9/-
SP41	1/6
SP61	1/-
SU25	19/6
SU2150	12/6
T41	9/-
TDD4	7/-
U10	7/-
U14	7/-
U19	30/-
U25	10/6
U26	10/6
U78	3/6
U191	11/6
U251	12/6
U301	13/-
U403	6/6
U801	18/6
UABC80	5/6
UAF42	8/9
UBC41	8/-
UBC81	7/6
UBF80	5/9
UBF89	6/6
UCC84	8/6
UCC85	6/6
UCF80	8/6
UCH42	8/6
UCH81	6/3
UCL82	7/6
UCL83	8/9
UF41	8/-
UF89	6/-
UL41	8/9
UL84	6/-
UM80	7/-
UU6	13/6
UU7	13/6
UU9	8/-
UY21	7/6
UY41	6/3
UY85	5/-
VMP4G	17/-
VP4B	27/6
VR105/30	5/-
VR150/30	5/-
VT25	29/-
VT31	59/-
VU111	6/-
VU120	12/6
VU508	30/-
W81M	5/-
X79	41/-
XH1-5	5/-
XP1-5	5/-
XSG1-5	10/-
Y63	7/6
Tubes	
3EG1	40/-
3FP7	16/6
5CP1	30/-
CV1526	40/-
ACR13	£3.16.0
VCR97	35/-
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AC127	8/-	OC25	11/-	OC71	4/6	OC81	4/-	OC82D	6/-
AF114	7/-	OC28	16/-	OC72	6/-	OC81m/pr	12/6	OC83	6/-
AF115	7/-	OC35	9/6	OC75	6/-			OC170	7/-
AF116	7/-	OC44	4/6	OC76	6/-	OC81D	4/-	OC171	8/-
AF117	5/-	OC45	3/6	OC77	8/-	OC82	6/-	OC200	8/-

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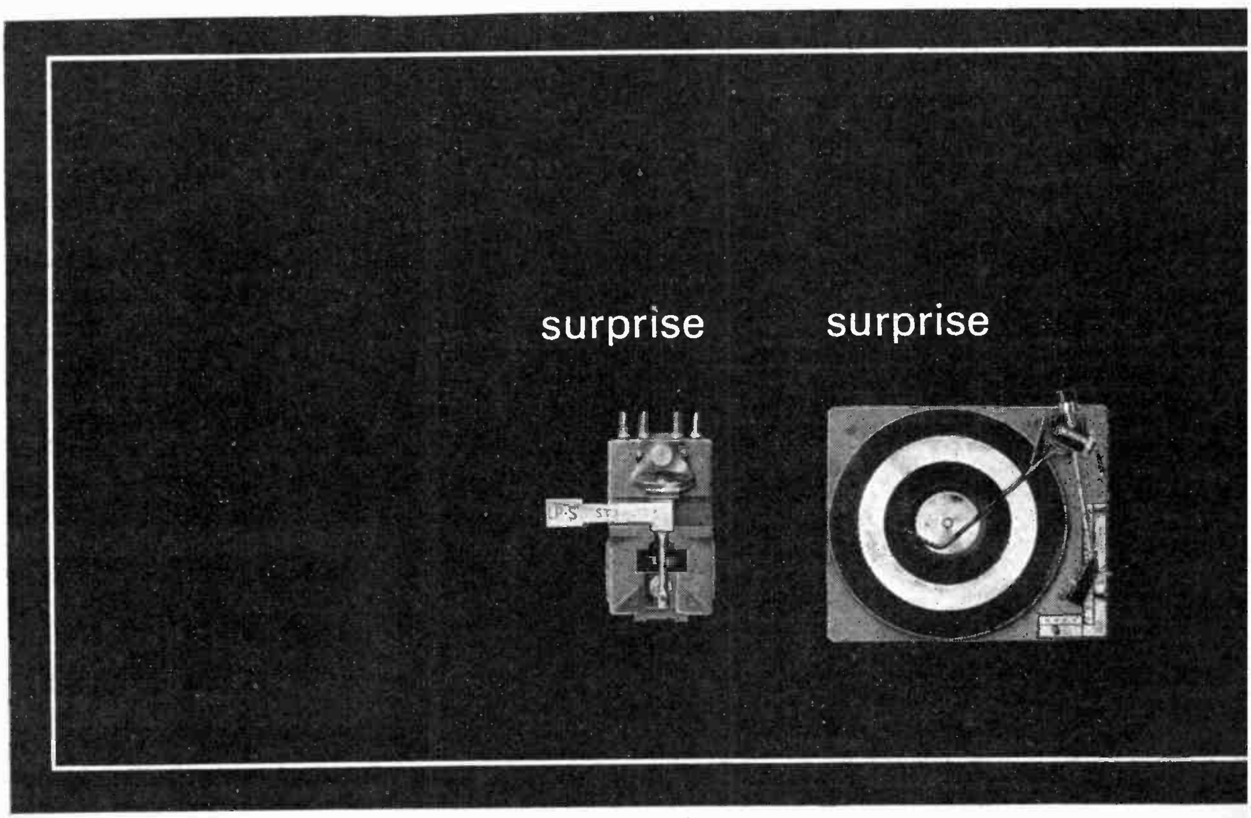
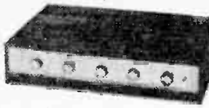


HI-FI AMPLIFIERS — TUNERS — RECORD PLAYERS

20+20 STEREO AMP. AA-22U



GARRARD PLAYER AT-60

TRANSISTOR MIXER. MODEL TM-1. A must for the tape enthusiast. Four channels. Battery operated. Similar styling to Model AA-22U Amplifier. Kit **£11.16.6.** Assembled **£16.17.6**

20+20W TRANSISTOR STEREO AMPLIFIER. Model AA-22U. Outstanding performance and appearance. 5 stereo inputs each channel, 20 transistor, 10 diode circuit. Kit **£39.10.0** Assembled **£57.10.0** (Cabinet **£2.5.0** extra)

GARRARD AUTO/RECORD PLAYER. Model AT-60, less cartridge **£14.12.10** With Decca Deram pick-up **£19.7.4** incl. P.T.

Many other Garrard models available, ask for Lists.

HI-FI MONO AMPLIFIER. Model MA-5. A general purpose 5W Amplifier with inputs for Gram., Radio. Modern functional appearance. Kit **£11.9.6** Assembled **£15.15.0**

10W POWER AMP. MA-12

9+9W STEREO AMP. S-99

HI-FI MONO AMPLIFIER. Model MA-12. 10W output, wide freq. range, low distortion. Use with control units. Models UMC-1 (Mono) or USC-1 (Stereo). Kit **£12.18.0** Assembled **£16.18.0**

CONTROL UNITS. Mono, UMC1. Kit **£9.2.6.** Assembled **£14.2.6.** Stereo, USC-1. Kit **£19.19.0.** Assembled **£27.5.0.**

DE LUXE STEREO AMPLIFIER. Model S-33H. De luxe version of the S–33 with two-tone grey perspex panel, and high sensitivity necessary to accept the Decca Deram pick-up. Kit **£15.17.6** Assembled **£21.7.6**

HI-FI STEREO AMPLIFIER. Model S-99. 9+9W output. Ganged controls. Stereo/Mono. gram, radio and tape inputs. Push-button selection. Printed circuit construction. Kit **£28.9.6** Assembled **£38.9.6**

POWER SUPPLY UNIT. Model MGP-1. Input 100/120V, 200/250V, 40-60 c/s. Output 6·3V 2·5A A.C. 200, 250, 270V, 120mA max. D.C. Kit **£5.12.6** Assembled **£7.2.6**

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Finished models provide years of superlative performances

NEW!

HIGH PERFORMANCE CAR RADIO, CR–1. Superb LW/MW entertainment, wherever you drive. For 12V pos. or neg. earth systems. Tastefully styled to match any car colour scheme. Many special features. Send for details. Can be built for a total price Kit (less spkr) **£12.17.0** incl. P.T. (6 x 4 LS £1.4.5 extra)

RADIOS

Oxford

UXR-1

"OXFORD" LUXURY PORTABLE Model UXR-2. Specially designed for use as a domestic or personal portable receiver. Many features, including solid leather case. Kit **£14.18.0** incl. P.T.

TRANSISTOR PORTABLE. Model UXR-1. Pre-aligned I.F. transformers, printed circuit. Covers L.W. and M.W. Has 7" x 4" loudspeaker. Real hide case. Kit **£12.11.0** incl. P.T.

JUNIOR EXPERIMENTAL WORKSHOP Model EW-1. More than a toy! Will make over 20 exciting electronic devices, incl.: Radios, Burglar Alarms, etc. 72 page Manual. The ideal present! Kit **£7.13.6** incl. P.T.

TRANSISTOR STEREO FM TUNER. Elegantly designed to match the Stereo Amplifier, model AA-22U seen above. Many special features include built-in power supply. Available in two units sold separately, can be built for a TOTAL PRICE KIT (STEREO) **£24.18.0** incl. P.T. Cabinet **£2.5.0** extra. (MONO) version **£20.19.0** Kit.

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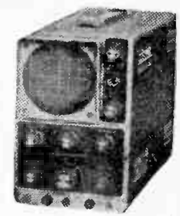
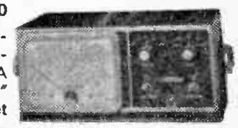
3" LOW-PRICED SERVICE OSCILLOSCOPE. Model OS-2. Compact size 5" x $7\frac{7}{8}$" x 12" deep. Wt. only $9\frac{3}{4}$lb. "Y" bandwidth 2 c/s-3 Mc/s ±3dB Sensitivity 100mV/cm. T/B 20 c/s-200 kc/s in four ranges, fitted mumetal CRT Shield. Modern functional styling. Kit **£23.18.0** Assembled **£31.18.0**



OS-2

5" GEN.-PURPOSE OSCILLOSCOPE. Model 10-12U. An outstanding model with professional specification and styling. "Y" band width 3c/s-4·5 Mc/s ± 3dB. T/B 10 c/s-500 kc/s. Kit **£35.17.6.** Assembled **£45.15.0**

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model 1M-13U. Circuit and specification based on the well-known model V-7A but with many worth-while refinements, 6" Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling. Kit **£18.18.0** Assembled **£26.18.0**



VVM, 1M-13U

VALVE VOLTMETER. Model V-7A. 7 voltage ranges d.c. volts to 1,500 A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0·1Ω to 1,000MΩ with internal battery. D.C. input resistance 11MΩ. dB measurement, has centre-zero scale. Complete with test prods, leads and standardising battery. Kit **£13.18.6** Assembled **£19.18.6**

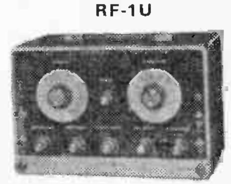
V-7A

MULTIMETER. Model MM-1U. Ranges 0–1·5V to 1,500V a.c. and d.c; 150μA to 15A d.c.; 0·2Ω to 20MΩ $4\frac{1}{2}$" 50μA meter. Kit **£12.18.0** Assembled **£18.11.6**

R.F. SIGNAL GENERATOR. Model RF-1U. Up to 100 Mc/s fundamentals and 200 Mc/s on harmonics. Up to 100mV output. Large accurate, calibrated dial scales. Factory wired and aligned coil and band switch assemblies. Ideal for the service shop. Kit **£13.18.0.** Assembled **£20.8.0.**

RF-1U

TV ALIGNMENT GENERATOR. Model HFW-1. Covers 3·6 Mc/s—220 Mc/s with 0-42 Mc/s max. sweep width. Stable all-electronic sweep circuit. Built-in marker oscillators—5 Mc/s crystal and 20 to 60 Mc/s variable. AGC circuit. Positive action return trace blanking. Kit **£38.18.0.** Assembled **£49.15.0.**

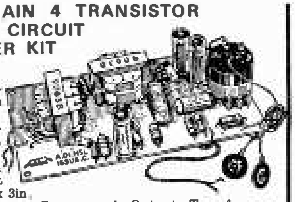


HFW-1

TRANSISTOR POWER SUPPLY. Model IP-20U. Up to 50V, 1·5A output Ideal for Laboratory use. Compact size. Kit **£35.8.0** Assembled **£47.8.9**

Prices and specifications subject to change without notice

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT
Type TA1

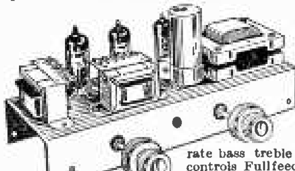


● Peak output in excess of 1¼ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET 114 or 81 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6. (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, 52/6. P. & P. 3/-.
A pair of TA1s are ideal for stereo.

STEREO AMPLIFIER

Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.

ONLY **£4.19.6** P. & P. 8/-



Super De-luxe version with ECL86 valves separate bass treble and balance controls Full feed back 8 gns. P. & P. 8/-.

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 waveband transistor superhet. ● Printed circuit panel (size 8½ x 2¾in.). ● 3 pre-aligned IF transformers ● High-gain Ferrite Rod aerial. ● All First-grade transistors ● Car aerial winding. ● Push-pull output ● All parts supplied with simple instructions. All parts sold separately. Set of parts if purchased at one time ONLY £4.5.0. P. & P. 2/6 (Circuit diagram 2/-. Free with set of parts.)

35 OHM SPEAKERS

Suitable for use with above. 2in. Goodmans' Ideal replacement for most pocket portables, 8/6; 3½in. 12/6; 7 x 4in., 21/-; P. & P. 2/- per speaker.

Portable CABINET

Size approx. 9½ x 6¾ x 3½in. Suitable for above using 3½in. speaker, 25/-. P. & P. 2/6.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 IF transformers one oscillator coil one driver transformer and wound Ferrite aerial (med. long and car aerial coupling), 32/6 complete post 2/-. 6 transistor printed circuit board to match 8/6. Post 1/-. Circuit diagram 1/6 extra.

BRAND NEW TRANSISTOR BARGAINS

GET 15 (Matched Pair) 15/-; V15/10p, 10/-; OC71 5/-; OC76 6/-; AF117 7/6.
Set of Mullard 6 transistors OC44, 2—OC45 OC81D matched pair OC81 25/-, ORP12 Cadmium Sulphide Cell 10/6.

EDISWAN MAZDA

PXA101 6/6; XA103 6/6.
R.F.1. Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp. (Equiv. OC44 and OC45) 10/6
R.F. 2 Pack: 2—PXA101 I.F. 1—PXA102 Osc.1—PXA102 Mixer 12/6
L.F.6 Pack: Consisting of PXB113 Driver Matched pair. PX171 mounted complete with heat sinks (Equiv. OC81D and OC81) 12/6
ALL TRANSISTORS POST FREE

LATEST COLLARO MAGNAVOX 363 TAPE DECK DE LUXE. Three speeds, 2 track, takes up to 7in. spools. 10 gns. Plus 7/6 Carr. & ins. on each (Tapes extra).

PORTABLE TAPE RECORDER CASE

Beautifully made and expensively finished in dark grey heavy grade rexine. Satin Chrome metal grille front and chrome fittings. Speaker aperture 9" x 4". Overall size 15½" w. x 15" d. x 7½" h. Will take any standard tape deck or single record player. Limited number only. Worth at least £5. OUR PRICE 49/6. P. & P. 8/6. Brand new and unused.

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, 18/6. P. & P. 1/6.
ACOS HIGH IMPEDANCE CRYSTAL STICK MIKES. Listed at 42/-. OUR PRICE 21/-. P. & P. 1/6.

Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser. 35/-. P. & P. 3/-.

NEON A.C. MAINS INDICATOR. For panel mounting, cut out size 1¼ x ⅜ x ⅜in. deep inc. terminal. White case with lens giving brighter light. For mains 200/250v. 2/6 each. P. & P. 6d. (6 or more post free).

BRAND NEW T.V. U.H.F. TUNER AND SOUND AND VISION I.F. PANEL

By world famous maker. Suitable for use in conversion of TV sets to BBC2 (625 line reception). OFFERED (less valves) AT THE BARGAIN PRICE OF ONLY 27/6. Post paid. (The components are worth far more than our price for the complete unit and due to the very high value we regret that no correspondence can be entered into regarding this item).

QUALITY RECORD PLAYER AMPLIFIER

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 3in d. x 6in. h. Ready built and tested. PRICE 69/6. P. & P. 6/-.
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE 89/6. P. & P. 7/6.

DE-LUXE QUALITY PORTABLE R/P CABINET

Uncut motor board size 14½ x 12in. Clearance 2in below, 5½in. above. Will take above amplifier and any B.S.R. or Garrard Autochanger or Single Player Unit (except AT60 and SP25) Size 18 x 15 x 8in. Price £3.9.6. Carr. 9/6.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU/12 ....£3.9.6 Carr. 5/6.
GARRARD SP25 De Luxe ....£12.0.0 Carr. 5/6.
B.S.R. GU7 with unit mounted pickup arm. £4.18.8 Carr. 5/6.

AUTO CHANGERS

Latest B.S.R. UA25 Super Slim...............£6. 2.6
GARRARD 1000 with special Hi-Fi cartridge....£6.19.6
GARRARD 2000 £7.10.0. GARRARD 3000 £8.15.0
GARRARD AT60. £10.10.0 Carr. 6/6 on each.
All the above units are complete with t/o mono head and sapphire styli or can be supplied with compatible stereo head for 12/6 extra.

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ACOS GP 69/1 MONO CARTRIDGE. For E.P. and L.P. Complete with stylus. ONLY 12/6. P. & P. 1/-.

BRAND NEW 3 OHM LOUDSPEAKERS

5in., 12/6; 6½in. 15/-; 8in. 22/6; 10in. 27/6; 7in. x 4in. 16/-; 10in. x 6in. 27/6.
E.M.I. 8in. x 5in. with high flux magnet, 21/-.
E.M.I. 13½ x 8in. with high flux ceramic magnet, 42/-. (15 ohm 45/-). P. & P. 5in. 2/-, 6½ & 8in. 2/6, 10 & 12in. 3/6 per speaker.

SPECIAL OFFER!

Limited number of 12in. 10 watt "R.A." Speakers: 3 ohm 25/-; 15 ohm 27/6. P. & P. 3/6.

E.M.I. PLASTIC CONED TWEETERS, 2½in. 3 ohm. Limited number 12/6 each. P. & P. 1/6.

BRAND NEW HEAVY DUTY 12in. SPEAKERS. Response 45 c/s—13 Kc/s. 1½in, voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at 89/6. P. & P. 5/-. Also 25 watt Guitar Model available at £5.5.0. And 35 watt Guitar Model £8.8.0.

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually 35/- yard. Our PRICE 13/6 per yard length. P. & P. 2/6 (min. one yd.) S.A.E. for samples.

SPECIAL OFFER!

GENUINE HIGH QUALITY TYGAN FABRIC. 48in. wide. Our price 10/- per foot run. P. & P. 1/6. 30/- per yard run. P. & P. 2/6.

SEMI SHROUDED DROP THRO' MAINS TRANSFORMER. Tapped pri 200/250 v. Sec. 300-0-300 v. at 110mA. and 6.3 v. at 3 amp. (E/8 screen). Stack size 3½ x 3½ x 1¼in. 30/-. P. & P. 3/6.

MAINS TRANSFORMER. For Transistor power supplies. Pri. 200/240 v. Sec. 9-0-9 v. at 500 mA. 11/-. P. & P. 2/6.

MAINS TRANSFORMER. For transistor power supplies. Tapped pri. 200-250 v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6.3 v. at .5 amp for dial lamps etc. Drop thro mounting. Stack size 1½ x 3½ x 3½in. 27/6. P. & P. 4/6.

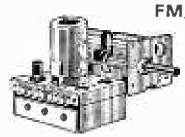
MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1½ x 1½ x ⅞in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/- P. & P.

7-10 watt OUTPUT TRANSFORMERS to match pair of ECL 86's in push-pull to 3 ohm output. ONLY 11/-. P. & P. 2/6.

MINIATURE PRECISION AIR-SPACED TWO GANG TUNING CONDENSER. 176+176 p.F. size 1½"w x ⅞"d x 1½"h with vanes open. Built in trimmers 5/-. P. & P. 1/-

TWIN TELESCOPIC AERIAL. Comprising two 3-section heavily chromed rods. Closed 12in. each extending to 32in. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket, coax lead and plug. Suitable for F.M. or TV. 12/6. P. & P. 2/6.

SPECIAL HARVERSON OFFER! FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer and Wadsworth Ltd. Supplied ready fitted with twin .0005 tuning condenser for AM connection. Prealigned FM section covers 86-102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-. Order quickly! Limited number also available with precision geared 3:1 reduction drive, 30/-. P. & P. 3/-.

MATCHED PAIR AM/FM I.F.'s

Comprising 1st I.F. and 2nd I.F. discriminator (465kc/s /10.7Mc/s). Size 1 x 1½ x 2½in. high. Will match above tuner head. 11/- pair. P. & P. 2/-.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PCC84 and PCF80 valves 34-38 Mc/s I.F Biscuits for Channel 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P. & P. 3/9.

GORLER F.M. TUNER HEAD

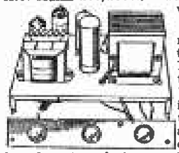
88-100 Mc/s, 10.7 Mc/s I.F 15/- plus 2/- P. & P. (ECC85 valves 8/6 extra).

3-VALVE AUDIO AMPLIFIER MODEL HA34

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.
The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 6/-

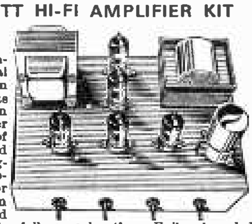
HSL 'FOUR' AMPLIFIER KIT

A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.



● Heavy duty double-wound mains transformer with electrostatic screen. ● Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss. ● Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor. ● Suitable for use with guitar microphone or record player. ● Provision for remote mounting of controls or direct on chassis. ● Chassis size only 7½in. wide x 4in. deep. Overall height 4½in. ● All components and valves are brand new. ● Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ● Supplied complete with valves output transformer (3 ohms only) screened lead, wire, nuts, bolts solder etc. (No extras to buy). PRICE 79/6. P. & P. 6/-.
Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).
This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

10/14 WATT HI-FI AMPLIFIER KIT



A Stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6 (Free with parts) All parts sold separately. ONLY £7.9.6. P & P 8/6. Also available ready built and tested complete with std. input sockets, £9.5.0. P. & P. 8/6. Carrying case for above 28/6 P. & P. 7/6.

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AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6 Mk 2, AT60, SP25 or Goldring GL68. Available with clear Perspex cover as illustrated **66/-** £5.19.11. *complete.*

RECORD PLAYING UNITS

Ready for plugging in to Amplifier or Tape Recorder.
RP2 Consisting of Garrard SP25 fitted Goldring CS90 high compliance ceramic Stereo/Mono ctrge with dmnd stylus. above plinth & cover. Normally £25. Carr. 15/- Only **19½ Gns.**
RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Normally over £33. Terms available both units. Only Carr. 15/- **26½ Gns.**

TAPE AMPLIFIERS 4–5 Watts Output

Suitable for use with Magnavox 363 Decks. Switched equalization. 200-250v Mains A.C. Originally 13 Gns. Size 11" × 2¼" × 6" **£6.19.11**

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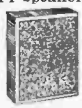
Consisting of matched 12in. 12.000 line. 15 ohm high quality speaker; cross-over unit and Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. Or Senior 20 watt inc. Fane 122/10 speaker 7 Gns. Carr. 8/9. **5 Gns.** Carr. 6/9

ALL LEADING MAKES OF HI-FI EQUIPMENT STOCKED Cash or Terms
Full range Hi-Fi Furniture

HI-FI LOUDSPEAKER ENCLOSURES

All types of pleasing modern design acoustically lined and ported and beautifully finished in light Teak or Walnut veneer. Credit terms available.
JE8. Size 16 x 11 x 8in. Gives pleasing results with 8in. Hi-Fi speaker. **£4.15.0**



SE8. For optimum performance with any Hi-Fi 8in. speaker. Size 22 x 15 x 9in. Carr. 7/6 **£5.19.9**
SE10. For 10in. Hi-Fi speaker with provision for tweeter. Size 24 x 15 x 9in. Carr. 10/- **£6.19.9**
SE12. For outstanding performance with any 12in. Hi-Fi speaker. Cut for tweeter. Size 24 x 20 x 10in. **8 Gns.** Carr. 10/-

NEW RANGE OF LINEAR HI-FI UNITS STOCKED

HIGH FIDELITY LOUDSPEAKER UNITS

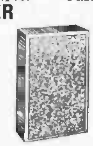
Cabinets of latest styling Satin Teak or Walnut, acoustically lined (and ported where appropriate). Credit Terms available on all units.

MINI 8 8 WATT rating. 3 or 15 ohm. Frequency response 50-13,000 c.p.s. Specially designed high flux 5in. speaker with low fundamental resonance. Handsome Teak veneered cabinet. 9¼ x 6¼ x 7in. Carr. 7/6 **£6/19/11**

The DORSET Size 16 x 11 x 8in. Response 45-18,000 c.p.s. Rating 10 watts. Fitted Audiotrine HF811D speaker. Impedance 3 or 15 ohms. Carr. 7/6 **£7/15/0**

The DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D Speaker. Rating 12 watts. Impedance 3 or 15 ohms. Frequency Response 30-20,000 c.p.s. Carr. 15/- **12½ Gns.**

The GLOUCESTER Size 24 x 20 x 8in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40-20,000 c.p.s. Impedance 15 ohms. Carr. 15/-. **12 Gns.**



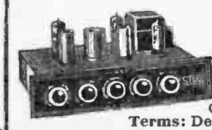
The BRONTE Size 22 x 15 x 9in. Fitted Wharfedale Super 8 RSDD or Audiotrine HF 815D Speaker, with Roll surround and dual cone. Rating 6/10 watts. Impedance 3 or 15 ohms. Carr. 15/-. **12½ Gns.**

Tweeters R.A. 3 ohm or 15 ohm 25/9

15 watt HI-FI TRANSISTORISED AMPLIFIER TYPE A15

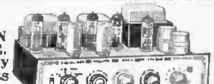
with integral pre-amp tone control stages. Output for 3, 7.5 and 15 ohm spkrs. Kit includes Printed Circuit and all parts including 9 latest type semi-conductors. Heat sink and full wiring instructions or with printed circuit fully wired and tested 21/- extra. **£4.12.9** Post 5/- **Frequency Response:** ±1dB 20-20,000 c.p.s. **Harmonic Distortion:** 0.1%. **Hum and Noise:** —80dB. **Sensitivity:** 2mV. **Bass Control:** +9dB to —14dB at 40 c.p.s. **Treble Control:** +8dB to —13dB at 10 Kc/s. **Will operate from batteries giving 24v.** Suitable Power Pack Kit **47/9** or ready built **69/9**

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER



A complete set of parts for the construction of a unit giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point to point wiring diagrams and instructions supplied. Send S.A.E. for leaflet.
Or supplied factory assembled with 12 months' guarantee for 11 gns. **£8.15.0**
Terms: Dep. 36/- and 9 monthly payments 25/5 (Total £13.4.9). Carr. 11/6

R.S.C. STEREO 20/HIGH FIDELITY AMPLIFIER



PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. Employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 5 millivolts maximum. **Harmonic Distortion:** (each channel): 0.2%. **★Four-position tone compensation and Input Selector Switch. ★Stereo/Mono switch. ★Will amplify direct from Tape Heads. ★Neon panel indicator. ★Handsome Perspex Frontplate. ★Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls.** Output transformers are high-quality sectionally wound to required specification. Output matching for 3 and 15 ohm spkrs. on each channel. Complete set of parts, point-to-point wiring diagrams and instructions. Carr. 12/6 **14 Gns.**
Or factory assembled, tested and supplied with our usual 12 months guarantee.
Or Deposit £3 and 9 monthly payments 43/2 (Total £22.4.6). *Send S.A.E. for leaflet.* Carr. 12/6 **19 Gns.**

R.S.C. TFM1 TRANSISTORISED VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams and instructions. Carr. 10/- **12½ Gns.**
Or factory built 15½ Gns. Or in Teak finished cabinet as illustrated 19½ Gns. Terms: Deposit £5 and 9 monthly payments 39/-. Total £22.11.0.

★ High-sensitivity ★ 200-250v. A.C. Mains operation. ★ Sharp A.M. Rejection. ★ Drift-free reception. ★ Output ample for any amplifier (approx. 500 m.v.). ★Simple alignment instructions. ★ Output available for feeding tuning meter. ★ Output for feeding Stereo Multiplexer. ★ Tuner head using Silicon Planar Transistors. ★ Designed for standard 80 ohm co-axial input.
Made to visually match our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only first grade transistors and components used. Our latest product giving you the best at half the cost of comparable units. Stereo Multiplexer available.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

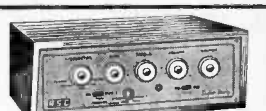
Heavy cast construction. Latest **high** efficiency ceramic magnets. Dual Cone for extended frequency range. Plastic treated surround giving low fundamental resonance. Response 40-18,000 c.p.s., Impedance 3 or 15 ohms. Carr. 5/6.

HF811D	8in. 10 WATT	4 Gns.
HF101D	10in. 12 WATT	5 Gns.
HF100D	10in. 15 WATT	£5.15.0
HF121D	12in. 20 WATT	£6.15.0
HF127D	12in. 30 WATT	9 Gns.

R.S.C. SUPER 15 HI-FI AMPLIFIER

FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3-4 ohms.
Maximum instantaneous Peak power output 28 watts.
PRINTED CIRCUIT CONSTRUCTION.
LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2.5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ± 2dB 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10 Kc/s.
BASS CONTROL: +12dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s. 0.25%.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 11/- **11 Gns.**
Supplied factory built 15 Gns. Carr. 12/6. Terms: Deposit 49/- and 9 monthly payments 33/9 (Total £17.12.9). Or fitted in beautiful Walnut or Teak veneered cabinet as illustrated, 4 Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

TECHNICAL SPECIFICATIONS COMPARE MORE THAN FAVOURABLY with SIMILAR AMPLIFIERS AT TWICE THE COST

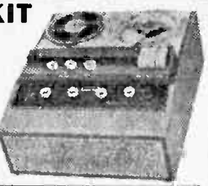


R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components.
CROSS TALK: —52dB at 1,000 c.p.s.
CONTROLS: 5 position Input Selector, Bass Control, Treble Control, Volume Control, Balance Control, Stereo/Mono Switch, Tape Monitor Switch, Mains Switch.
INPUT SOCKETS (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation.
Rigid 18 s.w.g. Chassis. Size approx. 12in. Wide, 3in. High and 8in. Deep. Neon Panel Indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.

THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon) CURRENTLY AVAILABLE, SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 13/9 **18½ Gns.**
Unit factory built 25½ Gns. or deposit 83/9 and 9 monthly payments 56/9 (Total £29.14.6). Fitted cabinet as Super 15 29½ Gns. Carr. 15/- or Deposit £4.14.9 and 9 mthly paymts 65/10 (Total £34.7.3). *Send S.A.E. for leaflet.*

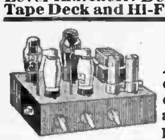
AUDIOTRINE HI-FI TAPE RECORDER KIT



REALISM AT INCREDIBLY LOW COST: CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS. S.A.E. for leaflet.
Incorporating the latest Magnavox Tapedeck. The Audiotrine High Quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a handsome Portable Cabinet of latest styling finished dark grey leathercloth. Size 14½ x 17 x 8½in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £50-£60 class. **Deposit 4 gns. and 9 mthly paymts 59/6 (Total 29½ gns.)** **26½ Gns.**
4 Track Model 3 gns. extra. Carr. 19/6

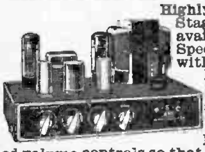
LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 1⅞in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most Tape Decks. Terms available. **10½ Gns.**

R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER



A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and practically all "mikes". Separate Bass and Treble controls giving "lift" and "cut". Hum level 71dB down. Negative Feedback 15dB. Reserve power supply 300v 25 m.a., 6.3v 1.5 a. for Radio Tuner or Tape Pre-amp. For A.C. mains 200-250v. Speaker output 3 ohms. Complete in every detail with fully punched enamelled chassis, point-to-point wiring diagrams and instructions. Or assembled ready for use 6 gns. plus 5/9 carr. **£4.17.9**

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

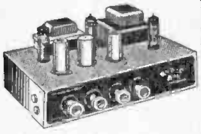


Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers available. Hum level —70dB. Frequency response ±3dB 30-20,000 c/s. Specially designed sectionally wound ultra linear output transformer with 807 output valves. All first grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that any kind of **Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls** or **Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts fully punched chassis, point to point wiring diagrams and instructions. **12 Gns.** Carr. 12/6
Supplied factory built with EL34 output valves. 12 months guarantee for **15 gns.** If required perforated cover with carrying handles can be supplied for **21/-.** Send s.a.e. for leaflet. **TERMS: Deposit 48/- and 9 monthly payments of 33/7 (Total £17.10.3).**

JASON VHF/FM TUNER Complete kit with valves. **£6.19.11**

LOUDSPEAKER CORNER CABINETS Attractive polished walnut finish. Model M for 10" speaker **59/11** Model S for 12 spkr & tweeter **5 Gns**

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP Two input sockets with associated controls allow mixing of "mike" and gram. etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. Frequency response ±3dB 30-20,000 c/s. Six negative feedback loops. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s, all types "mikes". Comparable with the very best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Reserve Power** provides 300v. 30mA, and 6.3v. 1.5a. for **Radio Tuner** or **Tape Pre-amp.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 4 and 15 ohm speakers. Kit complete to last nut. Chassis fully punched. Full instructions and point-to-point wiring diagrams (or factory built £11.15.0). Metal cover with 2 handles available for 21/-. **TERMS ON ASSEMBLED UNITS: Deposit 36/6 and 9 monthly payments of 25/9 (Total £13.8.3).** Send S.A.E. for illustrated leaflet of Cabinets, Speakers, Mikes, etc. **£8.15.0** Carr. 11/6

R.S.C. BASS-REGENT 50 WATT AMPLIFIER

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.

★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response. ★ 4 Jack Inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".
★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles. ★ Separate Bass and Treble Controls giving "lift" and "cut".

49½ Gns. Carr. 30/- Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at three times the cost. Or deposit £7.17.6 and 9 monthly payments of £5.10.10. (Total 55 gns.)

B20 MULTI-PURPOSE AMPLIFIER especially suitable for Bass Guitar

Incorporating massive 15in. high flux loudspeaker. Rating 25 watts. Individual bass and treble controls. Two jack inputs separately controlled. Substantial cabinet attractively finished in Rexine and Vynair. Size approx. 24 x 21 x 11in. Send S.A.E. for leaflet. Or Deposit £4.14.6 and 9 monthly payments of 66/-. (Total £34.8.6). Carr. 17/6. **29½ Gns.**

G15 15 WATT AMPLIFIER for Lead or Rhythm Guitar, Vocal Groups, etc.

High-fidelity output. Separate bass and treble controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Heavy Duty 12in. 20 watt Speaker. Cabinet covered in attractive Rexine/Vynair. Size 18 x 18 x 8in. Deposit 3 gns. **19½ Gns.** Carr. 15/-. and 9 monthly payments of 43/7 (Total £22.15.3). S.A.E. for leaflet.

LINEAR TREMOLO PRE-AMP UNIT

Suitable for use with any of our Amplifiers. Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume and Switch. **4½ Gns.**

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50 c/s is available. Complete kit with diagram 47/9 or ready for use 59/11.

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12 v. D.C. output. Max A.C. input 18 v.
1 a. 3/11. 2 a. 6/11. 3 a. 9/9. 4 a. 12/9. 6 a. 15/9.

HEAVY DUTY SELENIUM RECTIFIERS

12v. 15 amps, F.W. (Bridged). Only **19/9**

CLEARANCE SALE !

WATKINS COPYCAT ECHO UNITS Listed £38.10.0. Brand new **19½ GNS.** Carr. 17/6
15 WATT Ex Guitar Amplifiers 15 ohm output. 2 inputs Carr. 7/6. **7 Gns.**

POWER PACK KIT

Consisting of Mains transformer. Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6.3v. 2a Supplied with case in lieu of chassis 26/11. Or assembled 39/11. **22/11**

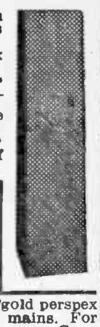
HEAVY DUTY BATTERY CHARGER KITS 6/12 v.

Consisting of Mains Trans. 200-250 v., Rectifier, Ammeter, Variable Charge Rate Selector, Panels, Plugs, Fuses and Holders. Fully punched stove enamelled case and circuit. **4a 49/11** **6a 69/11**
Or assembled ready for use 10/- extra.

LONDON-NEWCASTLE

New branches now open — see addresses

R.S.C. COLUMN SPEAKERS

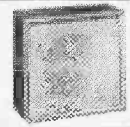


Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching.
Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. Or Deposit 44/-and 9 mthly pmts 31/5 (Total £16.6.9) **14 Gns.** Carr. 10/-
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- Or Deposit £3.11.0 and 9 monthly payments of 46/7 (Total £24.10.3). **21 Gns.**

30 WATT HI-FI AMPLIFIER for Guitar, Vocal or Instrumental Group

A 4 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Latest valves. Strong Rexine covered cabinet with carrying handles. Attractive black/gold perspex facia. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **17 Gns.** Carr. 12/6 Deposit £3 and 9 monthly payments of 37/5 (Total £19.16.9).

12in. HIGH QUALITY L'SPEAKERS



In teak veneered cabinets.
10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. Carr. 7/6 **£4.19.11**
20 Watt Model. 15 ohm. Size 18x18x10in. Gauss 12,000 lines. **£7.19.11**
Rexine covered £1 extra. Carr. 10/6
Terms available on both.

FANE HEAVY DUTY HI-FI SPEAKERS

12in. 20 watt. Type 122/10. Carr. 5/9 **5 Gns.**

LOUDSPEAKERS

Limited number at fraction of list price 15 ohms. impedance. Brand new, guaranteed.
12in. HEAVY DUTY 30 watts 7 GNS. Carr. 12/6 Normally £12 approx.
15in. EXTRA HEAVY DUTY 40-50 watts 11 GNS. Carr. 17/6
Massive units with 3in. Diam. Pole Pieces. Terms available. (Normally appr. £19)

R.S.C. GRAM AMPLIFIER KIT. 3-4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit. etc. supplied. Only 49/11.

HIGH FIDELITY 12in. 10 WATT SPEAKERS **59/11**

Flux Density 12,000 lines. Impedance 3 or 15 ohms.

TRANSISTOR SALE

Mullard OC71, OC72, OC81, 2/11, OC44, OC45, 3/11, OC75, 7/9, AF117 6/9. Post 6d. for 3.

INTEREST CHARGES REFUNDED on H.P. and Credit Sale Accounts settled in 3 months.

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED, Interleaved and Impregnated. Primaries 200-250v. 50 c/s. Screened.

MIDGET CLAMPED TYPE 2½ × 2½ × 2½in.

250v., 60mA, 6.3v. 2a	14/11
250-0-250v., 60mA, 6.3v. 2a	15/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a	19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	33/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	33/9
300-0-300v. 130mA, 6.3v. 4a c.t., 6.3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	33/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a.	42/9
425-0-425v. 200mA, 6.3v. 4a, c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6.3v. 4a, 6.3v. 4a, 5v. 3a	69/9
450-0-450v. 250mA, 6.3v. 4a, c.t., 5v. 3a	79/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a	19/9
250-0-250v. 100mA, 6.3v. 3.5a.	21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a.	22/9
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	32/9
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier	39/9
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	39/11

FILAMENT or TRANSISTOR POWER PACK Types 6.3v. 1.5a 6/9, 6.3v. 2a 7/9, 6.3v. 3a 9/9, 6.3v. 6a 19/9, 12v. 1a 8/9, 12v. 3a or 24v. 1.5a 19/9, 0-9-18v. 1½a. 15/9. 0-12-25-42v. 2a 27/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a, 13/11 2½a, 16/11, 3a, 18/11, 5a, 21/11, 6a, 25/11, 8a, 31/11

AUTO (Step UP/Step DOWN) TRANSFORMERS 0-110/120v.-200-230-250v. 50-80 watts, 14/9 150 watts, 29/11, 250 watts, 49/9, 500 watts, 99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	7/9
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	11/9
Push-pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15 Ω	21/9
Push-pull EL84 to 3 or 15 Ω 10-12 watts	19/9
Push-pull Ultra Linear for Mullard 510, etc.	35/9
Push-pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	29/9
Push-pull 20 watt high quality sectionally wound, EL34, 6L6, KT66, etc., to 3 or 15 Ω fully shrouded	55/9

SMOOTHING CHOKES
150 mA, 7-10H, 250 Ω 12/9.
100 mA, 10H, 200 Ω 9/11.
80 mA, 10H, 350 Ω 7/9.
60mA, 10H, 400 Ω 4/11.

R·S·C HI-FI CENTRES LTD.

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Dept PW5

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Telephone.(061) 832 7710

FREE GIFT OFFER

OF A BRAND NEW WORLD FAMOUS EMI FISK SOLARISCOPE VALUE £2.2.0, WITH EVERY ORDER VALUE £5 AND OVER. THIS UNIQUE INSTRUMENT WHICH IS A BOON TO SHORT WAVE LISTENERS CLEARLY SHOWS THE AREAS OF DAYLIGHT AND DARKNESS ALL OVER THE EARTH AT ANY GIVEN HOUR.

MINI-MOTORS 3v to 4.5v operation. Ideal for mini-racing cars, models and toys. "Large" ($1\frac{1}{5} \times \frac{7}{10} \times 1\frac{2}{5}$in.): 3/11d. Medium ($1 \times \frac{3}{5} \times 1\frac{1}{4}$in.): 3/9d. Small ($\frac{9}{10} \times \frac{1}{2} \times 1$in.) 3/3. P. & P. 9d. each.

BRAND NEW! Why use Sapphire Stylii in your record player when at very little extra cost you can have a first grade **GENUINE DIAMOND STYLUS** at 7/11d. plus 6d. P. & P. Available as replacements for the following popular types only at present: BSR.TC8LP; BSR.TC8 Stereo; BSR.TC8 LP/Stereo; Collaro Studio "O" LP/Ronette; Garrard GC8 LP; Acos GP 65/67LP; Ronette BF40/LP; Garrard GC2LP.

SPEAKERS. 12in. Round high quality British fitted tweeter cone. 6 watts—available in 3Ω or 15Ω. Wonderful value at 29/6d., P. & P. 3/6d. 12in. Round R & A, 3Ω 25/6d., P. & P. 3/6d. 3in. Round best British make. 80Ω, 8/6d., P. & P. 1/6d.

TWEETER. $2\frac{1}{2}$in. Black plastic cone, round on Square Frame, E.M.I. 3Ω, 12/6d. plus 1/6d. P. & P. P.A. HORN Speaker, 8Ω, 15 watt 9 x 9in. Swivel mounting brackets, £5.5.0. Carr. Paid. Many other sizes and types available from 2in.

TRANSISTORS: Some popular types from our range:
OC44 & OC45 3/6d. ea. OC71 2/9d. OC72 3/6d. OC81 & OC81D 3/- ea.
OC169 3/9d. OC170 3/6d. AF117 4/-. OC26 7/6. GET 8 5/9. General purpose (Approx. OC71) 1/- ea. Postage 6d. up to 3. Over 12 sent P. & P. paid.

MICROPHONES. LAPEL/HAND MIKE—$1\frac{1}{8}$in. dia. Lapel Clip, ideal for tape recording. With lead. Very Sensitive. 7/6. P. & P. 1/-.
CRYSTAL HAND MIKE—Robust and Sensitive. Cream Plastic Case. Just the thing for tape recorders. 8/6. P. & P. 1/6.
ACOS MIC 40—World famous Desk Mike .. .. 13/9 × P. & P. 1/3
ACOS MIC 45—Splendid Curved Hand Grip Crystal Mike 14/6 × P. & P. 1/6
ACOS MIC 60—"Stick" Type Crystal Mike .. .. 18/6 × P. & P. 1/6
ACOS Round Crystal Inserts, 1in. dia. 6/6; $1\frac{1}{8}$in. dia. 7/6. P. & P. on either, 6d.
DYNAMIC HAND/DESK TYPE. 50KΩ with cable and plug to suit most recorders, etc. 18/9. P. & P. 1/3.
TELESCOPIC FLOOR STAND. HEAVY BASE. Standard thread. Suits above or any other mike. 49/6. Carr. & Pkg. 2/6.
TELEPHONE PICK-UP COIL. For recording or amplifying both sides of telephone conversation. Suction cup fitting to phone. With lead, 7/6. P. & P. 1/-.

INTER-COMM. DE-LUXE 2 WAY. Ideal for offices, workshops, theatres, etc. Highly efficient, safe **BABY ALARM.** No mains—works off PP3 battery, which lasts for months, obtainable everywhere. Buzzer call system, complete with lead, plugs, battery, in handsome carton. 63/-. P. & P. 2/6d.

PICK-UP ARM. Lightweight, with T/O crystal cartridge and stylii for L.P. and 78 R.P.M. records on base with rest 27/6d. P. & P. 2/6d.

R.F. FIELD INDICATOR. Ideal for use with radio controlled models. Checks radiation from existing antenna. Tunes 1 to 250 MC in 5 bands. Sensitive 200 mA meter movement, 5 section plug-in aerial. Phone jack and crystal earpiece for monitoring. No battery required. Powerful magnet for attaching to metal surfaces. Complete with instructions. 47/6d. P. & P. 2/6d.

4 TRANSISTOR 3W AMPLIFIER. Size $2\frac{1}{4} \times 2\frac{3}{4} \times 1\frac{1}{4}$, 3, 8 or 15Ω output, 9 volt battery operated. Highly sensitive. Price (less battery) 52/6d. P. & P. 1/6d.

VERNIER DIALS—fit standard $\frac{1}{4}$in. spindle—approx. 8:1 ratio. Marked 0/100 through 180°. Small round 2in. dia.: 10/6d. Large 3in. dia.: 12/-. Post on either 1/-.
MAINS TRANSFORMERS: 350/0/350 80mA, 6v and 6.3v at 2A Chassis MTG. 230v or 110vIN Size $4 \times 3\frac{3}{4} \times 2\frac{1}{2}$in. 21/- ea. P. & P. 2/-. **VOLTAGE DROPPING TRANSFORMER** 230vIN, 3.5v, 9v and 17v out at 4 amps. Many uses. Ideal for Battery Chargers etc. $3 \times 2\frac{1}{2} \times 2\frac{1}{2}$, 22/6d. each. P. & P. 2/6d.

RECORD PLAYER DECKS. GARRARD.

SP25	De Luxe 4 speed single-player	£9. 9.6
MODEL 1000	4 speed Auto-Change ..	£5.19.6
AT6 MKIIA	4 speed De Luxe Auto-change	£8.19.6
MODEL 3000	4 speed Auto-Change ..	£7.10.0

All latest models. All fitted Mono Cartridge. Stereo 10/- extra. Carr. & Pkg. all models 7/6d. but price inc. free gift.

B.S.R. Automatic Record-Changer Decks—Latest Models.
UA 25—Very popular—4 speed. Capacity six 7", 10", 12" records. £5.19.6
UA 15 SS—Slim Design—first class 4 speed. Two-tone finish. £6.2.6.
UA 15/SS3D—As above, but with low mass p/u arm reducing record wear and heavier $10\frac{1}{2}$in. t.t. Finished in Pearl Grey and Black. £6.18.9.
P. & P. on all above 7/6d. Price includes Free Gift.

Magnavox '363' Tape Decks. Latest Models. World famous. Made to highest standards. Size $13\frac{1}{4} \times 11 \times 5\frac{1}{4}$in. below board. For 200/250v. 50 cycles A.C. 3 speed, digit counter, piano key controls. 7in. Reels. Every modern feature. Speeds $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s. With $\frac{1}{2}$ track Bradmatic head £10.10.0. With $\frac{1}{4}$ track Marriott heads £13.0.0. P. & P. 10/-. Price includes Free Gift.

PICK-UP CARTRIDGE REPLACEMENTS. STANDARD FIXING FOR MOST RECORD-PLAYER ARMS. ALL TURN-OVER TYPES WITH STYLII FOR L.P. & 78 RPM.
ACOS GP/67-2 Mono, 12/6 ea. ACOS GP/91-1 Mono de luxe, 17/6 ea. ACOS GP/73-2 Stereo, 25/- ea. Postage and Packing 9d. each.

Finest Quality British made Mylar Recording Tape. Fully Guaranteed.

3in. Message	5/-	$5\frac{3}{4}$in. 1200ft. Long Play ..	12/6
5in. 600 Standard Play ..	8/6	7in. 1800ft. Long Play ..	19/6
$5\frac{3}{4}$in. 850 Standard Play ..	11/6	5in. 1200ft. Double Play ..	15/-
7in. 1200 Standard Play ..	12/6	$5\frac{3}{4}$in. 1800ft. Double Play ..	22/6
5in. 900ft. Long Play	10/-	7in. 2400ft. Double Play ..	24/-

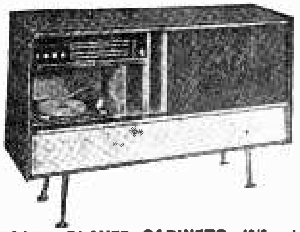
P. & P. 1/- per reel. Four reels and over post paid. *N.B.*—MYLAR based recording tape is of infinitely superior quality and far stronger than Acetate base tape.

POCKET MULTI-TEST METER. 1000Ω per volt. Volts 0/10/50/250/500/1000 AC and DC Current: 0-1-100-500mA. Resistance: 0-100kΩ. Complete with test prods., instructions. 37/6. P. & P. 1/6.

TERMS. Cash with order—No C.O.D. Orders totalling £5 and over sent carriage paid (excepting Record player decks and Transreceivers where carriage is shown). Guaranteed money refunded if goods returned perfect within 7 days of despatch.

REMEMBER THE NOVEL FREE GIFT EXCLUSIVE TO US!
Callers welcome—Very many more lines to choose from. Open 9.30 a.m.–6 p.m. Mon.—Sat.

COCKTAIL/STEREOGRAM CABINET £25



Polished walnut veneer with elegant glass fronted cocktail compartment, padded. Position for two 10in. elliptical speakers. Record storage space. Height $35\frac{1}{2}$in., width $52\frac{3}{4}$in., depth $14\frac{1}{2}$in. Legs 1 gn. extra.

OTHER MODELS, SEND FOR FREE LIST

RECORD PLAYER CABINETS, 49/6. Latest designed covered cabinets. Takes any modern Autochanger. P. & P. 7/6.
TRANSISTOR CASES 19/6 $9\frac{1}{2} \times 6\frac{1}{2} \times 3\frac{1}{2}$in. P. & P. 2/6.
TV TURRET TUNERS, 2/6. New, less valves, Slim models 5/-. Press button models 19/6. P. & P. 2/6.

17in.—£11.10.0

3 Star Guarantee
★ Tube ★ Valves
★ Components Carr. 30/-

TWO-YEAR GUARANTEE EX-RENTAL TELEVISIONS

FREE ILLUSTRATED LIST OF TELEVISIONS
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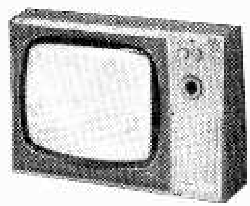
WIDE RANGE OF MODELS
SIZES AND PRICES
DEMONSTRATIONS DAILY

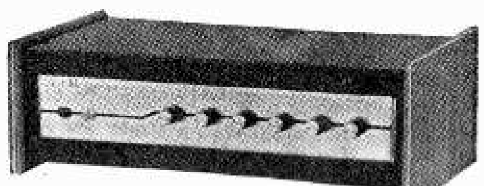


TWO-YEAR GUARANTEED TUBES 100% REGUNNED
14in.—69/6 17in.—89/6
21in. and ALL SLIMLINE TUBES 99/6
Carr. 10/6

EX MAINTENANCE TESTED TUBES
17in.—35/- 14in.—15/-
Carr. 5/- (not slimline)

DUKE & CO. (LONDON) LTD.
621/3 Romford Road. E.12 ILF 6001-2-3

VIKING STEREO 4 + 4 DE-LUXE HIGH QUALITY AMPLIFIER



PRICE **£13-17-0** COMPLETE

A high quality stereo amplifier, built to meet the requirements of budget Hi-Fi. Elegant styled cabinet in black rexine and woodgrained ends. Brushed aluminium panel, black and silver knobs. Quality components throughout. Ganged Bass and Treble controls, separate volume controls for each channel. Valves (Standard Model) 2 × ECL86 (De-Luxe Model) 1 × ECC83 (2) × ECL86. Output 3 ohms matching, suitable A.C. mains 230-240 volt. Cabinet size, $16\frac{1}{2}$in. wide $5\frac{1}{2}$in. high, $8\frac{1}{2}$in. depth. Full instructions and guarantee. Send for leaflet. S.A.E.

VIKING 10-12 A twelve watt amplifier for use on 230-240 volt A.C. mains. Inputs suitable Microphone. Record Player, Tuner, Tape Recorder, etc. Printed circuitry. Five Mullard valves, reliable components. Front panel contains 2 Input Jacks, 2 Volume Controls, 1 Tone, Neon and On/Off switch. Designed to fit into same type and size cabinet as Stereo. Fully guaranteed. Send for leaflet.
PRICE **£8-19-6** PLUS 12/6 P.P.

VIKING X.P.15. A frustrated order offered at a fraction of cost (original price 39 gns.). 15 watts output. Suitable for 210-240 Volt A.C. mains. Attractive Black chassis with slotted Chromed steel top cover, size $15 \times 7\frac{1}{2} \times 7$in. 4 Input Jacks, 2 volume controls, 2 tone. 5 Mullard valves. Fully guaranteed. Send for leaflet.

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$5\frac{3}{4}$in. reels each containing 1,200ft. of top quality polyester recording tape (Limited quantity.)
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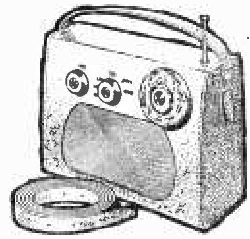
"A wonderful range of transistor radios using first grade components guaranteed results."

NEW ROAMER SEVEN Mk IV



7 WAVEBAND PORTABLE OR CAR RADIO

Amazing performance and specification ● *Now with PHILCO MICRO-ALLOY R.F. TRANSISTORS*

FULLY TUNABLE ON ALL WAVEBANDS ● **9 stages—7 transistors and 2 diodes**

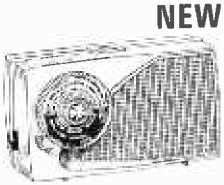
Covers Medium and Long Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room filling volume from rich toned 7 x 4in. speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M. & L. Waves and telescopic aerial for S. Waves. Real leather-look case with gilt trim and shoulder and hand straps. Size 9 x 7 x 4in. approx.
The perfect portable and the ideal car radio. (Uses PP7 batteries, available anywhere.)

● **EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, etc.**

Total cost of parts now only **£5.19.6** P. & P. 5/6

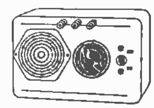
Parts Price List and easy build plans 3/- (Free with kit)

NEW MELODY MAKER SIX

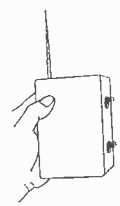


★**8 stages. Six transistors and two diodes.** Covers Medium and Long Waves and Extra Band for EASIER tuning of LUXEMBOURG etc. Top grade 3in. Loudspeaker for quality output. Two R.F. stages for extra boost. High 'Q' 6in. Ferrite Rod Aerial. Approx. 350 Milliwatts push pull output. Handsome pocket size case with gilt fittings. Size 6¼ x 3¾ x 1¼. (Uses long-life PP6 battery). Carrying strap 1/6 extra.

This amazing receiver may be built for only **£3.9.6** P. & P. 3/6. *Parts price list and easy build plans 2/-.* (Free with kit).

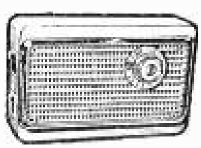


QUICK CHECK TRANSISTOR TESTER. Checks gain of R.F. and Audio Transistors. Also checks for noise level and duds. All parts ready to be assembled in attractive grey case with red grille, complete with Dial, Knobs, and Dynamic Speaker. Simple assembly instructions free with set of parts. **29/6.** P. & P. 2/6.



THE SIG-GEN. A versatile Signal Injector. Something no constructor should be without. The ingenious device generates an audible signal through the Audio and R.F. ranges. With variable output. Telescopic Probe. Pocket size slim line case measures 4¾ x 3¼ x ⅞in. Complete set of parts with full instructions. **19/6.** P. & P. 2/-.

NEW TRANSONA FIVE



Now with 3in. Speaker!

"Home, Light, A.F.N., Lux. all at good volume." G.P., Durham.

● **7 stages—5 transistors and 2 diodes**

Fully tunable over Medium and Long Waves. Incorporates Ferrite rod aerial, tuning condenser volume control, new type fine tone super dynamic 3in. speaker, etc. Attractive case. Size 6¼ x 4½ x 1½in. with red speaker grille. (Uses 1289 battery, available anywhere.)

● **Extended M.W. band for easier tuning of Luxembourg etc.**

Total cost of all parts now only **42/6** P. & P. 3/6 *Parts Price List and easy build plans 2/- (Free with kit)*

POCKET FIVE *Now with 3in. Speaker!*

● **7 stages—5 transistors & 2 diodes**

Covers Medium and Long Waves. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 3in. moving coil speaker, built into attractive black and gold case. Size 5¼ x 1¼ x 3½in. (Uses 1289 battery available anywhere.)

● **Extended M.W. band for easier tuning of Luxembourg etc.**

Total cost of all parts now only **42/6** P. & P. 3/-

STOP PRESS!
Pocket 5 med. and long wave version with miniature speaker.
29/6 P. & P. 3/-

Parts Price List and easy build plans 1/6 (Free with kit)

NEW ROAMER SIX

NOW, WITH PHILCO MICRO-ALLOY R.F. TRANSISTORS

● **6 WAVEBAND ! !**

● **8 stages—6 transistors and 2 diodes**

Listen to stations half a world away with this 6 waveband portable. Tunable on Medium and Long Waves, Trawler Band and two Short Waves. Sensitive Ferrite rod aerial and telescopic aerial for short waves. Top grade transistors. 3in. speaker, handsome case with gilt fittings. Size 7¼ x 5¼ x 1½in. (Carrying strap 1/6 extra.)

★**EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, ETC.**

Total cost of all parts now only **£3.19.6** P. & P. 3/6 *Parts Price List and easy build plans 2/- (Free with kit)*

TRANSONA SIX

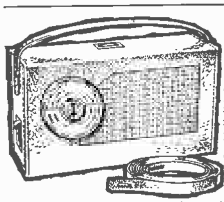
● **8 stages—6 transistors and 2 diodes**

A top performance receiver covering full Medium and Long Waves. High-grade 3in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6¼ x 4½ x 1½in. (Uses PP4 battery available anywhere). Carrying strap 1/- extra.

● **Extended M.W. band for easier tuning of Luxembourg etc.**

Total cost of all parts now only **59/6** P. & P. 3/6 *Parts Price List and easy build plans 1/6 (Free with kit)*

MELODY SIX



● **8 stages—6 transistors and 2 diodes**

Our latest completely portable transistor radio covering Medium and Long Waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. Ferrite rod aerial. Push-pull output. Wonderful reception of BBC, Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¾ x 3¼ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

Total cost of all parts now only **£3.9.6** P. & P. 3/6 *Parts Price List and easy build plans 2/- (Free with kit)*

SUPER SEVEN

● **9 stages—7 transistors and 2 diodes**

Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car, or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 RF Stages, push-pull output, 3in. speaker (will drive large speaker). Size 7¼ x 5¼ x 1½in. (Uses 9V battery, available anywhere.)

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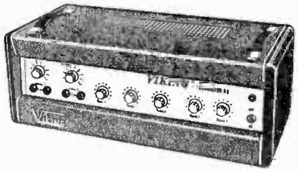
VIKING TRANSISTOR

40-50 WATT AMPLIFIER



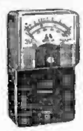
OPERATING INSTRUCTIONS GENERAL, An extremely reliable lightweight amplifier capable of giving 40-50 watts of undistorted sound, made possible by the use of the latest semi-conductors (transistors) and techniques which ensure space-age reliability under the most rugged conditions. It is designed as a general purpose amplifier particularly suitable for use with musical instruments that require exceptionally high treble response (not recommended for Bass Guitar). Tremolo facilities are available on Channel 1 only. INPUTS—CONTROLS—CHANNEL 1 (Tremolo): this contains two high gain input jack sockets controlled by **Volume Control 1** which is mounted directly above the two sockets marked tremolo. BASS 1: gives a controlled boost to the lower frequencies on Channel 1 only. TREBLE 1: gives a controlled boost to the high frequencies on Channel 1 only. TREMOLO: this operates on Channel 1 only and the variations of intensity and speed of the Tremolo beat is adjusted by the controls DEPTH and SPEED. A socket is provided in the rear of the amplifier so that the Tremolo may be switched on and off by the use of a footswitch plugged into the socket. If you wish the Tremolo to be used without the footswitch, this is possible as the footswitch is only used to short out the effect. INPUTS AND CONTROLS—CHANNEL 2 (Normal): this contains two high gain input jack sockets controlled by **Volume Control 2** which is mounted directly above the sockets marked **Normal**. TREBLE: gives a controlled boost to the treble frequencies on Channel 2 only. MAINS VOLTAGE: fully adjustable, 200-250 volts, A.C. 50 cycles. POWER OUTPUT: 40-50 watts sine wave British rating. Very little distortion. OUTPUT IMPEDANCE: 3 ohms. Price **21 gns.** plus £1 postage and packing.

WOLSEY U.H.F. AERIAL AMPLIFIER, two stage, gain 23 dB, noise factor 8 dB, power consumption 6 mA at 14 volts. Two AF186 transistors, complete with built-in power supply in metal case, list price 9 gns., our price **4½ gns.** plus 2/6 postage and packing.

MAINS TRANSFORMER, primary 200/250 volt, secondary 425/425 volt. 250 mA, 6·3 volt 4 amp, 5 volt 3 amp; fully shrouded. chassis mounting. Price **£2.5.0** plus 7/6 postage and packing. Auto transformer step-up-step-down, 240/110 volt 400 watt. Price **£1.5.0** plus 7/6 postage and packing.

MAINS TRANSFORMER 200/250 volt, secondary 250/250 volt, 70 mA, 6·3 volt, 3 amp drop through. Price **12/6** plus 4/6 postage and packing. Elac 10 inch, 10,000 lines ceramic magnet, 3 or 15 ohms, 7 watt, **£1.9.6** plus 4/6 postage and packing.

POCKET MULTI-METER



Size 3¾ x 2¼ x 1⅛in. Meter size 2¼ x 1⅛in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0·15, 0·150 0·1000. D.C. current 0·150mA. Resistance 0·100kΩ. Complete with test prods, battery and full instructions, 42/6. P. & P. 3/6. FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

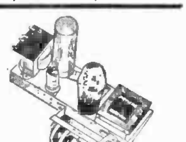
40W FLUORESCENT LIGHT KIT

Incorporating GEC Choke size 8¾in. x 1½in. x 1½in., 2 bi-pin holders, starter and starter-holder. P. & P. 5/6. **11/6**

Similar to above: 80W. Fluorescent Light Kit incorporating GEC choke size 11¾in. x 1½in. x 1½in. 2 bi-pin holders start and starter holder. P. & P. 6/6. **17/6**

Twin 40W Choke instant start for 2 x 2ft. tubes 17/6. P. & P. 5/6.

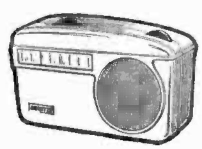
3 to 4 Watt AMPLIFIER



3-4 watt Amplifier built and tested. Chassis size 7 x 3½ x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6. £2.5.0 plus 5/6 p. & p.
The above in Kit Form, £1.14.6 plus 5/6 p. & p.

"MUSETTE" 6-Transistor Superhet Portable Radio

★ 2½" Speaker. ★ 6 Transistor Superhet Output 200mW. ★ Plastic Cabinet in red, size 4¾" x 3" x 1¾" and gold speaker louvre. ★ Horizontal Tuning Scale. ★ Ferrite Rod Internal Aerial. ★ IF 460 kc/s. ★ All components Ferrite Rod and Tuning Assembly mount on printed board. ★ Operated from PP3 Battery. ★ Fully comprehensive instructions and point-to-point wiring diagram. ★ Printed Circuit Board. ★ Tunable over medium and long waveband. ★ Car aerial and earpiece socket.



Price 39/6d. inc. carrying strap. Circuit Diagram 2/6 free with parts. P. & P. 3/6.

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Superb new 8-valve chassis covering long, medium and short waves on AM, also VHF transmissions on FM, AM circuit's high sensitivity permits internal aerial for most stations. Well-known Gorler tuning heart in separate FM input. Tone and volume controls. Extra large illuminated dial. External AM and FM aerial inputs. Gram. pick-up socket. Standard 3 ohm speaker. 200/250 volts A.C. Size 17 x 7 x 5¾ in. deep.

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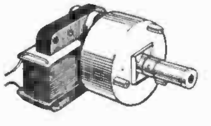
P. & P. £1

Type E MOTOR



Small A.C. mains motor 230/250 volts complete with gearbox, **6 r.p.m.** Price **15/-** plus 4/- P. & P. Similar to above motor but without gearbox. Price **9/6** plus 3/- P. & P.

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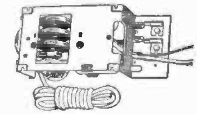

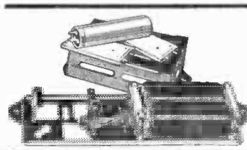

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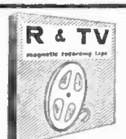

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5¾" Std.	850ft.	9/-	5"	L.P.	850ft.	10/6
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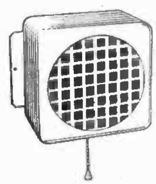
5¾" L.P.	1200ft.	11/6	5¾"	T.P.	2400ft.	32/6
7" L.P.	1800ft.	18/6	7"	T.P.	3600ft.	42/6
5¾" D.P.	1800ft.	18/6	4"	T.P.	900ft.	15/-

P. & P. on each 1/6, 4 or more post free

EXTRACTOR FAN



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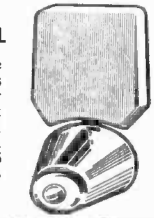
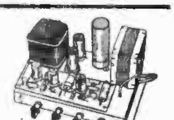


8-watt 4-valve PUSH-PULL AMPLIFIER & METAL RECTIFIER



Size: 9" x 6" x 1½". A.C. Mains, 200-250V 4 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested, £4.4.0. P. & P. 11/-, 8" x 5" speaker to suit price 14/6 plus 1/6 P. & P. Crystal mike to suit 12/6 plus 1/6 P. & P.

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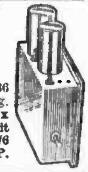
Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4¼ x 5½ x 1⅝in. Complete with circuit diagram. **35/-** plus 3/6 P. & P.



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Elegant Seven
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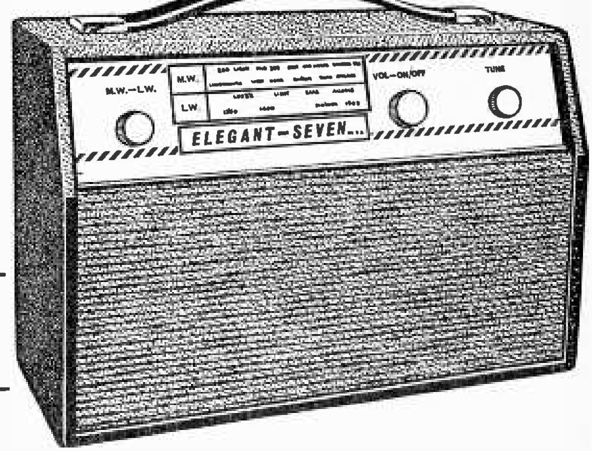

SPECIAL OFFER

7" x 4" P.M. Speaker at no extra charge

Buy yourself an easy to build 7 transistor radio and save at least **£10.0.0.** Now you can build this superb 7 transistor superhet radio for under **£4.10.0.** No one else can offer such a fantastic radio with so many de luxe star features.

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- ★ Parts list and circuit diagram 2s. 6d., free with parts.

ONLY **£4.4.0**

Plus 7/6 P. & P. Parts List and circuit diagram 2/6 FREE with parts.

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To purchasers of 'Elegant Seven' parts, incorporating mains transformer, rectifier and smoothing condenser, A.C. mains 200/250 volts. Output 9v 100mA. 7/6 extra.

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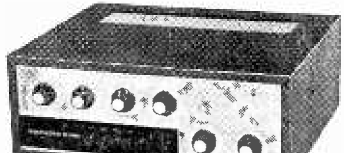

solid-state integrated Stereo amplifier

The most advanced design in brilliant new kit form—so simplified you can build it to professional standards without specialized knowledge and with simple tools.
Designed for kit builders from the beginning with a system of wiring that enables you to complete each solder joint as you proceed; nothing is soldered twice and there are no unfinished joints left waiting to overlook!
SULTAN performance is a natural result of superb design incorporating the most advanced full proved semi-conductors, and modular substage construction that permits searching quality control and precise matching at every stage of assembly. Particular attention has been given to the provision of all the additional input, output, and power take-off facilities ever likely to be required. The compact sized, craftsman finished teak cabinet and restrained styling ensures unobtrusive, harmonious matching with almost any decor.

Sultan kit of parts (less case) **£29.8.0** (Teak case only £3.3.0.) Carr. & Ins. 8/6

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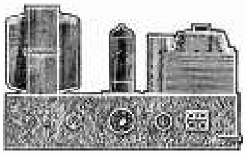

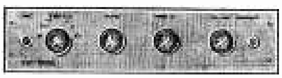

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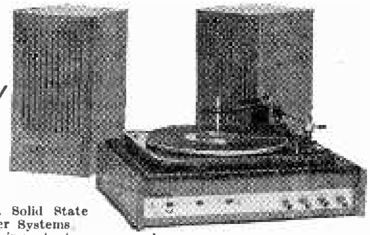

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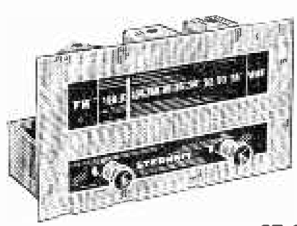

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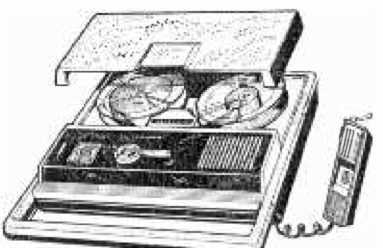

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PRACTICAL WIRELESS

VOL 43 No 2

issue 724

JUNE 1967

Clause 7—No person shall make equipment undesirable to Government if new Act becomes law.

AT first glance, the changes to the Wireless Telegraphy Act outlined in the recently published Bill appear to be a bold attempt to remedy some long outstanding ills. Strong measures are suggested for dealing with TV licence dodgers and evaders of car radio licences. But the section dealing with illegal radio transmitting merits a much closer investigation.

This journal has long campaigned for action to resolve the ludicrous situation whereby it is perfectly legal to import, offer for sale and buy 27Mc/s walkie talkies and yet impossible to use them without breaking the law. The Board of Trade, the GPO and radio dealers have for years shrugged off responsibility with some agility.

In the new Bill, the PMG introduces provisions presumably to deal with this situation and that of radio bugging devices. Presumably, we say, because in the potentially explosive Clause 7 it states that "where it appears to the PMG to be expedient", the provisions should "apply to wireless telegraphy apparatus of any class or description" and that "no persons shall manufacture any apparatus of that class or description whether or not for sale".

This loose phraseology could be interpreted to cover any form of radio apparatus deemed to be "undesirable" and amounts virtually to a blanket control over the manufacture, importation, sale and *construction* of radio equipment of any type which the Government considers undesirable.

We do not say that the PMG intends to use the sweeping powers implicit in the seven sub-sections of Clause 7, nor even that he has considered them in detail, but the fact remains that if this Bill becomes law as it stands, these powers will not only be available to the present administration but to all future PMGs.

In seeking to deal with specific problems the PMG has wielded a bludgeon. If classification is difficult it would have been better to isolate the real objectives by making it illegal to sell or buy *any* transmitting equipment except on the production of a suitable transmitting licence. This way, innocent bystanders would not get involved. Unless, of course, the PMG has more sinister motives.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

CONSTRUCTIONAL

GENERAL ARTICLES

JULY ISSUE WILL BE PUBLISHED ON JUNE 9th

Kits a success

During the past eight years I have built kits supplied by seven of your regular advertisers and I cannot fault one of them. In all cases the instructions were clear and easy to follow.

I think those who make claims that their kits can be built in an hour are not helping their own cause. Who wants to build a kit in an hour anyway? It is a hobby and how much better to make the interest last for a few days at least. There are sure to be setbacks, then out comes the test-meter and the interest is extended further.

Most early efforts fail because of poor soldering, through getting resistor values mixed up and switch and coil connections wrong.

I do not grudge the charge of 6d. per valve, bearing in mind the cost to the retailer of cartons, corrugated paper, packer's wages, etc. I would give a vote of thanks to the firms who send me good valves promptly, cheaply and beautifully packed.

P. J. Plater. Wallington, Surrey.

★ ★ ★

Mr. A. H. Brough of Staffordshire (P.W. May issue) will probably find that most firms specify P. & P., and packing involves corrugated card, cartons and often stout cardboard boxes, also employment of a packer and checker, all of which has to be paid for to ensure adequate protection in transit.

A. Deverell. Rickmansworth, Hertfordshire.

U.S. Citizens' Band

After reading the column "Amateur Bands" in the May 1967 issue, it appears to me that there is some confusion concerning Citizens' Band licences in the United States. As an American now living in England, perhaps I can straighten out the situation.

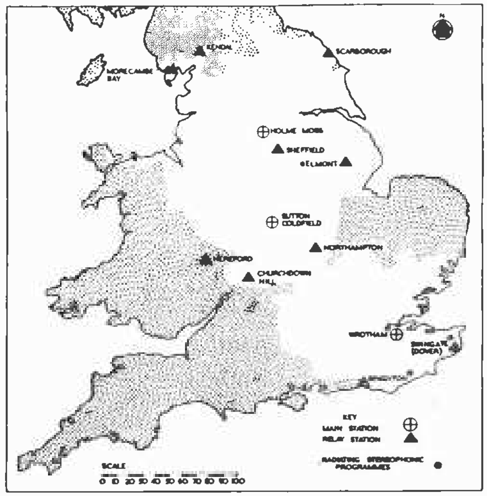
A Citizens' Band licence may be issued to any U.S. citizen over the age of 18 with no exam. required. A fee of $8.00 (£2 17s. 2d.) is charged, and the licence allows the bearer to transmit on the 27Mc/s band with a power not exceeding 5 watts. A callsign is assigned which usually consists of a three letter prefix followed by four numbers.

Any person, regardless of age, may use Citizen Band frequencies so long as the transmitter power does not exceed 100mW, and a vertical antenna of not more than 60 inches in length is used No callsigns are issued to these people, as they are not required to register with the Federal Communications Commission.

D. L. Potash. Ambleside, Westmorland.

NEWS AND..

VHF STEREO TRANSMISSIONS



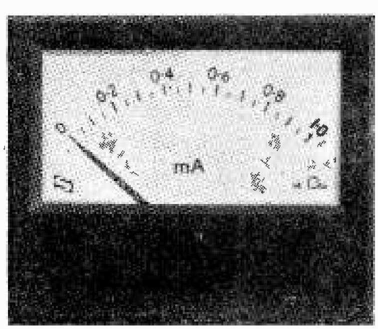
Work is in hand to extend the BBC stereophonic transmissions, at present radiated from Wrotham, Swingate and Brighton, to Sutton Coldfield and Holme Moss and certain relay stations fed from them, early in 1968. The unshaded part of the map indicates the areas in which satisfactory stereophonic reception should normally be obtained. In places where the field-strength is low, increased background noise may be heard on stereophonic programmes; improvements to the receiving aerial enable the noise level to be reduced.

ELECTRONICS CONFERENCE IN GREAT BRITAIN

A Technical Conference and Exhibition devoted to the engineers who build and produce electronic equipment will be held at Brighton in October 1968. This is the first such conference and exhibition ever to be held in this country or Europe.

Called NEP/CON-INTERNATIONAL it has for some time been held twice-yearly in the U.S., and will present a wide-ranging international technical programme. It will cover the most recently developed techniques such as printed circuitry, micro-miniaturisation, component and equipment manufacture etc. Talks will be given by leading engineers from the U.S., U.K. and Western Europe. Also there will be an exhibition where the latest components materials and machines will be on display.

SUB-MINIATURE METER



Sifam Electrical Instrument Co. Ltd., Woodland Road, Torquay, Devon, have introduced a new sub-miniature instrument in the "Director" series of moving-coil instruments.

The new "Director 14" is exceptionally compact, having an overall size of 1·92in. by 1·65in. with a scale length of 1·34in. It is flush mounting requiring a panel cutout of 1·5in. diameter.

The company emphasises that, despite its size, the instrument is a glazed-front, quality unit built to BS89: 1954 accuracies (i.e. ±2·5 per cent of full-scale deflection). The case is made from a special reinforced plastic with a matt black finish, resulting in an elegant yet highly practical case style, which blends well with modern equipment panels.

...COMMENT

PANEL LIGHTS TO ELECTRIC ORGANS

From Henry's Radio Ltd. comes the 1967 Electronic Components, Equipment and High Fidelity Catalogue. This edition—now over 200 pages—is more comprehensive than those published in previous years and includes details of many new items supplied by Henry's, including their Mayfair Portable Electronic Organ.

Included in this issue are five free discount vouchers which when used enable the customer to obtain 2s. in the pound discount. It is also interesting to note that further discounts are allowed for equipment in the Hi-Fi section of the catalogue.

The price of the catalogue is 7s. 6d. plus 1s. postage and copies may be obtained from Henry's Radio Ltd., 303 Edgware Road, London, W2.

PIRATES—ALL OR NOTHING

Discussing the Marine and Broadcasting (Offences) Bill in the House of Commons recently, Mr. Ian Gilmour unsuccessfully suggested that the Government should restrict the scope and impact of some offences covered by the Bill. He maintained there was no reason why penalties should be imposed on scriptwriters and others who provided material for the pirates. He had not, however any objection to imposing penalties on those who ran the pirate stations. Answering, the Postmaster General, Mr. Edward Short, said to omit the clause from the Bill would enable the pirates to continue receiving advertising revenue, records and tapes, etc., from which they made up their programmes and attracted an audience. It would make the legislation almost ineffective. Publication of information about future programmes of the pirate stations is to be prohibited.

The Bill had been carefully drafted, Mr. Short told the House, to catch only things which served as advertisements. References to past broadcasts would not be affected by the Bill but references to future broadcasts would be. Also anybody in this country giving assistance to the pirates will be liable when the Bill becomes an Act.

Referring to Clause 6 of the Bill (Penalties and Legal Proceedings) Mr. Short moved an amendment to increase the maximum penalty for unlicenced transmitting from £100 to £400. He maintained that £100 was nothing more than petty cash to a successful pirate broadcaster.

ELECTRIC EYE HELPS TO TUNE

From Philips comes a new four waveband portable costing 19½ guineas. Included in the features is an "electric eye" tuning guide which doubles up as a battery condition tester. Another feature is a separate battery cartridge holding four U11 batteries which is released from the radio at the touch of a button. Wavebands covered are long, medium, short and f.m. Output is 380mW, and a telescopic aerial is provided for reception on v.h.f. and s.w. Cabinet measures 9¾ x 5 x 1⅝in. and is finished in black polystyrene with silver grille.

New members wanted

I am writing on behalf of the Sheffield Amateur Radio Club which urgently needs new members. Anyone interested in any aspect of radio, especially amateur radio and short wave listening would be most welcome at any of our meetings. These are held every Friday evening at 8.00 p.m. at 8 Sandbeck Place, Sheffield 11.

Anyone requiring further information or details on how to reach the club H.Q. should contact me at the address below.

G. Watson. 25 Underwood Road, Woodseats, Sheffield 8, Yorkshire.

Well done Sirs

I am writing this letter to express admiration of two 60-year-old gentlemen whose letters appeared during 1965 stating that they had obtained their Amateur licences. These gentlemen fired my enthusiasm and I started to study for the RAE in October 1965 and passed in May 1966. I then started Morse practice and received my Pass slip recently.

I hope that this letter will encourage others, as I myself am 47 years of age. All study was done at home from library books and guidance obtained from the RSGB Radio Amateurs' Examination Manual and a study of five years' examination papers. The Morse code was also self-taught by means of an oscillator and a tape recorder.

F. Woolliscroft. Whitley Bay, Northumberland.

The spirit of readers

You printed a request in your "CQ" column for me in the May issue of this journal and within hours of PRACTICAL WIRELESS being on sale I had a satisfactory reply. In fact, someone personally brought around the "wanted" magazines and many other readers wrote to me.

I. Nicholls. Kilburn, London, N.W.6.

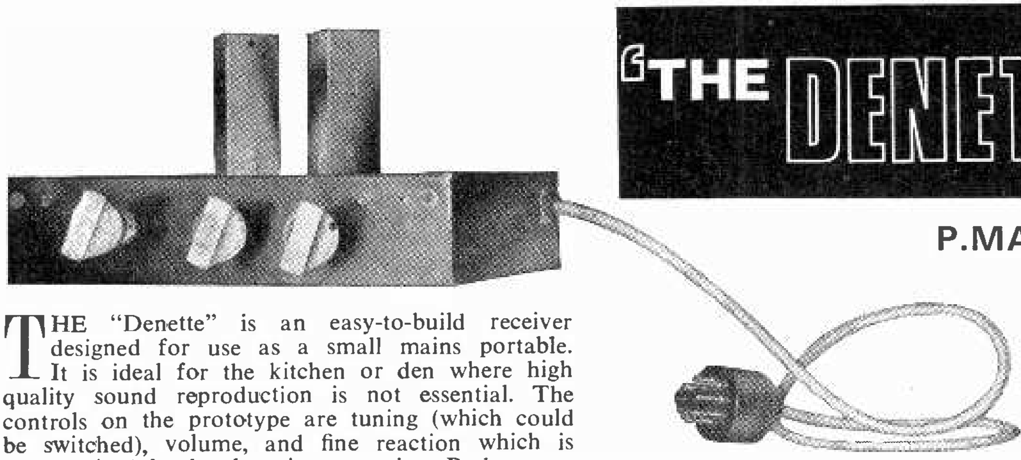
U.K. Police State?

I would like to bring to the attention of other readers that if the Government gets its own way on the amendments to the Wireless Telegraphy Act, we shall be told what we can build and what we cannot. This is very wrong and I suggest readers in agreement with me write to the P.M.G. personally — Edward Short, M.P., House of Commons.

C. Rolls. Highgate, London, N.6.

[*We are not very keen on the Government's proposals, for it covers virtually anything: see the Leader page for our views.*]—Editor

More News and Comment on Page 122



'THE DENETTE'

P.MATTHEWS

THE "Denette" is an easy-to-build receiver designed for use as a small mains portable. It is ideal for the kitchen or den where high quality sound reproduction is not essential. The controls on the prototype are tuning (which could be switched), volume, and fine reaction which is not required for local station reception. Both coarse reaction and tone are pre-set but could be brought out to separate controls on the front panel if desired. With a three foot piece of flex as an aerial the sensitivity is comparable to the average transistor portable, and in Northern Scotland the prototype receives Radio Luxembourg very well after dark.

The receiver contains very few components most of which are not critical, the circuit is thus ideal for experimentation. Both long and shortwave coverage can easily be added by the addition of suitable coils and a wavechange switch. This modification is described later in detail. Although two modern miniature valves are specified using B9A valveholders, the older octal-based types such as the 6SL7 and 6V6 should function equally well. If these older valves are used then the valvebases should be wired accordingly, since the pin connections are different to the B9A base wiring shown in the circuit and layout diagrams.

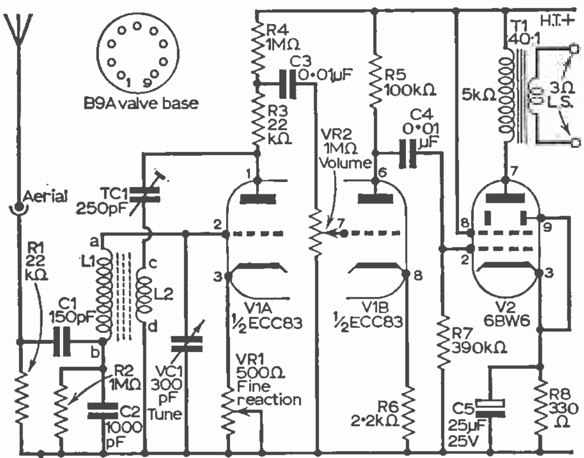
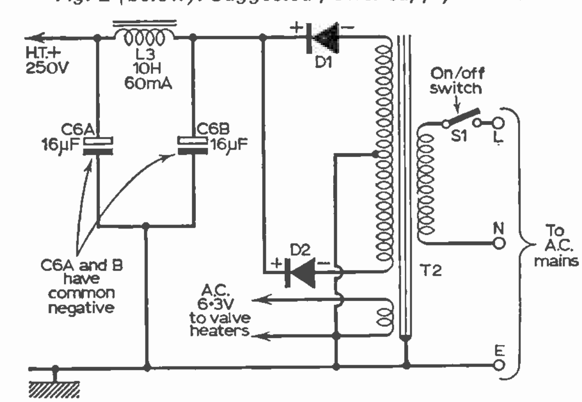


Fig. 1 (above): Circuit diagram of the Denette.

Fig. 2 (below): Suggested power supply circuit.



CIRCUIT DESCRIPTION

The two-valve circuit contains three stages—detector, a.f. amplifier and output. The power supply unit (p.s.u.) is built on a separate chassis which enables it to be used to power other equipment.

The regenerative detector (V1A) has unusual input circuitry. The signal from the aerial is fed to a capacitive potential divider consisting of C1/C2, through the tuning coil L1 to the grid of V1A. The d.c. continuity between grid and chassis is established by the grid leak R2, and resistor R1 is wired between aerial and earth to prevent a charge building up on the aerial. Feedback is effected by L2 and TC1, the fine control being made by adjustment of VR1. Note that TC1 is insulated from the chassis. Slight detuning is evident because VC1 is across the valve grid-to-cathode capacitance which alters slightly as the valve warms up. Detuning is also affected to some slight degree as the reaction is varied, but these effects are small and are thus ignored. The value of the anode load resistor R4 may be adjusted if regeneration cannot be readily obtained. Other methods of obtaining regeneration

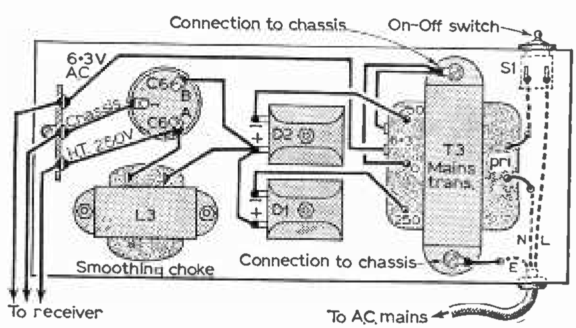


Fig. 3: Layout of the power supply shown in fig. 2.

are possible, however the method used works out very well. For those who like to experiment, the different "textbook" methods could be tried out.

From the junction of R3/R4 the detected signal passes via C3 and VR2 to the grid of the audio frequency (a.f.) amplifier V1B. This is an a.f. stage of conventional design other than the omission of the cathode by-pass capacitor usually wired in parallel with R6. In order to cut down the bass response when a miniature speaker is used, the cathode decoupling capacitor C5 may be reduced to 2μF. This will help prevent undue damage to the small speaker due to bass overloading. This step will not be necessary with the larger type of speaker. When using a small speaker, R8 could be increased to 1kΩ, this will limit the output and effect some economy.

POWER SUPPLY

The power unit is straightforward, using two contact-cooled metal rectifiers in a full-wave circuit. A valve, such as the EZ80, could be fitted in place of D1/D2, but this would require to be fed with 6·3 volts and would also contribute considerable heat. A double-wound mains transformer is strongly recommended and suitable types are readily obtainable from advertisers in this journal. It would be possible to make use of a miniature 220 volt 20/25mA mains transformer of the type used in tuners and preamps. In this case R8 should be increased to 1kΩ in order to reduce the current consumption.

MODIFICATIONS

Although the tuning capacitor VC1 gives satisfactory station separation on the medium and long wavebands, crowding occurs on the short waves. To combat this it is suggested that the s.w. band be split into two sections, and that the effective

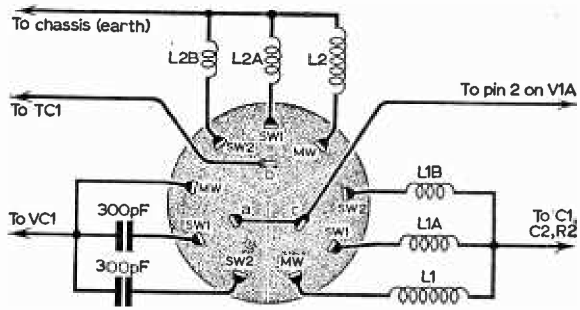


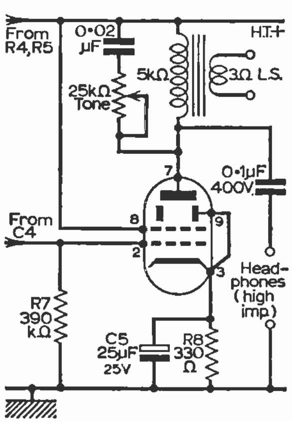
Fig. 6: Rear view of the wavechange switch for three-band coverage.

capacitance of VC1 be reduced. This latter suggestion can be easily performed by interposing a capacitor between VC1 and the junction of terminal *a* on L1, and pin 2 of V1A. By placing a fixed capacitor in series with VC1 in this way, the effective swing or tuning range of VC1 is restricted to a portion of the band. However, since this small portion of the band is now spread out over the entire 180° swing of VC1 instead of a few degrees, the stations received will be easier to tune. If the extra capacitor is made 300pF to start with, the constructor can experiment from there.

If band switching is required then a suggested method is shown in Fig. 6. As shown, the switch will give three-waveband coverage, the actual wavelenths covered depending on the coils used. Details for suitable coils are given later on.

Other worth-while modifications are a tone control and a socket for headphone reception. The simple top-cut control shown in Fig. 5 works well. The voltage rating of the capacitor between the anode and the headphone socket must be at least 1·5 times the nominal h.t. voltage. Do not fit a

Fig. 5 (below): Suggestions for the inclusion of a tone control, and for using headphones. It would be unwise to use a capacitor of less than 400V working in the phones lead to the anode of the valve.



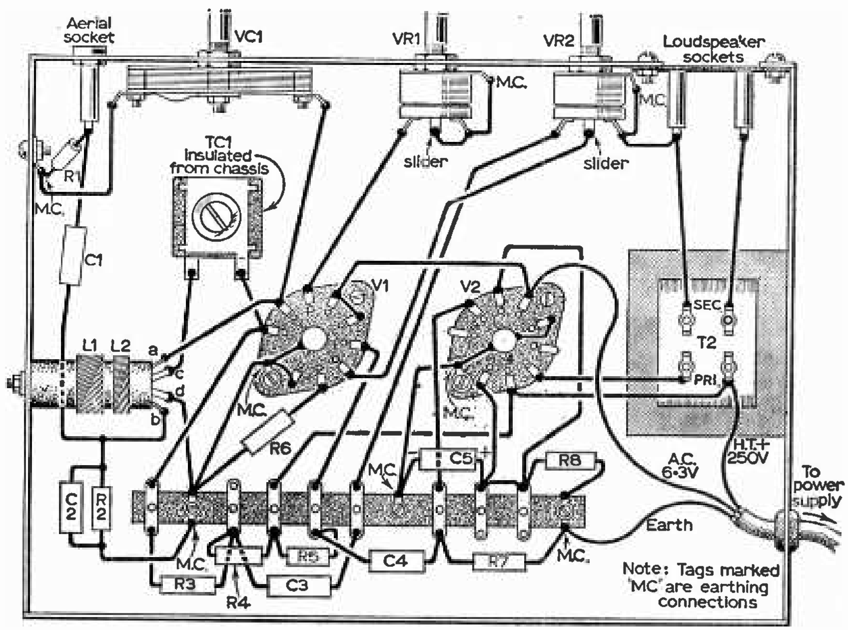


Fig. 4: Layout of components and wiring below chassis. Note that TC1 must be insulated from the chassis. This is essential for the circuit to function properly.

"normally closed" jack socket or this will short the signal to earth when the phones are removed.

CONSTRUCTION

The following procedure is recommended when all the parts, including the chassis have been obtained. Drill the chassis and mount all components securely. Wire up the power unit starting with the mains transformer. Wire the heaters of the valves with twisted leads and plug in both valves. After a careful check of the wiring switch on and note that the heaters inside the valves light up. If they do not, switch off immediately and re-check the wiring.

Switch off, unplug the valves and disconnect the power supply unit from the mains. Proceed with the wiring up of V2 starting with the output transformer working back to R7. Keep all leads as short as possible. Fit one end of C4 to pin 2 of V2

COIL	NO. OF TURNS	WAVEBAND
L1	45	MW
L2	5	
L1a	12	SW1
L2a	1–2	
L1b	5	SW2
L2b	1–2	

The table shows details of the coils. The type of wire and former diameter are mentioned in the text.

and temporarily solder a wire to the other end. After checking the wiring plug in V2 only, connect the loudspeaker and switch on. After the valve has warmed up there should be a slight hum from the speaker, this should increase as the wire on C4 is touched. There should be no whistling or clicking nor any instability. If the stage is functioning properly switch off, remove the wire from C4 and unplug the valve.

Wire up V1B and fit one end of C3 to the volume control VR2. Check the wiring and plug in both valves. Repeat the test for V2. As the wire from C3 is approached a loud hum should be heard. If all is satisfactory switch off, unplug the valves.

Wire up V1A taking every care to keep connections short and direct. Unscrew TC1 to minimum capacitance and set VR1 to maximum resistance. Now check all wiring very carefully as this last stage is more complex. Plug in the valves and the aerial (2 or 3 yards of flex), then switch on. There should be no howling or whistling, if there is reduce the coupling i.e. the distance between L1 and L2. If preferred the number of turns on L2 may be reduced instead. Now screw up TC1 to the point where howling or whistling just commences. Tune in a station, backing down VR1 until oscillation has just stopped. This is the most sensitive position for the set. Retune VC1 if necessary and set the volume control to a convenient level. Switch off taking care not to touch the h.t. line without first discharging the capacitors C6a and C6b to chassis. Check all components to ensure that there has been no overheating. The receiver may now be enclosed in its cabinet.

COILS

The medium wave coil on the prototype consisted of 45 turns of 22s.w.g. enamelled copper wire pile wound, with L2, five turns, wound over the top. The former was ½in. diameter fitted with an adjustable dust core. The former size is not critical except that the number of turns will need to be adjusted if the former is a different diameter to that specified. A long wave coil would require 140 turns for L1 and around 13 turns for L2. For short wave coverage less turns will be needed and if the wire used is thick enough no former will be required since the turns can be self-supporting. If the diameter is about one inch and the wire 16-20s.w.g. then between 5-12 turns for L1 and 1 or 2 turns for L2 will give coverage of 19-49 metres. These turns should be wound side by side on the same axis. ■

★ components list

Resistors:
R1 22kΩ
R2 1MΩ
R3 22kΩ
R4 1MΩ ½ watt
R5 100kΩ
R6 2·2kΩ 10%
R7 390kΩ
R8 330Ω

Capacitors:
C1 150pF
C2 1000pF
C3 0·01μF
C4 0·01μF
C5 25μF 25V
C6A, C6B 16+16μF (C5, C6A, C6B electrolytics)
TC1 250pF compression trimmer
VC1 300pF variable, solid dielectric

Valves:
V1 ECC83
V2 6BW6

Diodes:
D1, D2 Contact-cooled metal rectifiers 250V 60mA

Potentiometers:
VR1 500Ω
VR2 1MΩ

Inductors:
L1, L2 see text
L3 L.F. Choke 10H 60mA
T1 Output transformer ratio 40:1 suitable for mains pentode.
T2 Mains transformer 250-0-250V 60mA, 6·3V 3A.

Miscellaneous:
Two B9A valveholders, tagstrip, ½in. coil former, chassis, nuts, bolts, solder, wire, 1 Pole 2 Way on/off switch, wire for coils.

COMPONENTS FOR MODIFICATIONS

Tone Control:
25kΩ potentiometer
0·02μF capacitor

Headphone Reception:
Normally open jack socket
0·1μF 400V capacitor

Wavechange:
3 Pole 3 Way rotary switch, Extra coil formers, Wire for coils, Two 300pF capacitors

KEYING THE TEN-FIVE TX

by A.S.Carpenter
G3TYJ

Double the usefulness of the neat little rig described in the January, 1967 issue

DURING the time this transmitter has been on the air many pleasing and surprising reports have been received on both "Top Band" and "80" metres running but 9W and working into a G5RV multi-band dipole antenna at 28ft. through a Z-match coupling unit. In all fairness, however, it should be stated that results and reports do depend to a great extent on band conditions at any given time. The modest power available can hardly be expected to combat or flatten heavy QRM often prevalent—particularly at week-ends—but under fair conditions the transmitter performs surprisingly well and enables one to enjoy many interesting QSO's.

As originally described the transmitter is a phone rig (A3 emission) only, suitable for Fixed station or /M working, but the versatility can be increased beneficially to include keying thus enabling the user to work c.w. (A1 emission) when necessary.

It is not difficult to include keying facilities in the transmitter; only small changes are required which consist of fitting a voltage stabiliser to the v.f.o. section, adding a suitable key jack socket and adding a switch to disable the modulator.

Modifications

Fitting a voltage stabiliser. The inclusion of a type OA2 voltage stabiliser tube to the v.f.o. is obligatory but necessary if "chirp" is to be avoided; chirp is most likely to be found when the transmitter is working "straight through", viz. on "Top Band". The stabiliser chosen has a B7G base and a holder can be fitted between the v.f.o. valve proper and the front panel.

Theoretically, it would seem sufficient to apply a stabilised voltage to the triode section of the ECF80 valve only and this may be tried by connecting the stabiliser to point "Y" of the original circuit. In practice however, it has been found most beneficial to include both sections of the valve.

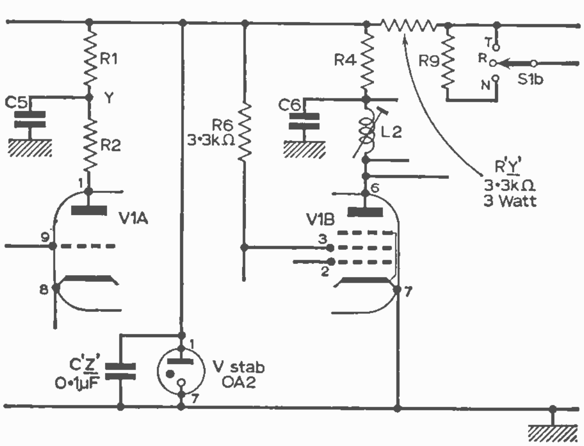


Fig. 1: Skeleton circuity showing position of extra stabilising components.

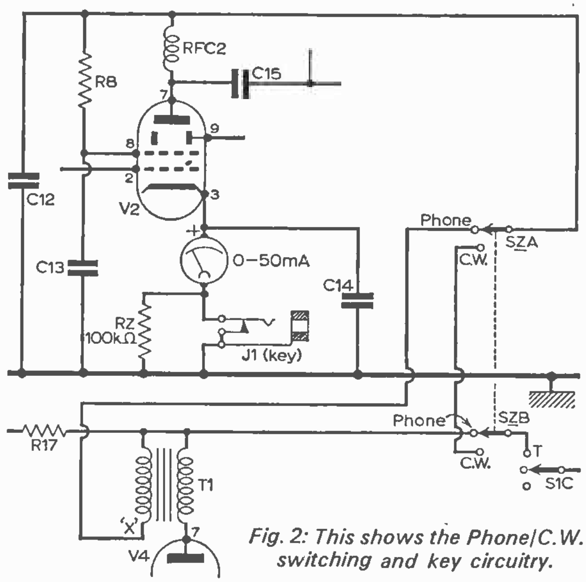


Fig. 2: This shows the Phone/C.W. switching and key circuitry.

The modified "bare bones" circuitry is given here in Fig. 1 and as may be seen three additional components are needed, viz. Ry—3·3kΩ, Cz—0·1µF and Vstab. Drive is diminished slightly when these items are added but 1mA is available and this is adequate.

Adding a key jack socket. By re-positioning the panel lamp and lens, a standard normally closed-circuit type jack socket may be fitted in the vacated hole. It should be connected between the negative terminal of the 0-50mA meter and the chassis; a 100kΩ fixed resistor is also connected across the key jack sockets.

Disabling the internal modulator. Since the internal modulator is not required for c.w. working an additional switch is needed. Referring to Fig. 2 the added switch, SZA/B, and its connections may be seen; the key jack socket and its resistor are also shown. Other items are identical with the original circuitry with the exception that R6 is reduced in value to 3·3kΩ.

Switch SZ is a DPDT toggle-type item and is easily located at the rear of the chassis above socket Sk4; it may be mounted on a small L-shaped aluminium bracket.

Provided that all wiring is correct lift the connection from pin 7 of the OA2 voltage regulator clear of the chassis and insert a testmeter set to read 0-50mA in series with the stabiliser. Switch to

—continued on page 146

SOME IMPRESSIONS OF THE 1967 INTERNATIONAL AUDIO FESTIVAL AND FAIR AT THE HOTEL RUSSELL, LONDON, MARCH 30 TO APRIL 2, AS SEEN BY THE P.W. TEAM.

Spread among the exhibition stands and hotel rooms were the static displays and live demonstrations of 96 exhibitors, an Aladdin's Cave for the audiophile. Readers familiar with the hustle and bustle of the Fair will appreciate the difficulty in seeing everything in the time available. The following notes are not intended as a comprehensive survey, but mainly impressions on trends.

Amplifiers, Tuners and Stereo

IN this field the steady migration towards semiconductors continues. Some years ago, H. J. Leak, in his presidential address to the B.S.R.A. observed, that for power outputs of up to 15 watts per channel the valve could no longer compete with the transistor. At the Fair, transistor amplifiers in the hi-fi class were commonly offered with outputs of up to 110 watts, and although it is difficult to appreciate listening to this output in the average living room, it does indicate the advances in transistors. Most manufacturers were not content to state that the equipment was "fully transistorised" but plugged that they were silicon types. So it looks like the trend this year for amplifier enthusiasts is to acquire a "Silicon Solid Status".

The complexity of the units seems to grow each year. One can remember not so long ago being content witht volume, treble and bass. Now one sees miniature Jodrell Bank-type front panels with Low-filter; High-filter; Equalisation; Input selector; Balance; Stereo reverse (should be interesting); Stereo left; Stereo right; Stereo left + right etc.

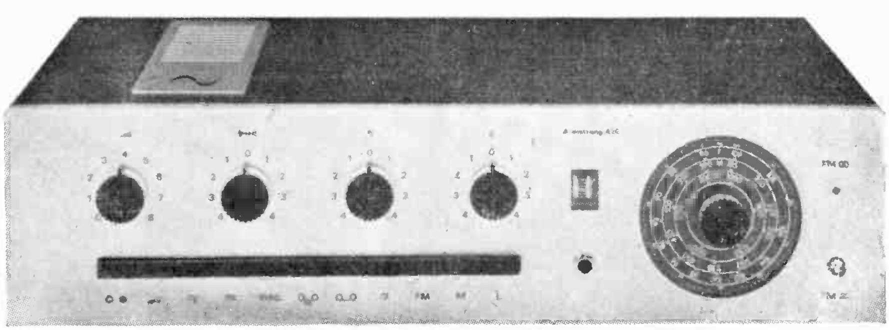
Stereo was very much in evidence and mostly solid state. The trend here was split right down the middle as regards units. Some were complete with amplifier, preamp and both speakers all in one package. Others had one or both speakers floating. Many speakers and indeed amplifiers were of the "bookshelf" type, usually in a matt wood. Listening to "Uranus" from the Planet Suite on stereo with large enclosures some 3ft. cube, and then on a couple of the small twelve inch bookshelf cabinets gave a vivid demonstration of the efficiency of the smaller units. They did lack the roundness in the bass, but the reproduction nevertheless was exceptionally good.

Prices varied, but on the whole were high, some very high. Perhaps the common-sense way in buying would be to say—if I'm satisfied with the performance of cheaper equipment then it's pointless to spend more, but if I want the ultimate in quality and my ears can appreciate the difference, then I will pay for quality.

All things considered there was nothing really startling at this year's Audio Fair. Most of the units on show are already displayed in the dealers' windows and have been for some time. Summing it all up: Transistors now outnumbered valves. Stereo is becoming commonplace and trends indicate that before long it could well be stereo only, since the units can receive and/or play mono too. Prices are high but then so is performance, and there are more knobs to twiddle. Bookshelf units are advancing with the advance in the frequency response of smaller speakers.

Perhaps next year we will have vest pocket stereo, but we wonder how they'll fit all those controls in!

The Armstrong 426 is an example of the growing complexity of audio units and the tendency towards "integration".



Tape Recorders

New trends this year in the tape recorder field were hard to find. The most noticeable was that more machines were making use of cassette loading. Also, we noticed fewer low-priced machines and more with comprehensive mixing and dubbing facilities. More are becoming available for vertical operation.

Philips, who pioneered the cassette-loading recorder market in the UK, released another battery-operated machine at the show—the EL 3302. Similar to its predecessors, it has almost double the audio output at 400mW, and an external loudspeaker socket. The price remains 27gns. Also from Philips come two mains-operated cassette-loading tape recorders—one stereo and one mono.

The range of Philips pre-recorded "Musicassettes" can be used on all of their cassette-loaded machines, and there are over 100 different mono/stereo Musicassettes available from the repertoires of EMI, Philips and Pye records.

Grundig's latest cassette-loading tape recorder, the C110, is also a mains-operated machine. Although it measures only 13$\frac{7}{8}$ x 9 x 4$\frac{5}{8}$in., it has a two-watt push-pull amplifier and seven-inch eliptical speaker. Using the half-track recording system, it has a recording and play-back time (for DC90 tape) of approximately 1$\frac{1}{2}$ hours. The technical specification gives a wow and flutter figure of better than ± 0·4%, a frequency range of 50c/s to 10kc/s, and a signal-to-noise ratio of better than 45dB. Grundig claim this machine to be virtually foolproof —click-in cassette loading, simple press-button controls, a green light to indicate the machine is switched on and a red warning light when the recording button is depressed. The price is 48gns.

Most of the four-track machines shown this year have comprehensive mixing facilities, permitting one to record on one channel while listening to the other. To permit this, three tape heads and independent and play-back amplifiers are necessary. An example is the Truvox R104 at 89gns. This machine, which has been on the market for some time now, has the facility aptly labelled *duo-play*.

The *Fidela* range of four-track tape desks and recorders from the Waltham Electronics Company of Geneva (handled in this country by Denham and Morley Ltd.) attracted a lot of attention for they were on show for the first time in this country. All of these are suitable for vertical or horizontal operation. The recorders have solid-state amplifiers and attractive specifications along with appropriate price tags—75 and 138gns. The tape decks are also expensive; Model 707 costs 119gns, but it comes complete with separate record and play-back amplifiers having a 30c/s to 22kc/s frequency response. The other deck, Model 780 at 145gns. also features adjustable bias for optimum performance with different types of tape.

Among the Telefunken exhibits were the Magnetophon 200 series of vertical and horizontal recorders. The 204E is a two-speed (3$\frac{3}{4}$ and 7$\frac{1}{2}$in.) stereo machine with a frequency range extending up to 18kc/s on the higher speed. This 106gn. machine has comprehensive mixing facilities.

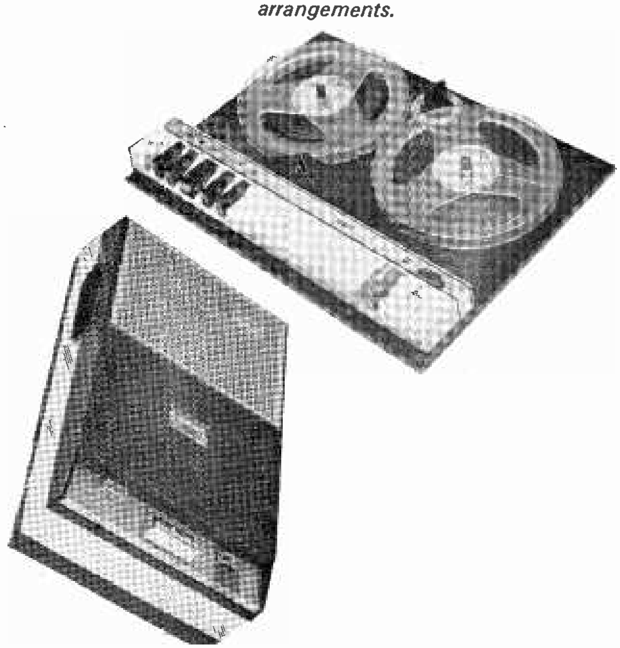
Another semi-professional performance/stereo machine is the Tandberg Series 6x. This 'x' series is similar to earlier models, but incorporate an additional bias head, improved frequency response and

One of the Fidela vertical tape recorders shown for the first time at the Audio Fair.

signal-to-noise ratio—within 2dB from 20c/s to 25kc/s and a 62dB signal-to-noise figure on the fastest speed of 7$\frac{1}{2}$in./sec. Wow is less than 0·1% and crosstalk rejection is better than 60dB. Two and four-track recorders using this deck are offered at 115gns.

The newest model in the Uher range of professional recorders is the 1000 Report Pilot. With this machine, one can synchronise sound with film as well as reporting under professional conditions. Features of this £243 portable recorder include

Latest in the range of BSR popular tape decks—The TD20, available with a wide range of stereo or mono head arrangements.



One of the growing range of cassette tape recorders—the new Philips Model EL3302.

stroboscopic tape speed control and switchable equalisation. It has only one tape speed—7½in./sec.

BSR's latest three-speed tape deck, the TD20, introduced at the end of last year, was prominently displayed. It is available in both stereo and mono versions with two or four-track heads. The control linkage has been improved and only requires the lightest pressure to operate the direct-action keys. Wow and flutter is claimed to be better than 0·15% on 7½in./sec., 0·25% on 3¾in./sec., and better than 0·35% on 1⅞in./sec. It will take up to seven-inch reels and there is provision for a third head.

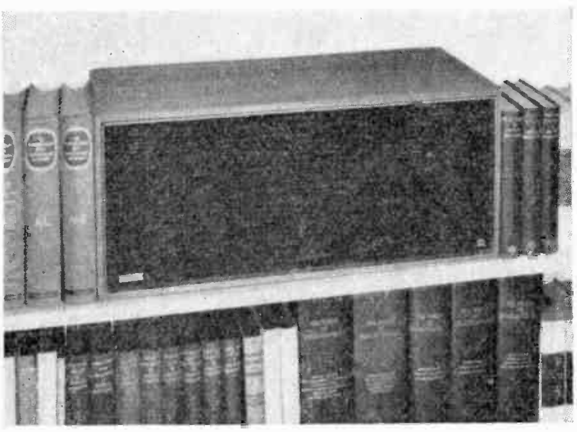
Tape Recorder Developments Ltd., who announced their first tape deck just over a year ago had on show seven variations of their TRD 1 deck, and silicon semiconductor electronic units to complete a hi-fi system—with any of the deck variations. As an indication to the type of deck, the wow and flutter specification is as follows: 0·04% at 30in./sec.; 0·05% at 15in./sec.; 0·08% at 7½in./sec.; 0·13% at 3¾in./sec.; 0·2% at 1⅞in./sec.; and 0·35% at 15/16in./sec.

Tape Recorder Spares Limited had their usual wide range of pre-packed leads, plugs and accessories. Often it is not realised that this company deals with more than tape recorder accessories. In fact, they have a very wide range of connectors that could well solve many problems of the hi-fi and audio enthusiasts.

Microphones and Pickups

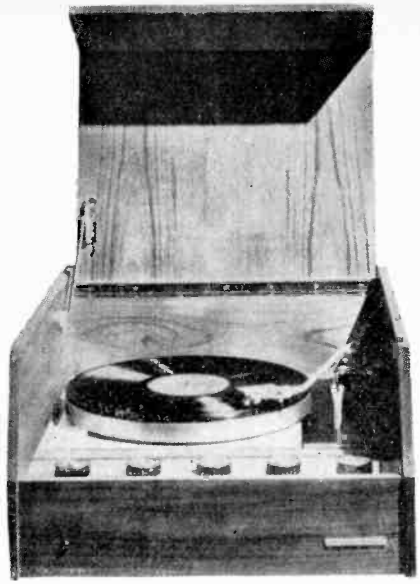
It is a very far cry from the carbon granules of yesteryear to the array of sophisticated microphones now available on the market; microphones of range and diversity to meet all requirements and depths of pocket.

One of the new developments noted at the Fair was a dynamic unit by AKG which combines two moving coil capsules, one covering high frequencies, one covering low frequencies. Philips also had a unit with two moving coil units; this was a stereo type (Model EL179) in which the two m.c. units are detachable.



A trend in speaker enclosures—the Celestion Ditton *3-element 15-watt system for bookshelf mounting.*

Another interesting model was the Sennheiser unit which combines the directional properties of the gun microphone and the high performance of a condenser (or should we say capacitor?) microphone. It is in fact, a transistorised r.f. condenser type.



Parmeko stereo record reproducer incorporating the latest in pickups—the Miniconic transistor cartridge.

It is impossible in this space to detail the many mentionable microphones on show, but those which attracted our attention included the new series of subminiature ribbon units by Lustraphone, the new Unisphere models by Shure which are based on the Unidyne dynamic cardioid type, the three new dynamic models from M.B. Mikrofonbau and the latest high-quality cardioid microphone from STC —who also showed for the first time the 4119 hyper-cardioid ribbon microphone.

Pickups, cartridges and gramophone decks, as to be expected, showed a general tendency to higher efficiency and slicker presentation. The most unusual exhibit was the new semiconductor stereo pickup introduced by Miniconic.

Insensitive to hum fields and turntable noise, the pickup is claimed to have a power output 40dB greater than a magnetic cartridge, 20dB greater than a ceramic cartridge. It functions by modulating the flow of d.c. provided by the amplifier power supply through a semiconductor strain gauge element (the resistance of which varies as the stylus is flexed) to produce signal current variations. In other words, energy is provided by an external source and not, as conventionally, by the record groove.The makers claim a frequency response of an octave below and two octaves above audible range, reduced record wear and chatter, a cleaner signal with increased dynamic range. The first British stereo equipment to incorporate this revolutionary pickup is the System 22 system marketed by Parmeko.

Also new at the Fair was the range of moving magnet stereo cartridges by Audio Technica, the new Studio 1000 range of amplifiers, tuners and speaker units by Braun and the *ffss* Mark 4 heads and cartridges by Decca. Focus of interest on the Garrard stand was their new Model 50 automatic turntable unit which incorporates pause and cue control, tubular pickup arm and calibrated force adjustment. ■

repairing radio sets

PART 3

GORDON J. KING

Having heard from H. W. Hellyer (last month) on the use and choice of tools and service equipment we now continue with fault symptoms in the "electronics" of the animal and thence to their diagnosis.

Part 1 investigated the first two or three stages of a typical valved receiver. These stages collectively are often referred to as front ends, being composed of r.f. amplifier (if the set has one), mixer and local oscillater. Modern a.m./f.m. sets have two front-ends, one for medium-frequency (and possible short-wave) a.m. and another for v.h.f./f.m.

FRONT-END NORMAL

Assuming that first tests failed to reveal any conclusive defect in the front-end, we can conclude that the mixer, or that section of the frequency changer, is delivering off-the-air signals converted to i.f. as they are tuned in by the set's dial. Something, then, is preventing these signals from reaching the detector and later stages. That is, assuming the symptom is the easy one of "no signals" or "set dead".

The best plan under these circumstances is to apply a modulated signal at the set's i.f. to the input of the first i.f. amplifier. A straightforward valved set usually has a single i.f. amplifier stage, a typical circuit being shown in Fig. 3—1.

Here the control (first) grid of the i.f. amplifier valve receives an i.f. signal from the secondary winding of the first i.f. transformer, whose primary

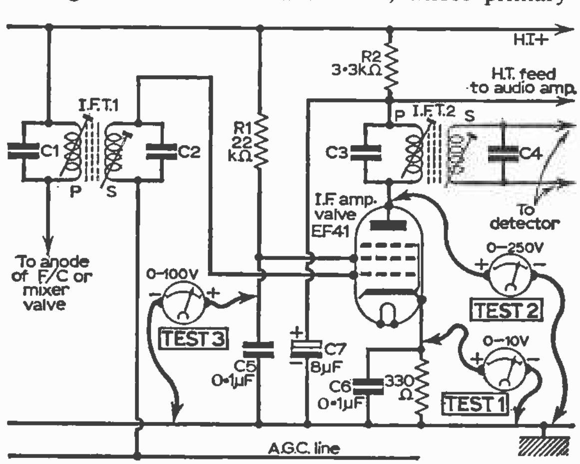
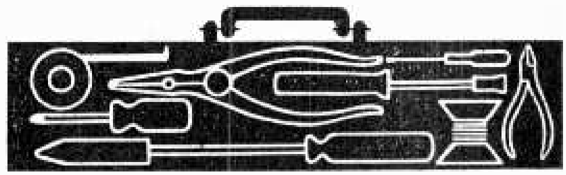


Fig. 3—1: Typical a.m.-only i.f. stage, showing three prime tests.



is loaded into the anode circuit of the mixer or frequency-changer valve. It should be understood that the nature of this testing for a "dead set" starts at the aerial input, works through to the frequency-changer, checks the local oscillator (as in Part 1) and then goes on to the i.f. stages, commencing at the input of the first i.f. amplifier valve (Fig. 3—1).

Assume that we have a signal generator and tune it to the set's i.f. (recent models 470kc/s, earlier models 465kc/s), then switch on the audio modulation and apply the signal to the control grid of the first i.f. valve. Signal continuity from this grid to the loudspeaker should give a modulated tone output. If there is no response the next move is to check the i.f. stage up to the detector input. If discontinuity remains, then the trouble is either in the detector or audio stages (to be considered in Part 5).

Useful first-action tests are (i) check that the i.f. valve heater is alight (change valve and/or check heater supply circuit if not) (ii) check the valve envelope for temperature with a hand (a "cold" valve—with heater alight—could indicate lack of anode and screen grid current) and (iii) try tapping the valve with the set running to establish the possible presence of internal inter-electrode shorts or open-circuits.

BASIC D.C. TEST

If these tests give no clues to the fault, a more scientific approach will be necessary. A good test for valve emission is to measure the voltage across the cathode resistor **(see Test 1).** A valve normally operating will yield about 2·2 volts d.c. across this resistor. A test voltage appears because the sum of the anode and screen-grid current passes through the cathode resistor, and this develops a voltage drop across it of magnitude depending (a) on the value of the resistor and (b) on the current value.

It is easy to find the cathode current (in mA) by dividing the voltage measured (in volts) by the value of resistance in kilohms (thousands of ohms). For example, 4 volts measured across 500Ω (0·5kΩ) signifies a current of 8mA.

If this first basic or "key" test indicates cathode current, we are sure that: (i) the valve has emission, (ii) its heater is aglow, (iii) the valve has both anode and screen grid voltage and (iv) the general d.c. conditions of the stage are reasonable—if not normal. A more exacting indication on the d.c. conditions can be obtained from a knowledge of the anode and screen grid (i.e., cathode) current of the valve in the circuit. Such operating parameters are usually given in the service sheet, manual, or valve data book.

Abnormally low cathode current could mean (a) low emission valve, (b) low screen grid voltage, (c) low anode voltage or (d) reduced heater current. (This is often overlooked.)

To establish (a), **Tests 2 and 3** (see Fig. 3—1) would be made, and if the anode and screen grid voltages are reasonable (refer to service sheet, if possible), check the valve either by substitution (often the best way) or with a valvetester. Typical values are *anode 225 volts* and *screen grid 100 volts*.

So far we have established that the i.f. signal cannot be passed through the set from the control grid of the i.f. amplifier valve and, assuming Tests 1, 2 and 3 to be positive, that the d.c. conditions of the stage are reasonable.

There is a remote chance that the valve has some internal short or open-circuit which is failing to affect the d.c. conditions yet preventing the passage of signal. A sharp tap on the envelope of the valve with a screwdriver handle may prove something here; but valve substitution is much more conclusive a test in a case like this.

Some enthusiasts may not possess a signal generator or other equipment, yet may wish to try their hands at radio repairs. Where possible, therefore, suggestions based on instrument-less testing will be included. One instrument, however, is indispensable and that is a good quality multirange testmeter with a d.c. sensitivity not less that 10,000 ohms/volt (bearing in mind that low voltage and current readings may have to be made in transistor equipment).

Signal continuity in the i.f. stage can sometimes be proved by connecting an aerial to the control grid. This should pick up random signals in the i.f. band and reproduce them in the loudspeaker. Another dodge is connecting the contact points of a low-voltage electric buzzer between chassis and the control grid via a 100pF capacitor. The impulsive "signal" produced by the working buzzer contains many harmonic components well into the i.f. band, and signal continuity is revealed by a harsh buzz in the speaker. This, of course, also proves the detector and audio stages at the same time. Special transistor, pulse generating signal continuity test instruments are also available commercially, but there is nothing to beat a good modulated signal generator.

I.F. stage continuity can also be vaguely assessed by rubbing the tip of a screwdriver blade on the control grid pin of the i.f. valve while holding a finger in contact with the metal blade. Good response in the i.f. channel is then indicated by fairly loud crackles from the speaker when the test is performed.

DYNAMIC TROUBLE

We now assume that the d.c. conditions are normal, yet the signal fails to pass through the stage. This is often called "dynamic trouble", signal rather than d.c. A prime factor here is misalignment of the i.f. transformers. These are best checked—and aligned—by a modulated signal generator, as explained in Part 1 (April issue).

It will be recalled that the signal is applied to the signal grid of the frequency-changer valve (at fairly high level if the circuits are well out of alignment) and then the *second* and first i.f. transformers adjusted—secondary and then primary—aiming for maximum output at the detector or audio stage.

ALIGNING THE I.F.'s WITHOUT INSTRUMENTS

It is possible to align the i.f's. without a signal generator, assuming that the front-end circuits are in alignment. The technique is first to bring the i.f. windings to exactly the same frequency, irrespective of the *actual* frequency. This can be done by "clicking" the screwdriver blade on the frequency-changer signal grid or by the use of a buzzer (as already explained) or other pulse-type harmonic generator and adjusting the i.f. trimmers or cores, one after the other, until maximum output is attained. The circuits will all be tuned to the *same* frequency, not necessarily the *correct* one.

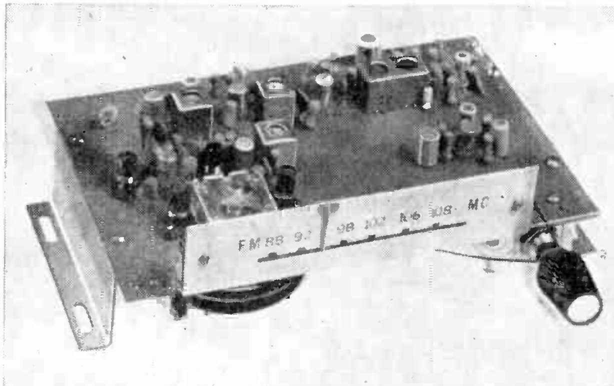
Next, apply an aerial signal with the set tuned to the longwave Light Programme. Since the i.f's. will most likely not be tuned to their correct frequency, the Light Programme will come in well off tune and possibly weakly, so full volume setting must be used.

The i.f's. can then be tuned nearer to the correct frequency by adjusting the main tuning so that the Light Programme can still be heard yet may still be off tune although closer to the actual 1,500 metre mark on the dial. The i.f's. should again be peaked in turn for maximum signal output and the process repeated until the i.f's. can be peaked with the tuning spot-on the station setting on the main dial. The i.f's. should then be in fairly reasonable alignment.

A dynamic fault can exist due to a short-circuit across one (or more) of the i.f. transformer windings. Note that an open-circuit, at least in the primary, would be brought to light by the d.c. testing earlier described. Typical trouble is a short across a trimmer (if used) or fixed parallel tuning capacitor (i.e., C1/2/3/4 in Fig. 3—1). A short can also occur across an internal tag panel, and such possibilities can only be examined by taking the screening can from the transformer. Incidentally, an open-circuit capacitor across a winding will be revealed during the alignment process by that particular tuned circuit failing to peak at the correct frequency.

If tuning is by a trimmer capacitor, the tendency towards maximum output will occur with the trimmer fully compressed (assuming that there is also a fixed trimmer), while if tuning is by dust-iron slug, the slug will be fully in the core and still not tuning the winding properly. Incorrect i.f. ★2 alignment aggravates adjacent channel interference effects, and these will be recognised from Symptom 2 on the record issued free with the April issue.

A fault typical of i.f. transformers is intermittency in the winding(s) or parallel capacitor. The primary winding (carrying h.t. current) is the one that often goes down in this way, but on some transformers leakage between primary and secondary is possible. Symptom 5 on the record typifies the noises ★5 that can be expected from this trouble. To see whether the fault is in the first or second i.f. transformer, the control grid of the i.f. valve



FMT.41 Transistorised FM Tuner

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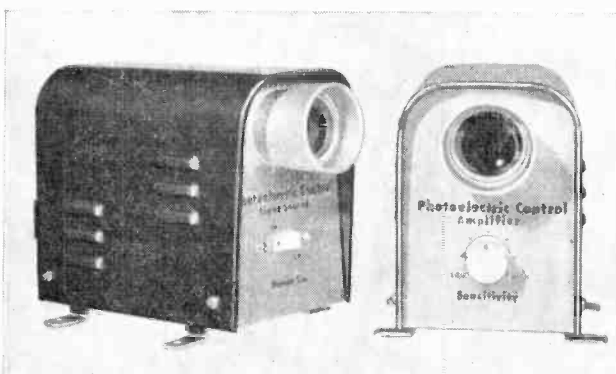

PEA.400. Photo Electric Relay System

EAGLE products

The "Eagle" Brand was launched 10 years ago. It was impossible to foresee that in such a short time the range would grow to cover over 500 items, all carrying the "Eagle" name. Whether you are interested in Hi-Fi, Amateur Radio, Do-it-Yourself projects or any field of Electronics, "Eagle" offer you the widest choice of sensibly priced products and by the end of the year we plan to increase our range to cover the formidable total of 700 items.

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can be shorted direct to chassis. If the symptom persists, it is definitely not in the first i.f. transformer or in the front-end sections.

It may be a good idea to short out the secondary of the second i.f. transformer at this juncture to prove the audio section. If the noise effects cease, then the second i.f. transformer is almost certainly responsible. If they persist, the audio stages should be investigated (dealt with in Part 5).

If intermittency in the primary winding is responsible, it is often possible to "see" this in terms of a flickering pointer when the voltmeter is connected as for Test 2.

I.F. INSTABILITY

Oscillation in an i.f. stage can be brought about by incorrect i.f. alignment. Some sets are sensitive when the windings are peaked, and if they are the ★1 amplifier could change into an oscillator and produce the effect of Symptom 1 on the record. This kind of set requires so-called stagger-tuning in which one winding is detuned relative to the other on each transformer, but not sufficiently to reduce the sensitivity or to encourage adjacent channel interference.

Instability can also result from a bad valve (old valves with sprayed-on gold-coloured conductive coating were troublesome in this respect, but there are very few of these about now!) and from an open-circuit screen grid capacitor (C5 in Fig. 3—1).

An open-circuit in the cathode bypass capacitor (C6 in Fig. 3—1) will usually result in reduced sensitivity rather than instability owing to negative feedback effects. A set with an electrolytic in position C7 in the circuit could also go low-gain due to its open-circuit.

Other troubles that occur in the i.f. stage are (a) noise (Symptom 5) due to badly seating valves and/or dirty valve pins and faulty sockets, (b) burn- ★5 ing resistors due to a shorting bypass capacitor (i.e., R1 would overheat due to C5 shorting, or R2 due to C7 shorting), (c) overloading due to ★4 an a.g.c. fault (Symptom 4) to be considered later and (d) intermittent operation due to a badly soldered connection, bad valve and poor connection of valve pins with its holder sockets. Valve bad seating can often be brought to light by wriggling the valve in its holder while the set is running.

A.M./F.M. I.F. STAGE

All that has so far been said applies equally to the i.f. stage employed in a.m./f.m. sets. From Part 1 it will be recalled that sets of this mode employ two i.f. transformers in series, one tuned to 470kc/s for a.m. and the other to 10·7Mc/s for f.m.

An i.f. stage typical in this respect is shown in Fig. 3—2. This shows that the basic d.c. parts of the circuit are almost identical to those in Fig. 3—1. The valve is a more modern version since it has to provide reasonable gain at 10·7Mc/s as well as at 470kc/s, and the voltages to be expected on a valve of this kind are shown on the diagram. Alignment of the a.m. transformers is performed first, and these then present the correct impedance to the much higher frequency f.m. transformers, allowing their subsequent alignment.

The control grid of the valve is fed from the secondary windings of the first set of i.f. transformers (which are also in series with each other), and in some sets there is a switch to short out the primary of the first f.m. transformer when the set is set to a.m. working.

It may be remembered from Part 1 that on f.m. the a.m. mixer section of this kind of set works as an additional i.f. amplifier with the local oscillator section switched off. This gives another f.m. transformer, which is usually located in the v.h.f. tuner section (f.m. front-end).

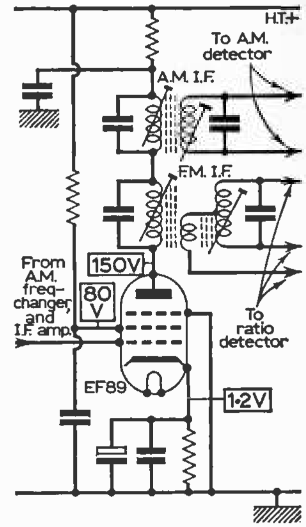

Fig. 3-2: This kind of i.f. stage is found in a.m./f.m. receivers.

Dynamic testing through this dual-type of i.f. amplifier follows the practices already described, and the fact that the circuit is normally responsive to two widely differing i.f. signals means that failure of one channel only cannot be caused by a valve fault or incorrect d.c. conditions. The reason is often related to misalignment of the affected channel or trouble in the appropriate i.f. transformer section.

DETECTOR AND A.G.C.

Now let us look at the detectors, starting with a.m. circuits. A detector a.g.c. circuit in common use is shown in Fig. 3—3. This employs a double diode-triode valve, but only the two diodes interest us at this time; the triode is used in the audio stages and will be considered in Part 5.

The detector is nothing more complex than a diode connected in series with the secondary winding of the second i.f. transformer, along with its

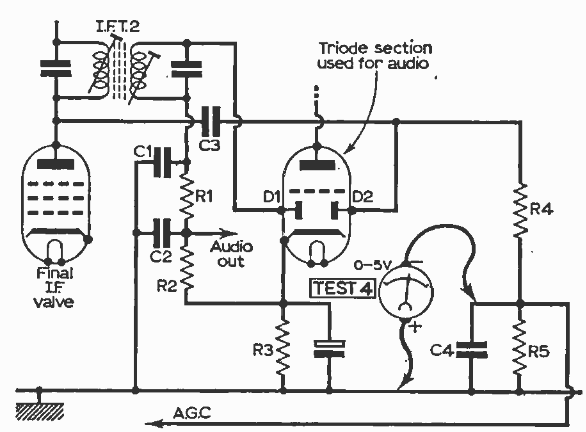

Fig. 3—3: An a.m. detector and a.g.c. circuit, showing a test for a.g.c.

load. It looks much more involved, however, when tied up in a complete circuit Fig. 3—3).

The detector diode is D1 and its load is R1 and R2 in series, with the bottom end returned to valve cathode instead of chassis. This is to avoid biasing the diode by the voltage dropped across the cathode resistor R3 when the triode is passing current. The audio signal thus appears across R1 and R2, and it is tapped-off at their junction. C1 and C2 are i.f. filter capacitors, taking away the residual i.f. signal, leaving only the audio component.

The i.f. signal from the anode of the final i.f. amplifier valve is passed to the second (a.g.c.) diode (D2) through the coupling capacitor C3. Rectified i.f. current thus flows through R4 and R5 and a d.c. voltage is developed across these resistors of a magnitude governed by the strength of the i.f. signal applied to the diode. This represents the a.g.c. bias, and since its full strength is not required a suitable level is tapped off the potential-divider R4/R5. This charges C4 and a time-constant is formed with R5. Residual i.f. signal is also bypassed by C4.

On the a.g.c. line therefore, is a negative potential (with respect to chassis) which is used as extra grid bias for the i.f. amplifier and frequency-changer (mixer section) valves. As the mutual-conductance (and hence stage gain) is determined by the amount of grid bias—the greater the bias the less the gain—the overall amplification of the signal circuits is automatically regulated by the strength of the signal. Rapid fading is also combated by the time-constant on the a.g.c. line.

FAULTY A.G.C.

One fault which can develop in the detector/a.g.c. stages, and cause bad overloading, is open-circuit of ★4 C3. This effect is clearly illustrated in Symptom 4 of the record and, apart from distortion due to "envelope distortion", intermodulation troubles can occur on strong signals giving a background whistle accompaniment.

A conclusive a.g.c. test is shown in Fig. 3—3 at **Test 4.** Here a voltmeter is used to measure the actual a.g.c. voltage produced by the signal. There is no point in attempting this test with a voltmeter of less than 10,000Ω/V sensitivity, however, for the meter would swamp the circuit and give virtually no reading even on a very strong signal. A reading up towards 5 volts should be obtained at the point indicated on the circuit on a strong signal.

In some sets the a.g.c. voltage is transferred to the control grids through very high (order of megohms) resistors, so even a highly sensitive meter would give very little reading at these points. A valve voltmeter or equivalent transistor instrument would, however, be suitable.

A noteworthy point of the a.g.c. circuit is that it is delayed. This comes about by the biasing given to the a.g.c. diode due to triode current flowing through the cathode resistor. Thus, the cathode is at some voltage positive with respect to D2 (since in this case D2 *is* returned to chassis through R4/5), and this means that D2 will not conduct until the signal reaches the delay level given by the bias. This means that the set's gain is always at maximum on weak signals.

The detector itself rarely develops faults except perhaps when an i.f. filter capacitor goes open-circuit. This can aggravate instability and introduce whistles. Since the diodes are working at very low power they rarely fail, even though the triode may go low emission.

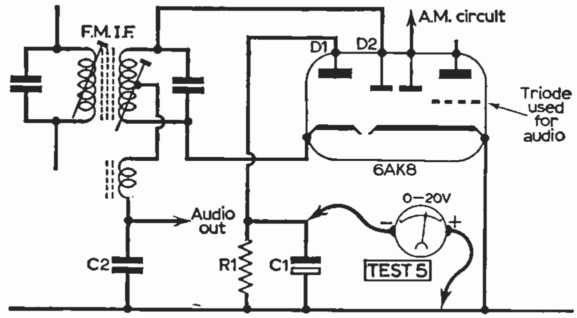

Fig. 3—4: The ratio-detector formed by two isolated diodes in a triple-diode-triode valve. A ratio detector test is shown.

RATIO-DETECTOR

In a.m./f.m. sets, the detector valve is usually a triode (for audio) with *three* diodes, one with its own cathode and two using the common triode cathode. One of the diodes common to the triode cathode is used as an a.m. detector, which is often arranged to provide a.g.c. as well, while the other diode, in conjunction with that with its own cathode, is used in a ratio-detector for f.m., as shown in Fig. 3—4.

Here D1 has its own cathode and D2 a shared cathode. The ratio-detector circuit is formed by D2 anode going to one side of the ratio-detector transformer secondary and D1 cathode to the other side. D1 anode and D2 cathode are then connected across the d.c. load of the detector (as is conventional practice) comprising R1/C1. The audio is developed across C2 connecting to the third winding on the transformer. This looks a bit messy in this form but if it is worked out into a different pattern it will be found to conform to the ordinary ratio-detector circuit.

A good test for this kind of detector is to measure the voltage across the d.c. load, as shown by **Test 5** in the circuit. With a correctly working circuit, up to 20 volts will be measured across the load when the f.m. set is tuned to a strong transmission.

Difficult tuning and poor interference suppression is often caused by C1 of the load going down or becoming open-circuit. This would not be indicated by the test across the load and a new capacitor (about 4μF electrolytic) should be hooked on as a trial. Shorting C1 would, of course, prevent a voltage reading and certainly kill normal working of the detector.

If R1 goes high in value the effect is a sort of "overhang" on the f.m. tuning, it being difficult to establish quickly the correct tuning point.

This triple-diode-triode valve can cause a hum or buzz on f.m. only under certain fault conditions ★3 (not unlike the first interference effect in Symptom 3 of the record). The valve may not immediately be suspected since a.m. is invariably unaffected, but a substitution test soon shows that the valve is to blame.

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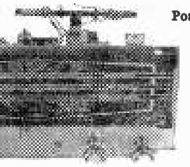

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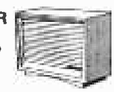

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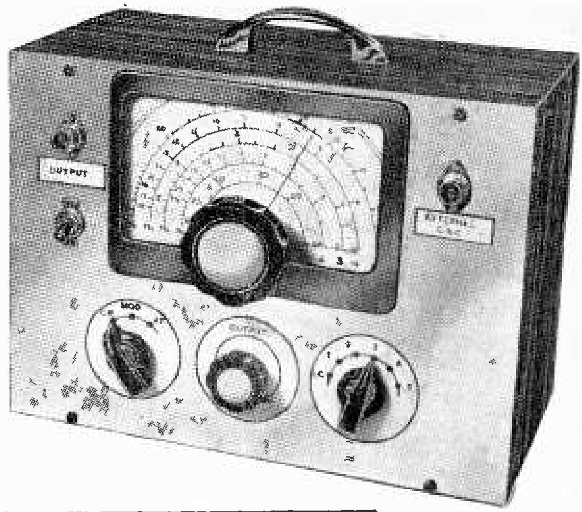


H. WEBSTER

NEXT to the multi-range testmeter probably one of the most useful items of equipment in the amateur workshop is a generator of signals covering a wide frequency spectrum. While such an instrument can be quite complex and costly, for most amateur requirements a simple, stable, modulated oscillator is sufficient for most purposes. With the aid of such an oscillator, alignment of receivers is easily carried out and the degree of uncertainty associated with trial and error methods eliminated. Apart from this prime function the signal generator is an invaluable aid to fault tracing in receivers.

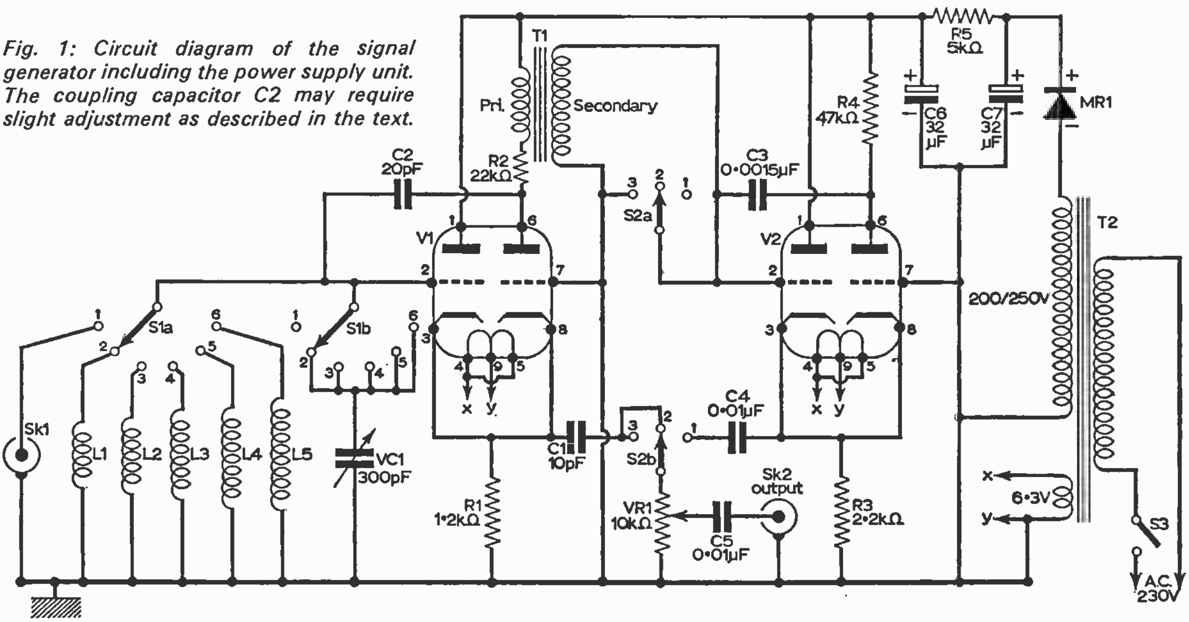
The basic requirements of an oscillator suitable for alignment purposes are as follows. It should be stable and not require recalibration at frequent intervals. Changes in supply voltage should not have an adverse effect on the oscillator frequency. Radiation of energy other than by the output socket should be reduced to a minimum. Finally, the output of the oscillator should be controllable. Although none of these desirable features is easy to obtain and is reflected in the relatively high cost of commercial instruments, nevertheless, by careful attention to screening and suitable choice of oscillator, it is possible to construct a generator which approaches these ideals.

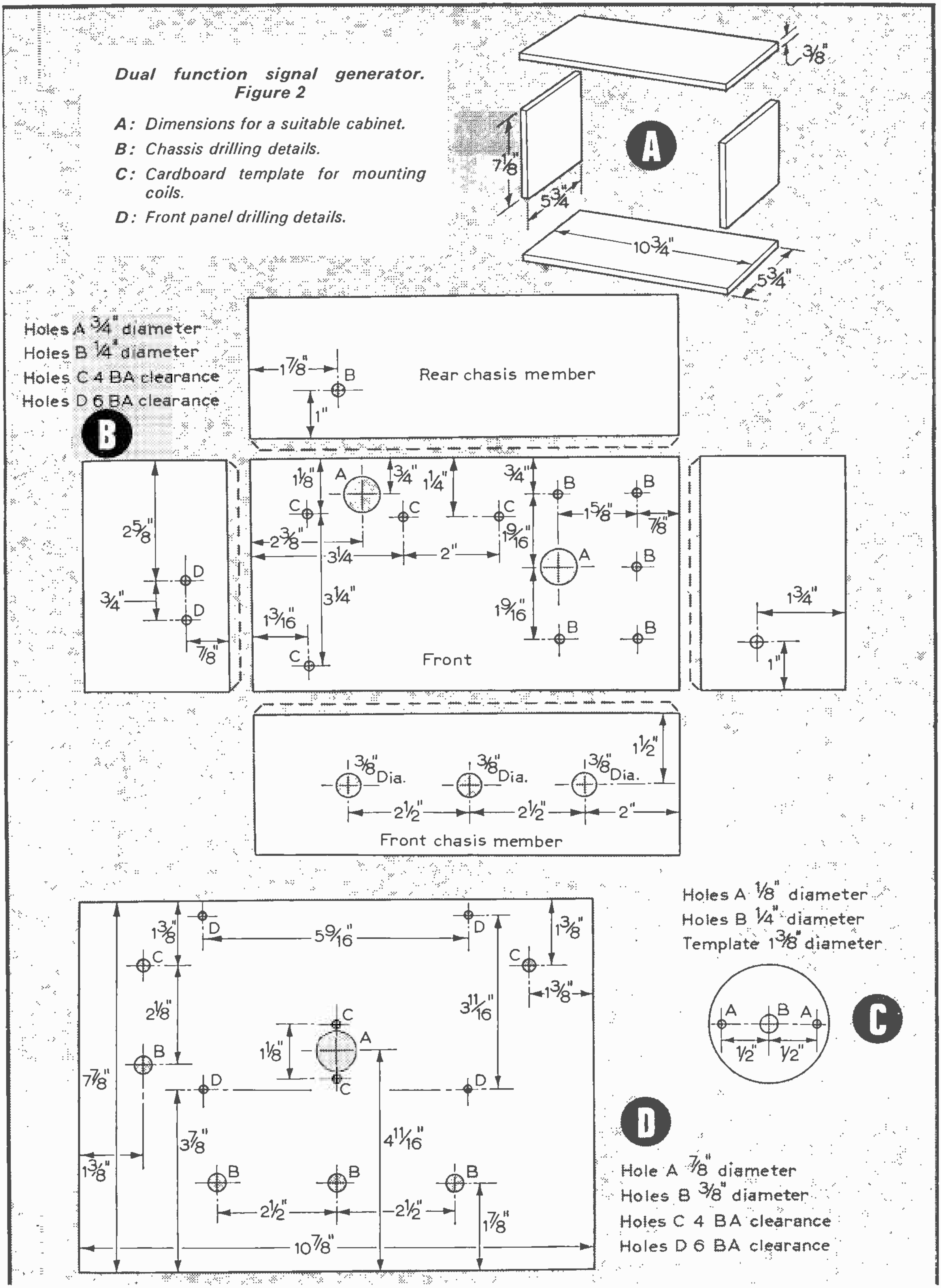
The signal generator described in this article has been designed with these features in mind. As well as performing all the usual functions of the normal oscillator, a further valuable feature enables the experimenter to extend the scope of the instrument to inductance and capacitance testing. This aspect of the design will be dealt with briefly in the latter part of the article.

CIRCUIT DESCRIPTION

An examination of the circuit given in Fig. 1 will show that both the radio and audio frequency oscillators are of the "two terminal" type. In each case a double triode is employed, one section being used as a cathode follower and the other as a grounded grid amplifier. Energy in the correct phase is fed

Fig. 1: Circuit diagram of the signal generator including the power supply unit. The coupling capacitor C2 may require slight adjustment as described in the text.





Dual function signal generator. Figure 2

A: Dimensions for a suitable cabinet.
B: Chassis drilling details.
C: Cardboard template for mounting coils.
D: Front panel drilling details.

back from the second section of each triode into the grid circuit in such a way that continuous oscillation is maintained. The coupling capacitor, C2, between the anode of the section triode section of V1 and the grid of V1 is rather critical. Since valve and component tolerances vary somewhat, it may be found that some experiment is necessary to achieve optimum results. Generally a value between 10 and 50pF will be adequate. An indication that the value is too high will be shown by violent squegging.

Anode modulation of V1 is achieved by connecting the h.t. supply to V1 in series with the primary of the audio transformer T1. The audio component developed in the secondary of T1 is inductively transferred to the primary winding of the transformer. An audio signal for amplifier testing is taken from the cathode of V2. Selection of the desired signal, whether r.f., modulated r.f. or a.f. is by means of switch S2.

The frequency span of the generator is from 200kc/s to 30Mc/s. This range is covered using five inductors, L1 to L5, taken from the Denco range of iron cored coils. The screening cans supplied with these coils have been retained since they help materially in reducing extraneous radiation. Power requirements for the unit are quite modest and any small transformer with an output of 200-250 volts at 20mA and 6·3 volts at 1 ampere is adequate. The specified audio transformer in the modulating section has a primary rated at 8mA and if any other type of transformer is substituted it must have a similar rating.

Although in the interests of compactness, miniature type valves have been specified, there is no reason why older types such as the octal based 6SN7 or 6SL7 should not be used. These two valves function perfectly satisfactorily in this circuit without any alteration in component valves. Naturally the use of the larger octal valve holders will necessitate some chassis dimensions changes.

CONSTRUCTIONAL DETAILS

The generator is built on a 9in. x 5in. universal chassis. Full drilling and mounting details are given in Fig. 2. The front panel drilling dimensions given in Fig. 2D are applicable to the specified Eddystone dial. A flexible coupler is used to connect the epicyclic drive mechanism to the variable capacitor. When fitting the drive to the capacitor spindle care must be exercised in the alignment of the spindle and drive mechanism since slight misalignment will mar the smoothness of the drive system. Although many generators, both amateur and commercial, use a direct drive system, the use of a slow motion drive

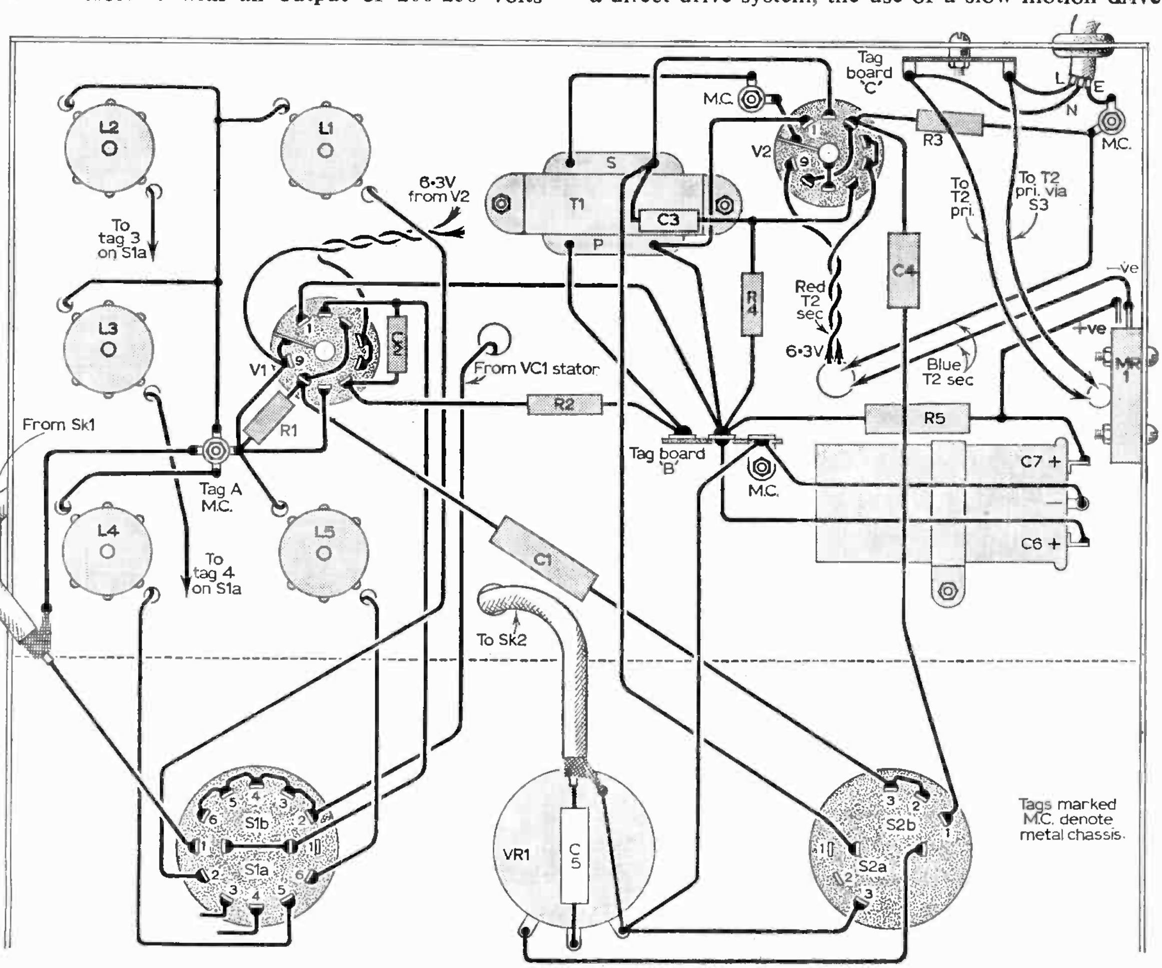


Fig. 3: Under chassis layout and wiring diagram. Note, tags marked MC are bolted directly to chassis.

enables more precise settings to be obtained.

The inductors, L1 to L5, together with the screening can lids are mounted ensuring that the holes in the chassis and can bases coincide. The cardboard template shown in Fig. 2C may be used to facilitate drilling of the chassis and can bases. Since the coil formers and associated plastic securing nuts are of polystyrene it is important that overtightening of the securing nuts is avoided.

When mounting the two valve holders, make sure that they are correctly orientated as shown in Figs. 3 and 4. The completely wired chassis is also shown in the same figures. On all coil ranges the primary windings are shorted out and connected via the earthy end of the grid coil to earth. It may be found on ranges 4 and 5 that the coils have wire ended terminations. If this is the case the grid wire must be insulated with a short length of sleeving before passing it through the chassis.

Wiring of the unit is straightforward although care must be exercised when soldering connections to the coil pins. Excessive and prolonged heating of the pins will lead to distortion of the polystyrene formers. On completion of the wiring check the resistance between the h.t. line and chassis. A reading of approximately 500kΩ should be obtained. A much lower reading should be investigated and any obvious faults remedied.

The writer housed the instrument in a wooden box lined with aluminium foil. Constructional details are given in Fig. 2A and are self explanatory. The rear of the box is covered with a nominal 11in. x 8in. aluminium top plate taken from the universal chassis range. When covering the interior of the box with foil make sure sufficient overlap is allowed at the edges so that intimate contact between the front panel and back plate is obtained. This method of construction was adopted in the interests of cheapness, and a metal box would be preferable.

Calibration based on comparison with signals of known frequency has been given many times in PRACTICAL WIRELESS and although no attempt will be made to give exhaustive details a brief description is given for the benefit of the newcomer.

The method requires a receiver, not necessarily accurately calibrated, covering a wide frequency range. After setting the receiver to a transmission of known frequency, the generator is adjusted to zero beat with the known frequency. By choosing an adequate number of frequencies for each band, a

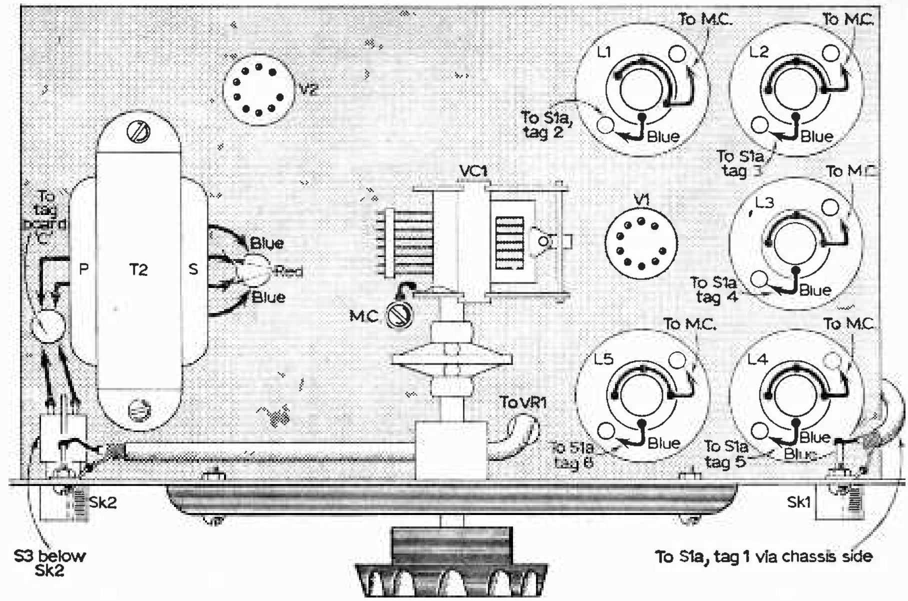


Fig. 4: Layout of components above chassis.

TABLE 1

Range 1		Range 2		Range 3		Range 4		Range 5	
f kc/s	Dial	f Mc/s	Dial	f Mc/s	Dial	f Mc/s	Dial	f Mc/s	Dial
200	98	0·6	98	1·8	98	5·5	98	9	93
250	72	0·7	80	2·0	85	6·0	85	10	79
300	54	0·8	65	2·5	62	7·0	69	12	62
350	41	0·9	54	3·0	45	8·0	57	14	49
400	30	1·0	45	3·5	31	9·0	47	16	38
450	21	1·1	37	4·0	22	10·0	39	18	30
460	19	1·2	31	4·5	14	11·0	32	20	23
470	18	1·3	25	5·0	8	12·0	26	22	18
500	14	1·4	20	5·5	4	13·0	21	24	13
550	8	1·5	15	—	—	14·0	17	26	9
600	3	1·6	11	—	—	15·0	13	28	5
—	—	1·7	7	—	—	16·0	10	30	2
—	—	1·8	4	—	—	17·0	7	—	—

The table shows approximate dial readings against frequency. The coils should be adjusted as advised in the text in conjunction with Table 2.

graph may be drawn of frequency versus dial readings. Care must be exercised during this procedure since it is quite easy to confuse harmonics with the fundamental frequency. If a superhet receiver is used for calibration purposes, additional difficulties may arise, particularly on frequencies above approximately 10Mc/s. Simple superhets with an intermediate frequency of 450kc/s and without adequate selectivity prior to the mixer, will almost certainly suffer from second channel interference. As an example, consider a receiver of this type tuned to a known frequency of 15Mc/s. If, as is generally the case, the receiver oscillator is tuned to the higher frequency side of 15Mc/s, then in order to give an intermediate frequency of 450kc/s the receiver oscillator will be set at 15·45Mc/s. A little thought will show that a transmission on 15·90Mc/s

TABLE 2

Range	Frequency Range Mc/s	Core Turns
1	0·2— 0·6	5½
2	0·6— 1·8	6
3	1·8— 5·5	12½
4	5·5—17·0	12
5	9·0—30·0	20

For approximate calibration the coil cores are unscrewed to their fullest extent and then screwed in. The number of revolutions is shown in the table.

will equally give rise to an i.f. of 450kc/s. In terms of the generator calibration this means that when the generator is tuned from the low frequency end a first response will be obtained at 15Mc/s. Further tuning of the generator will give a further response when the generator frequency is 15·9Mc/s. In general terms, for each receiver setting on the high frequency ranges, two generator responses will be evident, one when the generator is set to the actual frequency, and a second in which the generator is set to this frequency plus twice the i.f. of the receiver. Although all this may appear rather formidable, in practice the actual calibration of the higher frequency ranges is quite simple and provided the foregoing is borne in mind, no real difficulty should arise. In any case, a graphical check will reveal any errors.

APPROXIMATE CALIBRATION

For those constructors who feel hesitant about this procedure and have no receiver covering the whole gamut of frequencies the following approximate calibration will enable them to make a start. The iron cores of each coil are gently unscrewed to their fullest extent. Do not apply undue force. The cores are then screwed back into the formers the number of complete turns shown in Table 2. The calibration chart shown in Table 1 is applicable to this procedure. If this method is adopted it is imperative that the specified coils are used and the wiring lay-out of Figs. 3 and 4 followed as closely as possible. It must be stressed that the foregoing method is of an approximate nature and is only intended as a preliminary aid to calibration and as a help to the constructor who has no suitable reference standard. More accurate calibration may be carried out at a later stage. When the finalised calibration has been completed the five scales of the dial may be marked in with indian ink.

★ components list

Resistors:

R1	1·2kΩ	R5	5kΩ 5 watt
R2	22kΩ	R6	400Ω
R3	2·2kΩ	R7	400Ω
R4	47kΩ	VR1	10kΩ carbon pot

All fixed resistors 1 watt except where otherwise specified

Capacitors:

C1	10pF	C4	0·01μF	C7	32μF
C2	20pF	C5	0·01μF	C8	200pF
C3	0·0015μF	C6	32μF	C9	400pF

Variable Capacitor:
VC1 300pF Jackson E1

Valves:
V1 ECC82 V2 ECC82

Inductors:
Chassis mounting types
L1 Denco Maxi Q Yellow Range 1
L2 Denco Maxi Q Yellow Range 2
L3 Denco Maxi Q Yellow Range 3
L4 Denco Maxi Q Yellow Range 4
L5 Denco Maxi Q Yellow Range 5
RFC: See text
T1 Intervalve type 3:1 ratio
Radiospares 8mA rating

Mains Transformer
T2 Osmabet 230v 45mA 6·3v 1A

Miscellaneous:
MR Metal rectifier contact cooled 250V 50mA
B9A Skirted valve holders (2), B9A screens (2), Coax sockets (4), 2P 6W switch S1a, b; 2P 3W switch S2a, b; SPST switch S3, Universal chassis 9 x 5 x 3, Home Radio Aluminium panel 10¾ x 7⅞ (2), Dial—Eddystone 598 (Stratton), Flexible shaft coupler; knobs, sleeving, coaxial cable, etc.

DUMMY AERIAL

A suitable dummy aerial for use in conjunction with the signal generator during receiver alignment is given in Figs. 5 and 6. This dummy aerial is satisfactory for frequencies between 150kc/s and 2Mc/s. For the higher frequencies up to 30Mc/s the simple form shown in Fig. 7 is recommended.

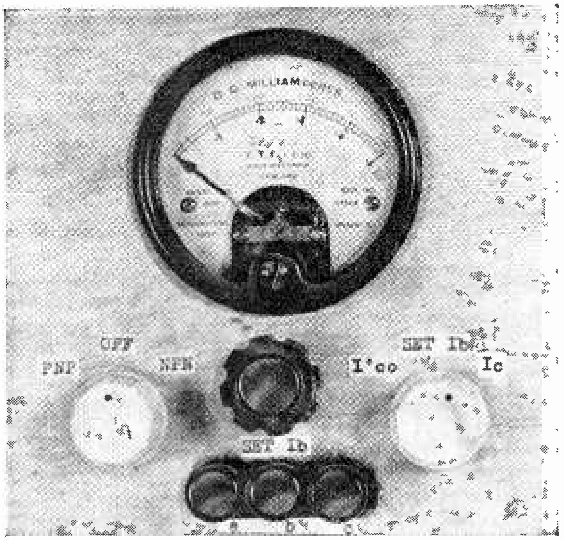
In each case the dummy aerial may be mounted inside a discarded tobacco tin as shown in Fig. 5. The 20μH choke used in the medium frequency version consists of 70 turns of 34 gauge enamelled wire close wound on a ⅜in. diameter former. The remaining details given in Fig. 5 are self explanatory.

A feature of the generator not generally available

—continued on page 142

SIMPLE TRAN

Transistors are now readily available from variou manufacturers' surplus units, and some of these ar here enables some of the more useful transistor provide constructors with a very useful piece of



THIS design offers simplicity coupled with versatility. The tester will check p-n-p or n-p-n transistors for leakage (I'co), a.c. and d.c. gain. The circuit has been arranged to minimise the switching and consequently enables the cheaper and more easily available types of switch to be used. By careful perusal of the advertisements in this magazine it could, at the time of writing, be built for about thirty shillings.

Circuit details

Having now discussed what it does and how much it will cost, let us turn to the question of how it works. Basically, a measured d.c. current is fed into the base of the transistor under test, and then the collector current is measured. The resistance of VR1 controls the base current, while R2 performs the function of preventing this current from

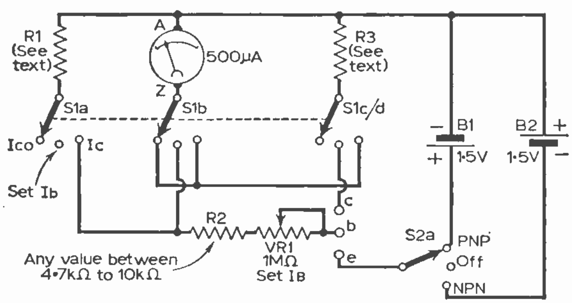
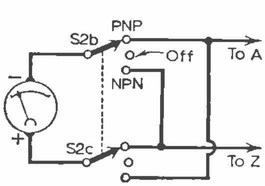


Fig. 1 (above): Basic circuit of the tester.



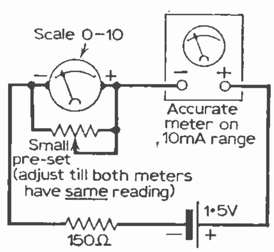


Fig. 2 (left): Modification for testing n-p-n transistors.
Fig. 3 (right): Calibration of the unit.

becoming excessive when VR1 is at its minimum value.

With the function switch S1 in the "Set Ib" position, the meter is connected in series with R2 and VR1, and thus measures the base current set by VR1. In the "Ic" position S1 switches R3 across the meter terminals to give it a full scale deflection (f.s.d.) of 10mA, thus enabling it to measure the collector current. In order to perform a leakage test, i.e., measure I'co, S1 connects the meter in series with the transistor across the supply voltage, with the base open-circuit.

To enable the tester to be used for both n-p-n and p-n-p transistors, the circuit of Fig. 1 is modified slightly by the addition of Fig. 2. The meter is

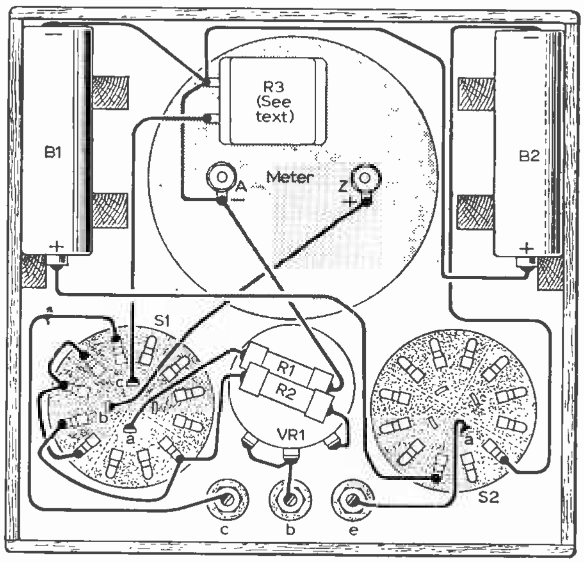


Fig. 4: Layout of the prototype tester. Compare this with the photograph in the heading on the right.

connected to points A and Z on Fig. 1 via the p-n-p/n-p-n switch S2. This enables both the meter and the supply to be reversed for testing n-p-n transistors (see Fig. 2).

Calculations

Resistor R1 should be equal to the meter's d.c. resistance, ± 20 per cent will be satisfactory, while R3 the 10mA shunt resistor *must* be made very accurate. Its precise value will depend on the meter used and its value may be calculated as follows:

$$R = \frac{\text{Meter's f.s.d.}}{\text{f.s.d. required} - \text{Meter's f.s.d.}} \times \text{Meter's resistance.}$$

ISTOR TESTER

BY G. A. BOBKER

ources quite cheaply. Others are obtainable in nmarked. The simple but efficient unit described haracteristics to be measured and it will thus st gear at low cost. Construction is uncritical.

Example: Supposing we are using a meter having a f.s.d. of 500μA and a resistance of 250Ω. In order to give a f.s.d. of 10mA it would require a shunt resistor whose value will be:

$$R = \frac{500}{10{,}000 - 500} \times 250$$

This equation gives the value of R3 as approximately 13·1Ω, therefore a preset potentiometer of some 25Ω will be ideal. To calibrate accurately, the meter is placed in series with another meter of known accuracy as shown in Fig. 3. As the shunt has to be very accurate it is switched in the tester by *two* of the switch contacts wired in parallel, S1c and S1d. This has the advantage of reducing the contact resistance of the switch.

As the leakage current of some a.f. output transistors can be as high as 450μA, if a more sensitive meter is used then S1c/S1d should be arranged to switch in a 500μA shunt in the "I′co" position. The switch S1 should be the normal 4-pole 3-way type. If fancy switches, or switches to hand are used, difficulty might be experienced if they are not of the "Break-before-make" type.

Construction

The cabinet was made from plywood fixed together with glue and panel pins, the finished case being covered with "Fablon" or "Contact". The final size of the case will be determined by the size of the meter used. The clips to hold the batteries were made from strips of brass pilfered from a defunct cycle-lamp battery, and these were fixed to the cabinet with Araldite. This is very easily achieved and is far superior to soldering wires direct to the battery cases.

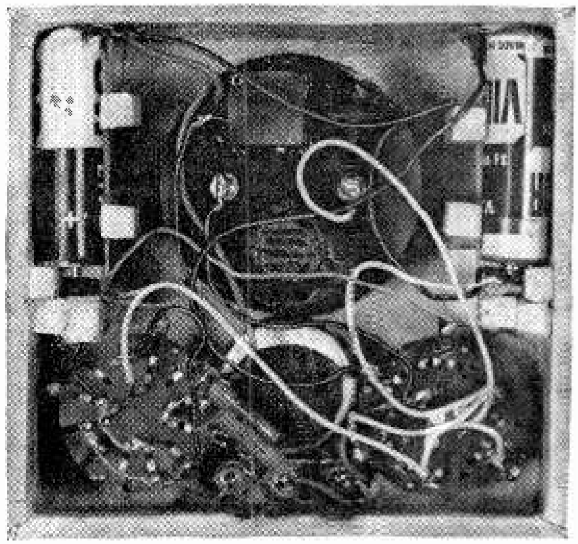
The terminals used in the prototype were of the spring loaded variety and were obtained from surplus equipment. Alternative terminals can be made either from bolts or from three crocodile clips as shown in Fig. 5. Constructors may use their ingenuity as to terminals but whichever type is used they must provide good positive action holding the wires tightly. They should also be kept clean.

★ components list

Resistors:	**Switches:**
R1 see text	S1 4 pole 3 way
R2 4·7kΩ–10kΩ see text	S2 3 pole 2 way
R3 1MΩ potentiometer	**Meter:**
R4 see text	500μA f.s.d.

Miscellaneous:

Terminals, Batteries—2 penlight 1·5V, Materials for case, solder, wire etc.



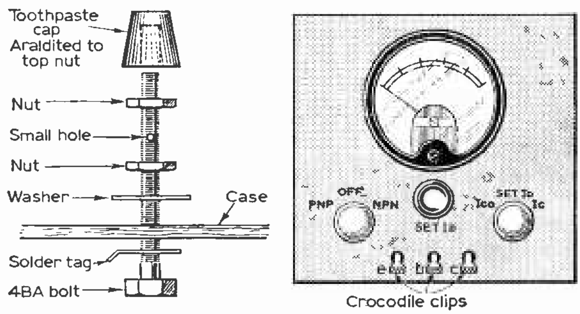


Fig. 5: Suggested approach to the problem of making suitable terminals, these may be modified bolts, or made from crocodile clips.

Using the tester

Set the p-n-p/n-p-n switch to the appropriate position and turn the function switch to the off position. (1) Connect the transistor to the terminals, switch to "I′co" and note the reading. (2) Switch to "Ib" and adjust "Set Ib" to give 20μA reading. (3) Switch to "Ic" and note the reading. Repeat (2) and (3) but this time using Ib=40μA. The d.c. gain is simply Ic divided by Ib. The small signal or a.c. gain is obtained from the readings noted in steps (2) and (3);

$$\text{A.C. gain} = \frac{\text{Change in Ic in } \mu\text{A}}{\text{Change in Ib in } \mu\text{A}}$$

Example: If 20μA gave 1·2 mA, and 40μA gave 2·6mA then gain $= \frac{2600 - 1200}{40 - 20} = \frac{1400}{20} = 70$

If the meter scale is marked at the 20μA and 40μA positions then steps (2) and (3) are made very simple. ■

Let's Keep the Pirates

You have published many letters and articles in your pages against Pirate radio stations. One of the more recent letters dealt with the shortage of medium-wave channels. Has anyone ever looked to see how many channels are allocated to this country and how efficiently they are being used? It seems to me that using nine channels for the Home Service alone, is not doing things efficiently. Surely by using synchronised transmitters on one channel, we could release eight channels at once for other services. Any regional variations, few and short-lived as they are, could be accommodated on v.h.f.

The public has proved the demand for what the Pirates are providing. Why not let them provide it from land-based stations using channels already allocated to the UK?

R. E. Tinson. Wilford, Nottingham.

Comments from New Zealand

This is a somewhat belated reply to H. C. Pryse who wrote in the December issue of PRACTICAL WIRELESS, concerning his inability to obtain spares for his H.E.30 receiver. The Lafayette brand name is only one of many names used on this receiver which is made by the Trio Corporation, 6—5 Ichome Shibuya, Shibuya-KU, Tokyo, Japan, to which he may care to write.

Many amplifiers and receivers which are sold in the USA with American names on them are made in Japan and as to Mr. Pryse's inability to receive a reply from the Lafayette Co. I am in full sympathy with him. I find there are quite a few British firms including advertisers in PRACTICAL WIRELESS who do not answer my letters when I request information or catalogues. I get the impression that British firms are not interested in overseas orders!

S. Burrage. Auckland, New Zealand.

Ease of Pronunciation

There has been a certain amount of controversy over the last few months on the subject of changing cycles to Hertz. I personally do not care one way or the other since it is just as easy to write MHz as it is to write Mc/s.

The point that seems to be overlooked is the pronunciation of the new term. For example, Mc/s and kc/s are usually pronounced "Megs and and Kaycees". The new terms MHz and kHz will now, I suppose, be pronounced "Megger hurts and Killer hurts."

V. E. Green. Redditch, Worcestershire.

NEWS AND..

EDDYSTONE RADIO FOR "EDDYSTONE" LIGHTHOUSE

The Eddystone Lighthouse has been presented with a transistorised receiver by Eddystone Radio Limited. This new receiver type EB35 will provide the lighthouse keepers with high quality reception on all the broadcasting frequencies in the long, medium, short and f.m. wave bands.

The receiver was presented at the lighthouse by Mr. A. C. Edwards, Director of Eddystone Radio Limited, and accepted, on behalf of Trinity House, by Principal Keeper Emerson. Mr. Edwards is seen here with Principal Keeper Emerson (centre) on the afterdeck of the Trinity House vessel *Stella* as the receiver was being delivered to the lighthouse. The Eddystone lighthouse and Smeaton's Stump can be seen in the background.

"CONTACT" FOR THE SWL

We have recently received a copy of "Contact", the monthly journal of the World Communication Club of Great Britain. It gives useful information for the SWL and contains articles of a nature that would also appeal to Hams.

The aims of the Club are: to interest more people in the international aspect of radio; to provide fellowship to all interested; to encourage and help DXers in their hobby and to learn more about the world we live in through the medium of short wave radio.

If anyone would like further information and details of membership of the Club, contact Mr. S. Green, 26 Tolhouse Street, Great Yarmouth, Norfolk.

ST. DUNSTAN'S CALLING

On Saturday, 8th April, a new callsign was heard on the amateur bands, GB3STD. This was the temporary callsign allocated to St. Dunstan's Holiday Home and Training Centre for men and women blinded on war service, when they held a weekend reunion of war-blinded radio Hams at their centre at Ovingdean near Brighton. The station was equipped with the very latest in amateur radio equipment. They had as their host, Lord Fraser of Lonsdale, St. Dunstan's Chairman who, despite his blindness, was one of the pioneers of amateur radio.

...COMMENT

HELP FOR WEATHER WATCHERS

A high-frequency communication system is to be supplied by The Marconi Company for the East African Meteorological Department. The system will use remotely controlled, self-tuning transmitters, and has been ordered through the World Meteorological Organisation in Geneva. It forms part of a general programme to improve and speed-up the transfer of weather information throughout the world for the World Weather Watch, an international study aimed at increasing the understanding of the fundamentals of meteorology.

The equipment will be installed at Nairobi in Kenya, at the Central Terminal for the clearance of meteorogical information from Africa to the Northern Hemisphere. It will provide a greatly improved service from there to Offenbach, near Frankfurt, headquarters of the West German Meteorological Service which will disseminate the information received to the main meteorological telecommunications trunk circuit which runs through Offenbach. The transmission will also be received at Cairo where the information will be relayed to the Moscow World Weather Centre.

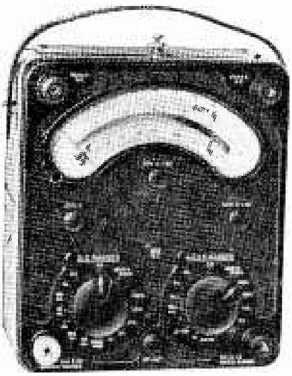
Two of the self-tuning transmitters will be installed at one of the East African Meteorological Depts. transmitting stations at Embakasi, just outside Nairobi.

SWEDISH DEALERS VISIT ENGLAND

The first of two parties of Swedish TV and radio dealers recently arrived in London. The visit has been arranged by Luxor Industri Aktiebolag, the largest Swedish-owned radio and TV manufacturer, and the Swedish Radio Dealers' Association. In all, 500 dealers from all over Sweden visited Britain for a combined educational and recreational trip.

Colour TV is expected to start in Sweden in 1970, and during the two visits the Swedish dealers studied British TV and had talks with the BBC and the ITA. They also met representatives of the Radio and Television Retailers' Association.

IMPROVEMENTS FROM AVO



An improved version of its panclimatic Avometer is announced by Avo (MI Group). The new model, which has been granted Ministry of Defence approval (to specification DEF-155), is designated Avo multirange test set no. 1. It will replace the previous models 8SX, 9SX and 40SX which for some years have been extensively used in the Armed Services.

The new version, like its predecessors, is specially designed for use in conditions of extreme temperature or high humidity.

The Avo multirange test set no. 1 retains design features of earlier Avometers, including mechanical cut-out, movement reverse button and interlocked range switching. The five-inch scale has markings for both voltage and current measurements, with a separate scale for resistance measurements. Additional overload protection is provided by a fuse connected in series with the ohms range.

The instrument is supplied with an ever-ready carrying case, a pair of rubber-covered test leads, two spring clips and a pair of test prods.

Dah Di Dah Dit Dah Dah Di Dah

I think it ought to be publicised that the Postmaster-General will do all he can to assist in making alternative arrangements for the place and time for sitting the GPO Radio Amateurs' Morse Test for those who, because of their location, have a long way to travel to any of the officially designated centres.

From my own home in Workington, the nearest designated centres are Whitley Bay and Glasgow, 220 and 270 mile journeys respectively. Alternative arrangements were however made to take the test at Ambleside, 40 miles away, with the further suggestion that it could be taken in Workington but only at very short notice.

All readers working for the Morse Test, living in places remote from named Test centres should write to the GPO Radio Services Headquarters, where I have no doubt they will be given courteous consideration, and some easier-reached centre arranged.

A. G. Thorburn, G3WBT. Workington, Cumberland.

Useful Lists

I would like to congratulate Mr. H. W. Hellyer on his Repairing Radio Sets article in the May issue of PRACTICAL WIRELESS. The lists of Test Gear and Bench Aids that he gives on pages 38 and 39 are an invaluable aid and certainly save hunting through lots of old issues of the three "Practicals" for the article that you know is there but for the life of you, just cannot find! Many thanks H.W.H.

P. Keeling. Woodford Bridge, Essex.

Oh Henry!

I read with interest Henry's remarks on page 27 of the May issue of PRACTICAL WIRELESS regarding Retail Price Maintenance. I do not know how Henry can possibly say servicing will suffer because dealers may have to bring prices down to compete with the "big boys".

It is a fairly common fact that from manufacturer to consumer, the price of a product is nearly doubled. Part of this is taken by the wholesaler—about 10%—so where does the rest go? Why, to the retailer who cannot cut his prices to the man in the street because it will affect his servicing organisation. Already most servicing facilities are rather shoddy, so what have we got to lose?

A. Read. Walthamstow, London, E.17.

VIBRATO & TREMOLO UNITS

by A. J. Bassett

LET us begin with a definition. "Tremolo" is a sound effect caused by rhythmic variations in the amplitude of a musical note or notes.

Another, radically different, effect is often confused with tremolo. This is "vibrato" i.e. rhythmic variations in the pitch of a musical note. Various amplitude-modulation devices now on the market are wrongly described as "vibrato" units. This is a gross inexactitude for a true vibrato effect can be achieved only by *frequency modulation* of the note.

Acoustic vibrato units are based upon the well-known "Doppler" effect; a note emitted at frequency "n" c/s by a moving object will have an apparent frequency "f" c/s when received by a moving or stationary auditor (e.g. listener or microphone).

The difference between "n" and "f" is the apparent shift in note frequency. This shift depends upon the velocity and direction of movement of both source and auditor. Similarly an apparent frequency-shift can be produced when a note from a stationary source is reflected from a moving object and the reflected sound waves received by a stationary auditor.

Thus arising from the "Doppler" effect we have three main acoustic means to an apparent change in pitch of a musical note radiated at a fixed frequency:

(1) Moving source of sound
(2) Moving auditor
(3) Moving reflector of sound waves.

in a single installation and the paddles run at different speeds to produce an exhilarating "chorus" effect.

Best speed of rotation is in the region 100 to 300 r.p.m. for average use. The effect is best applied to the high and middle response speakers, large brass speakers being left alone.

Four main output loudspeakers are mounted in a "pitch" circle on a plywood wheel, which acts as a baffle. The wheel is driven silently round at about 80 r.p.m. Slip rings with multiple phosphor bronze brushes are used to make connections to the loudspeakers. Sound waves are guided outwards by means of a stout wooden panel as shown in Fig. 2. Destructive interference between waves of opposing phase contributes toward a tremolo effect, in addition to the vibrato effect which is the main feature of this device.

Echo Device

Here a real echo chamber is used. Once again, both vibrato and tremolo are produced, with the addition of echo and reverberation. In Fig. 3 a corner mounted loudspeaker (L) operating at a low level produces a complex pattern of direct and reflected sound-waves in the chamber. The sound is picked up by a rotating high-quality directional microphone (M). Because of the varying path-

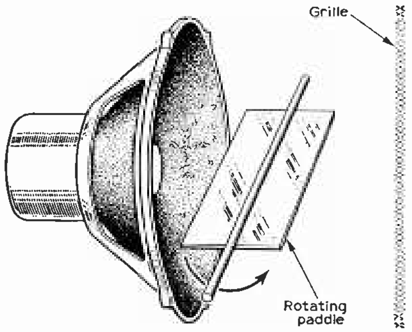
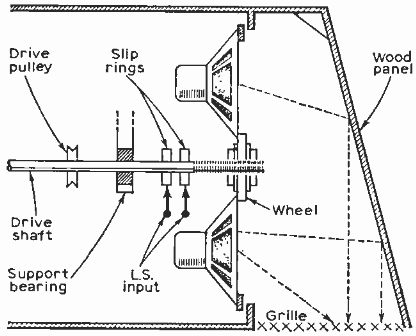


Fig. 1 (left): Rotating paddle method. The paddle may be polished or felt covered (see text).

Fig. 2 (right): Rotating loudspeaker device producing vibrato and tremolo effect.



The "loudspeaker paddle" method is shown in Fig. 1 where a wooden or metal paddle is rotated in front of the loudspeaker, producing a cyclic change in both pitch and amplitude. To enhance the tremolo effect, the paddle should be smooth and polished, thus promoting reflection of sound waves. If only vibrato is required, the paddle may be covered with felt.

There is no reason why several units should not function simultaneously at different speeds. Thus several loudspeakers may be fitted with paddles

lengths of the reflected and direct waves, a phase-shift effect emerges, which is sampled at various, angles by the microphone to produce a more or less intense vibrato effect. Tremolo is produced because some of the sound waves are stronger at different angles.

The degree of echo produced by such a chamber may be undesirable for certain types of music. This echo is determined by the length (S) of the chamber, which could be only 4ft. for minimum echo, though a length of 12ft. might be acceptable in other instances. This is a subjective matter, and much depends upon the size and character of the main room or hall.

The chamber itself may be constructed in an unused passage or cellar from which extraneous noise is excluded. The walls are best constructed of concrete, brick, stone or heavy galvanised iron. The microphone is driven at about 300 r.p.m. from a silent-running electric motor using plastic or

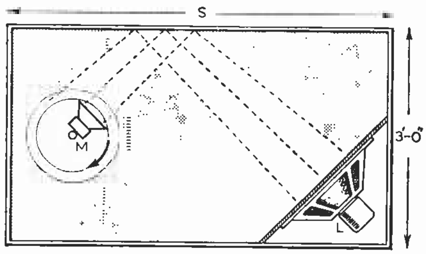
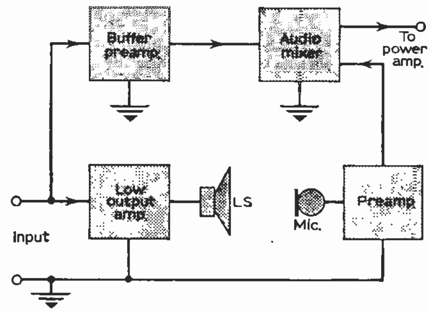


Fig. 3 (left): Echo chamber containing loudspeaker and microphone—only the microphone rotates.

Fig. 4 (right): Block schematic of complete system when using an echo chamber



rubberised gears. Its output passes to slip rings on its drive spindle where multiple phosphor-bronze brushes are used for smooth, electrically silent contact. Fig. 4 shows the block diagram of a circuit suitable for use with the echo chamber.

Electronic Units

In these days of fierce commercial competition, and the consequent production of cheap goods, discrimination suffers, and there is a general tendency to accept substitutes which can never really satisfy the enthusiast. Amongst the many items which fall victim to this trend, we find an important accessory to modern music; the "electronic vibrato unit". This unfortunate device has suffered to such a degree that there are very few genuine electronic vibrato units on the market, and none of the many "constructors' circuits" which the author has seen will give a genuine vibrato effect. The majority of vibrato units do in fact operate as amplitude-modulation devices. Some of these a.m. devices operate by means of screen-grid modulation of a pentode. A typical circuit is shown in

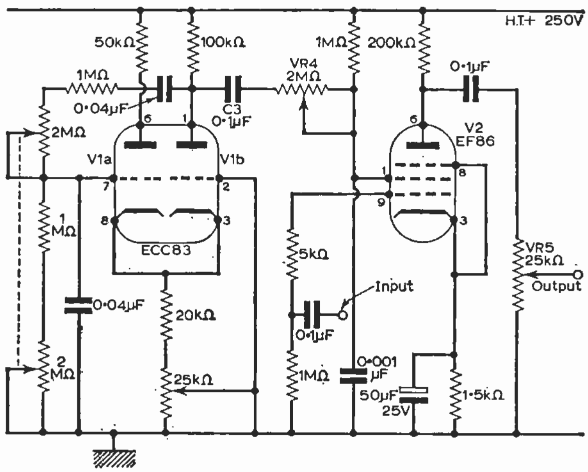


Fig. 5: Tremolo unit suitable for electric guitar or electronic organ.

Fig. 5. V1, a double-triode valve (ECC83) and its associated network form a low-frequency Wien-bridge oscillator, whose output is fed to the screen-grid of V2 via C3 and depth control VR4. The gain of V2 varies in sympathy with the changes in the voltage on its screen-grid, thus providing amplitude-modulation of the audio signal. VR5 is a gain control, which may be adjusted until the mean gain of the unit approximates unity. The output may contain, in addition to the input frequencies, traces of the tremolo frequency, but these are small and are usually not objectionable. This unit could not possibly produce frequency-modulation of any note it might receive from the pre-amp. A different approach is clearly needed.

We will now discuss a unit which does not rely upon acoustics; can be built fairly small, and which will produce a true vibrato effect; the basis of operation is a phase shift ladder network, whose theoretical diagram is shown in Fig. 6 together with associated amplifier circuits.

To each stage of the ladder is connected a capacitor plate P1, P2, - - -P6, these plates being arranged in a ring in the order given. Above this ring is placed a ring of thin sheet dielectric (e.g. perspex) pressed flat against the plates. A sliding pick-up plate P7 is arranged to run round on the dielectric, thus providing capacitive pickup of the audio signal, from each of the plates in the ring, in turn.

Because the phase of the signal is different at each stage of the ladder network, the output waveform derived from P7 is alternatively "compressed" and "expanded" with regard to the time axis. If the device is correctly adjusted by extra pads or dielectric where need be, amplitude-modulation is rendered negligible. The result is a frequency-modulated output derived from a constant frequency input.

Fig. 7 shows a rough sketch of a printed circuit board, showing arrangement of the capacitor plates P1—P6. It will be noticed that plates P2—P5 are split into different positions in the ring as shown. This aids in the production of a smooth output. An electric motor (not shown) drives the wiper plate P7 (not shown) over these plates to pick up the signal via the dielectric. Signal pickup from P7 is effected by a phosphor-bronze sliding contact. Speed of rotation of P7 is adjusted to about 300 r.p.m. for average use. The ladder network components shown are on the other side of the board. The paired capacitor plates are connected together by wires. The size of the printed circuit, etc., may be left to individual choice, but a pitch circle of 4 to 6 in. should be adequate for plates P1—P6, the

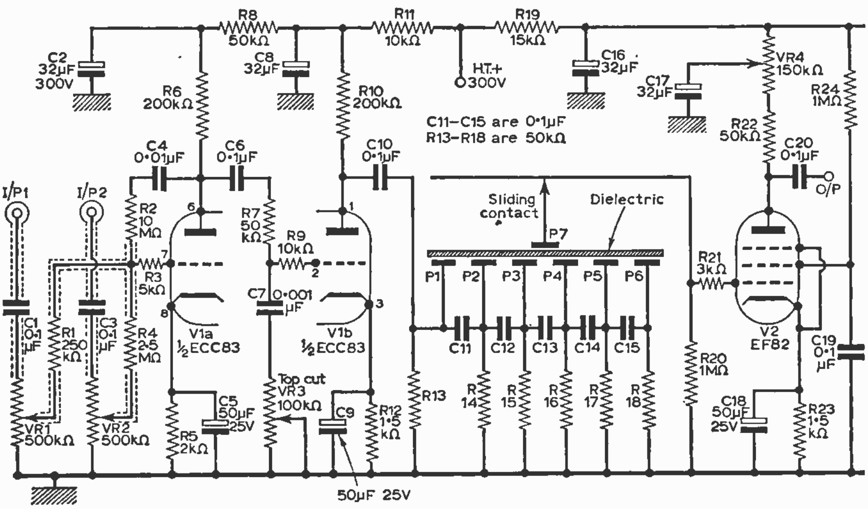


Fig 6: Phase-shift ladder network and associated amplifier—producing true vibrato effect. The component values in the ladder network may be varied (see text).

larger plates producing a better quality. The wiper plate P7 may be big enough to just cover one of these plates, or possibly a little shorter. This may be determined by subjective listening, or by the use of an oscilloscope to obtain good output waveform.

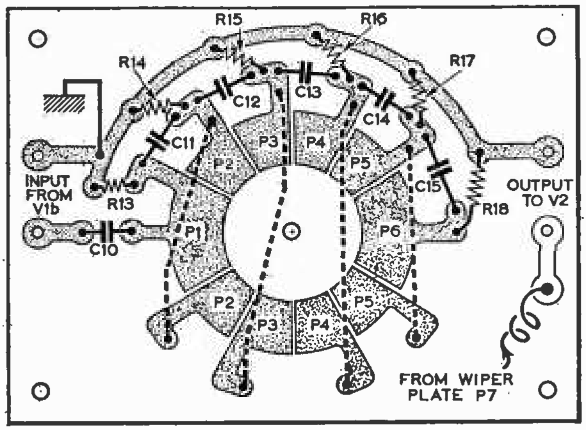


Fig. 7: Suggested layout of printed circuit board showing arrangement of the capacitor plates P1–P6.

Almost any small electric motor may be used provided the power is adequate to drive P7 against the small friction involved; however, a synchronous or regulated type is to be preferred. The motor should be geared down by non-metallic gears to avoid hum pick-up. Several modellers' motors are available with suitable plastic multi-speed gearboxes, and these should be tested in the shop to ensure that they are reasonably silent-running.

The whole unit should be well shielded against external capacitive pick-up; special care being taken to shield the motor leads (use shielded twin cable), and the valves in separate compartments to avoid audio feedback.

V1 of Fig. 6 forms a preamplifier with high and low sensitivity inputs, and volume controls VR1, VR2. The top-cut tone control VR3 operates in conjunction with low-pass filter network R7, C7, R9. This is necessary to compensate for bass attentuation in the phase-shift network. The output from V1b is fed to the ladder network, and having passed to P7, is amplified by V2. VR4 is a gain control, which cuts down the voltage gain of V2, and will help combat any tendency to a.f. oscillation in this high-gain circuit. Output from V2 is fed to the main amplifier through C20.

The values of C11—C15 and R13—R18 may be varied to suit individual taste and the type of instrument to be used. Thus for bass instruments, a higher value of capacitor may be preferred.

With regard to the mechanical section of this unit, the constructor is not bound to use a printed circuit at all; thus the capacitor plates may be assembled in the form of a cylinder, inside which is a film of dielectric round which runs plate P7. In fact the whole design is quite flexible, and with care the constructor may build a vibrato and/or tremolo unit more suited to his purpose than many on the markets of today. ■

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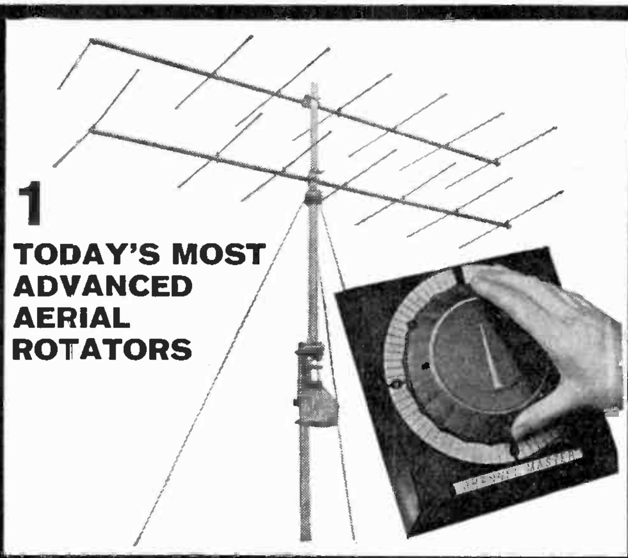

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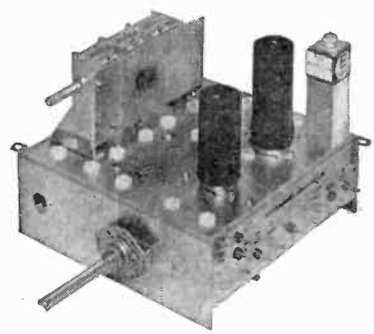

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MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

ALBANIA: *Radio Tirana* (Rue Ismail Quemal, Tirana) European English schedule is 0630-0700 6,157 plus possibly 7,120; 1500-1530 1,214 (some reports say 7,265/1,277); 2000-2030 7,265; 2200-2230 7,265 (plus 1,310 in some reports). Non European English TX believed to be 0200-0300 9,715/7,265 and 0400-0430 7,265/9,390/1,310.

Radio Shkodra (Drejtoria e Radio Shkodres Shkoder) may just be heard at 1700-1930 on 8,217.

Andorra: *Radio Andorra* (c/o 82 Chelsea Manor Street, London, S.W.3) has been testing on 719 at 1800-0100 with a view to starting an external service beamed to the U.K.

Bulgaria: *Radio Sofia* (4 Boulevard Dragan Tsankov, Sofia) reported with new frequencies 11,930/11,955 for African English TX at 2105-2130.

France: O.R.T.F. (Maison de l'O.R.T.F., 116 Avenue du President Kennedy, Paris 16) has English 0515-0530 9,500/11,960; 1100-1115 17,850/21,650; 1300-1330 15,245/17,740/21,580; 1915-1930 15,245/9,700.

Germany: *Deutsche Welle* (Bruederstrasse 1, Postfach 344, 5 Koln) has made following changes in English TX: 1550-1620 11,765/15,435; 1100-1115 11,930/15,275/17,875; 1900-1910 11,925/15,380.

Westdeutschen Rundfunk Wallrafplatz 5, Koln) is to increase the power of its 1,586 TX to 800kW.

Radio Free Europe (1 Englisches Garten, Munchen) shows the new frequencies of 7,215 and 21,575 in its latest schedule.

Great Britain: BBC (CEXB, Bush House, London, W.C.2) using 25,750 for 1200-1300 Chinese TX.

Holland: *Radio Nederland* (P.O. Box 222, Hilversum) using 25,610 for some programmes. The 1600-1720 Sunday Happy Station session has been reported on 17,765/11,730 A special QSL is to be issued from April 28 to October 7 to commemorate the Canadian Expo 67 exhibition. A new picture series will then follow.

Hungary: *Radio Budapest* (Brody Sandor—S.U. 5—7, Budapest VIII) now uses 3,995/6,234/7,100/7,220/9,833 for the 2200-2230 English session.

Italy: *R.A.I.* (Viale Mazzini 14, Rome) has completely revised schedule. English is now aired as follows: 2135-2155 9,710/7,275/6,050; 0100-0120 11,810/9,575; 2200-2255 11,905/9,540/6,095; 0350-0410 17,770/15,310/11,905; 0425-0504 7,275/6,050; 2025-2045 9,575/7,235/6,130.

Monaco: *Trans World Radio* (Rue de la Poste 5, P.O. Box 141, Monte Carlo) has English 0630-0730; 7,295; 0730-0815 9,655/7,295. 0815-1000 Sunday, 1200-1245, 1430-1530 9,655. Frequencies are subject to confirmation.

Poland: *Radio Warsaw* (Warsaw). Revised European English schedule is: 1830-1857, 2130-2155 9,525/7,125; 1930-2000 9,525/7,285/7,125/1,502; 2030-2100 9,675/9,540; 2230-2300 9,540/7,285/1,502; 2303-2330 818.

Rumania: *Radio Bucharest* has new English transmission at 1200-1230 on 11,920/15,250 and 1300-1330 11,920/15,250/15,318. The 1500-1530 is now on 11,885/11,920/15,250.

Spain: *Radio Nacional de Espana* (General Yague 1, Madrid) has a new Hungarian TX at 1300 on 9,760.

Sweden: *Gothenburg Radio* (Omsala) reported testing at 0700, 1223 and 1715 on 11,820. Does anyone know anything about this station?

Radio Sweden (Box 955, Stockholm 1) now has English: 0900-0930 9,625/21,585; 1100-1130 9,625/15,240; 2015-2045 9,625/11,705; 1900-1930 11,705/17,840; 1230-1300 15,240/21,690; 2245-2315 9,620/11,705; 1400-1430 21,585/17,840; 0515-1545 17,840; 1600-1630 17,840/15,240; 0200-0230, 0030-0100 11,805; 0330-0400 11,705; 2330-2400 1,178.

Switzerland: *Swiss Broadcasting Corporation* CH 3000, Bern 16). The summer English schedule is: 0130-0315 6,120/9,535/11,715; 0515-0700 9,695/11,715; 0700-0900 (not Sundays) 6,135/9,535; 0700-0900 9,590/11,775/17,890; 0915-1030 15,305/21,520/17,830; 1115-1300 9,665/11,865; 1315-1500 15,235/17,775/21,520; 1515-1700 15,305/17,830/21,540; 1900-2045 9,665/11,865. Available transmitter powers are now 25/100/150/250 kW.

U.S.S.R.: *Radio Moscow* (Moscow) now broadcasts 24 hours a day in Chinese to China.

Radio Kiev (Ukrainiske Radio, Radio Centre, ul Khreshchatik 24, Kiev, Ukrainian SSR) has English to Europe Mondays, Thursdays and Saturdays at 1900-1930 6,020/6,040/9,640; 2230-2300 1,241. To North America on the same days 0030-0100 7,120/7,280/7,290/7,330/9,680; 0430-0500 7,250/7,290/7,330/9,600.

Yugoslavia: *Radio Belgrade* (70 Borisa Kidrica, Belgrade) has English 1530-1600 11,735/15,240/9,505; 1830-1900 6,100/7,200; 2200-2215 1,268/6100/7,200/9,505.

Clandestine: *Radiofonicas Stamos i Foni.* This is a communist station with Greek programmes produced in East Germany and probably transmitted from Bulgaria. It can be heard 0510-0545 on 6,215 and 1730-1800 on 8,065.

Radio Portugal Libre transmits at 0700-0730 on 12,008; 1200-1230 11,510;1900-1930 and 2115-2145 9,445.

Radio Espana Indepentiente transmits 0600-0700 6,950; 1300-1400 15,365; 1615-1800 9,430/10,130; 1800-2230 6,950/7,005/9,430.

Contributions came this month from Radio Sweden, R. J. Warner, A. E. Roxburgh, R. Severn, J. McDonald, J. W. Smith, D. S. Abbott, K. Proctor, W. E. Bartlett, D. Owen, J. Fitzgerald, and the Swiss Broadcasting Corporation.

WE will spend two minutes with heads reverently bowed in silence before pressing on. This token of mute sympathy is for the G3JDG receiver which passed peacefully away—just as ten metres was beginning to get interesting too. The mains "trany" has shorted itself out so it looks like I'm stuck with the t.r.f. until after Easter. Have you ever noticed how things always break down on a Sunday or a bank-holiday, when all the shops are shut? Prior to being struck "mains tranyless" however, things were going great guns and most bands appeared to be very busy. Ten metres has yielded VK stations at 5 and 7 on a.m. phone; fifteen has gone literally potty with signals at times and seems more consistently open these days; twenty has been, well twenty, lots of DX and quite good openings to the Pacific and Oceana. On seven megs lots of noise, commercials and DX too if you can stand the pace and have the skill to winkle them out. Eighty metres, well I didn't do too well this month but others have sent in some very fine logs for 3·5 so it must be me. (More exciting confessions next month.)

LOW FREQUENCIES

Still very few people send logs for the l.f. bands. Everyone seems to stick h.f. where DX falls like ripe plums into the ears of anyone who cares to listen out. Some people are persistent however.

N. Henbry (Sussex), EA12, 20 metre dipole for 7mc/s, 7ft. vertical copper rod at 30ft. for all other bands. Norman really goes to town on the l.f. segments. On 80 s.s.b. he logged—FØAO/M, K1SLZ, K2DPA, K3UQU, K4SXT, K7UIT/9A1, KP4AST, TF3EA, TI2NA, VE1AHP, VE2BTS, VS9ALV, W1ZBT, W2ZPO, W3BMS, WA3DCG, W4SIB, 3A2MJC, 3AØAE, 3B1FG, 3C1UA, 3C2WM, 3C3FJZ/SU, 9H1AB. Up higher on 7Mc/s the log reads — CN8AW, CN8BV, GC8HT, K5OSH, PZ1CF, WB2CKS, W4OMW. It's no good, I shall have to lay a long lead from Norman's shack to my place to plug in a spare pair of phones.

L. Smith (Glasgow), 19 set (modified), 66ft. long wire went s.s.b'ing on forty and hooked—CN8AW, CN8BB, DJ4AX, DJ7QV, DL9ME, EP3AM, I1BAF, OE2EGL, PY6NW, UA3KBO, UB5KIW, YU3LB. Nearly all the reports this month were for the h.f. bands, so let's turn the bandswitch to 20/15/10 and see what's about.

HIGH FREQUENCIES

A. Darragh, QTH not stated so we'll put him down as no fixed abode, GC1U, 100ft. long wire running N/S. On 20 s.s.b.—AC4AK, CE1FC, CE3TS, CP8OS, CT1BK, EP1BP, EP2BI, HI8LAL, HK4KL, HV3SJ, IS1KW, JA—1AEA, EZT, 4TRV, KC6BW, KH6BT, KL7BZ, KR5CUN, KR6UL, KS6BT, LU5AH, OX3LY, OX4AA, OY7S, PX1PA, TF3EA, TG2IA, TG8IA, TI2PAS, TU2DC, UA7JA, UA9FC, UF6KPA, UJ8KAA, UN1CC, U5ARTEK, VK—2ID, 3AUP, 4KS, 5LT, 6KK, 7SS, W4EFB/P/KH6, XE1FFA, XF1KB, YS1AG, ZL—1AI, 3BE, 3QH, ZS—2PD, 3FT, 6AJL, 6RA, VU2BX, 3A—ØAE, 2BS, 2MJ, 2RJC, 3B—1GL, 3C—3BVE, 5SV, 6ALX, 7ZU, 8AD, 4U1SU, 4X4MO, 5A1TV, 5A5TV, 5H3TG, 6Y5MJ, 9G1ND, 9H1A, 9M2DX, 9X5PB.

S. Porter (Surrey), has an R1155 with a 20 metre dipole. He reckons the best time to listen is around sunrise, and from 1800 onwards. His log for twenty includes — EL3D, KA6BFU, KP4CSV, KP4AXC, VK2NI, VK2ID, VL9UC, XE1CE, YV5BSL, 3A2KO, 4X4BL, 5A5TV, 7XØAH, 9X5A.

D. Clark (Bucks), progressive s/het plus PR30, 60ft. NW/SE, 20 s.s.b.—IS1DMN, K1EPG, K2AGZ, K3FGO, K4LZU, K5ZSX/MM, KG6AQG, KL7EBK, KP4ID, KR6UL, OD5FA, OX4VT, SVØWII, TF3HS, VE1ACD, VE1AGH, VE3DJE, VK2AFD, VK3SX, W—1/2/3/4/5/9/Ø, WA8CH/MM, YN1JW, YV4AZ, ZE1AE, ZF1GC, ZL3UY, ZS1JM, 3A2CP, 5A1TG.

P. Baker (S. Wales), HE30, 120ft. l.w., heard these on 15 metres, mostly s.s.b. the rest a.m.—CN8FT, CR3KD, CR4BA, CR7BO, CR8AL, CT2AP, EA6BG, EA9EJ, EL6B, EP2RT, EP3AM, HC2SW, JA—1OYY, 1TTL, 4AXW, 9JX, K6PIZ, KP4CQV, KV4CX, MP4—BBA, BGM, BGL, OA4TF, OD5BU, OX5AR, PY9AI, VE6QG/SU, SVØWL, TF2WKE, TI2RLJ, UA9DT, VE7PV, VK5HT, VS9ALV, WB2FBQ/MM, W6ITA, W7VSM, YS1TF, ZE6JL, ZL—3KA, 4JI, 4MZ, ZB1YR, 3C5HV, 3C6AJY, 4X4LL, 5A1TV, 5N2ABB, 7XØWW, 9G1EZ, 9H1X, 9U5BB.

J. Preece (Cheshire), PCR3, 60ft. l.w., 15 metres all a.m. — CN8CF, CO8RA, CR4EJ, CR6AU, CR7FM, EA9EJ, EP2RT, FG7XE, FM7WQ, HC2SW, HI8BGA, KG6AAY, LU5DZ, MP4BGL, OD5ET, PY1MGW, ST2SA, SV1DL, TF5TP, TJ8AC, VP6BW, WA5QQF, W6QBA, YV4ON, ZE6JE, 3C3GCO.

P. Knowles (Cheshire), CR45 plus PR30, 70ft. l.w., listened on ten metres a.m. for—CT1JW, EA3HL, K1ZFP, LA2XK, MP4BGM, UA3AWK, UB5EVW, VP7NP, W1DT, WB2QEH, ZS6RQ.

G. Taylor (Staffs), HE30, 135ft. l.w., ten metres a.m.—PJ3CL, VP6UN, XE1CT, 9Y4BS, on s.s.b.—CR7ER, DU1FH, EP2GI, FG7XL, HC1MF, JA2BVY, KV4EY, VK4TT, VP2MK, XW8AL, YV1EJ, ZE4JS, 5R8AS, 9L1TL.

P. Allsop (Derby), GC1U, 66ft. l.w. all a.m. on ten metres — K1ZKD, K2BJR, K3HTZ, KØQMU/P, VE3CKM, W1UHY, W2BFZ, W3DJW, W5WS, W9MZM, XE2CJ, ZC4MO.

P. Elliott (S. Africa), 5 valve s/het, 105ft. l.w logged these on phone on 10—CE6EZ, HBØWEE, KR6BF, KV4CX, KV4EY, MP4BBA, OD5EC, PY2PA, SVØWFF, VE6ALA, WA6UEK, YA5RG, YV1PP, YV3FBP, 3C3FDZ/P/SU, 4Z4AO, 5N2ABA, 5R8AS, 9H1HR, 9M2LO, 9V1NY.

WHERE AND WHEN

Contests and rallies are on the increase now that the warmer months are coming. In May there's quite a few and my diary reads—7th, Thanet Mobile Rally at Ramsgate; 7th, 2 metre portable contest; 20th—21st, 1296Mc/s contest; 27th—28th, 432 Mc/s contest; 29th, Redbourne Fair (Herts) listen on 160; June 3rd—4th, National Field Day. Deadline for this month is 20th. The deadline for all logs in future will be the 20th of each month.

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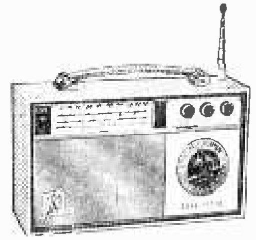

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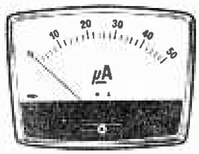

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3¼in.	Triple play, 600ft. Mylar	10	0	5¾in.	Triple play, 2400ft. Mylar	45	0
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5in.	Standard play, 600ft. PVC	8	6	7in.	Double play, 2400ft. Mylar	26	0
5in.	Triple play, 1800ft. Mylar	35	0	7in.	Long play, 1800ft. Acetate	15	0
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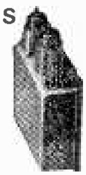

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VALVE UHF MODEL (illustrated)

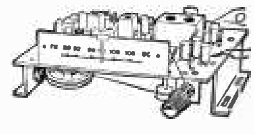
In metal case size 4 x 6 x 1½in. Fully tunable—complete with PC86 and PC88 valves. LASKY'S PRICE **29/6** Without valves **12/6**

TRANSISTORISED VHF TUNER

Sub-miniature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors. In metal case size 3 x 1½ x 2½in.

LASKY'S PRICE **37/6**

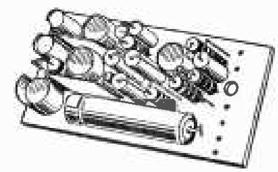
TRANSISTOR FM TUNER CHASSIS



Fully tunable— range 88 to 108 Mc/s. Completely wired on printed circuit. 10·3 Mc/s. IF. 6 transistors and 3 diodes. Slow motion tuning drive. Size 6½ x 4 x 2½in. Operates from any 9v. D.C. source. Full data and circuit supplied.

LASKY'S PRICE **£7.19.6** Post 5/- extra.

NEW—LASKY'S MINIATURE TRANSISTOR AMPLIFIER MODULES



Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extreme small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9v. miniature battery. Add 1/- on each for Post and Packing.

TYPE LRPC 1. 3 transistor. Input sens. 50mV. output 150mW output imp 40Ω, size 2 x 1 x ¾in. ...... PRICE **27/6**

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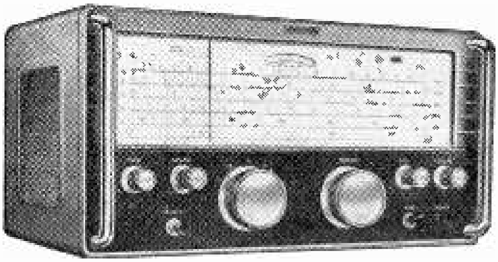

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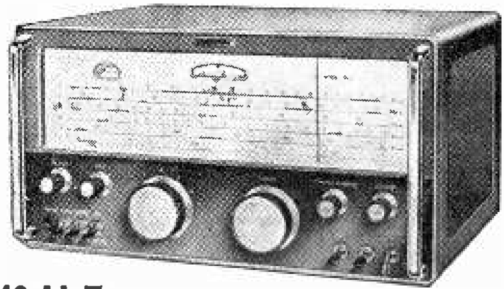

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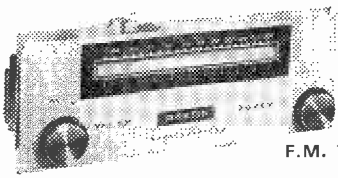
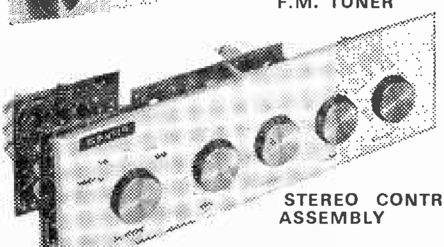


F.M. TUNER



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PW67

practically wireless commentary by HENRY

No. 34

Lead us not . . .

THE price of newsprint is going up. Space must not be wasted. It is Henry's duty to utilise this column in a forthright, serious, progressive way. This was underlined by a letter on Page 821 of the March PRACTICAL WIRELESS. I.N.R.W. Newport accused the Editor of wasting space in comment; space that could have been better used for constructional articles. The sting of Mr. Newport's letter came in the tail. "*A far better policy would be to refuse advertised non-convertible 27 Mc/s walkie-talkie spreads unless boldly indicated as such.*"

The key-word is *boldly*. Our correspondent expects the advertisers to proclaim: "Buy it NOW—but use it NEVER." He may be right. It is scandalous that potentially illegal apparatus should be blatantly peddled for the innocent reader to be corrupted. What about those radio tuners for the front end of your hi-fi kit, feeding a tape recorder aren't they just a little naughty? Even the impeccable Mr. Molloy released the secret (Page 839, same issue) that the phone output of the R1155 was suitable to load a tape recorder. Shame on him!

We must draw the Editor's attention to another article that appeared in the same issue. A top-band transceiver is described by T. Simon.

Here the felony is compounded by an attractive cover picture that even includes communications in foreign languages, aye, whisper it, from behind the Iron Curtain. What a gift to some potential George Blake.

The article bristles with law-breaking possibilities. In the first place, for only £15, our innocent is tempted to transmit. Or is it simply that the Editor is fanning another controversy on ham-licences and the anachronistic need to learn the Morse Code?

Let us look a little deeper at the article. Near the bottom of column 1, Mr. Simon tells us that in his area ". . . there is a strong break-through from the BBC at Brookmans Park (908 kc/s 2nd harmonic)". Who knows what else may break through, even using a well-peaked tank circuit. We may find ourselves clandestinely eavesdropping on the police, fire service, ambulances, even taxis. In a south-coast town even the dust-carts have two-way radio.

Further on we see two stages of modulation defended with the statement ". . . the QSO can be conducted in a confidential whisper with the mike gain half-way up." We have roamed the amateur bands and heard a few of those confidential whispers, thank you. It's a good job Mrs. Whitehead is only bothered about professional TV. What a fine hunting ground the ham-bands would provide for someone with a prurient mind.

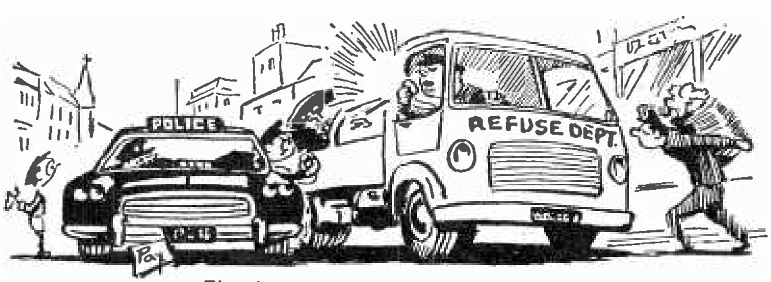
True, Mr. Simon cares about v.f.o. swishers and does his best to eliminate the beat note. He also uses frequency modulation the better to avoid t.v.i. Perhaps Mr. Newport would wonder darkly whether he has some ulterior motive — perhaps the family has demanded uninterrupted Coronation Street.

Yet the constructor still has to put 100pF across the mike to avoid BBC re-radiation. Tape recorder owners will recognise the phenomenon. Free radio programmes, lightly veiled in an innocent text. It's anarchy, that's what!

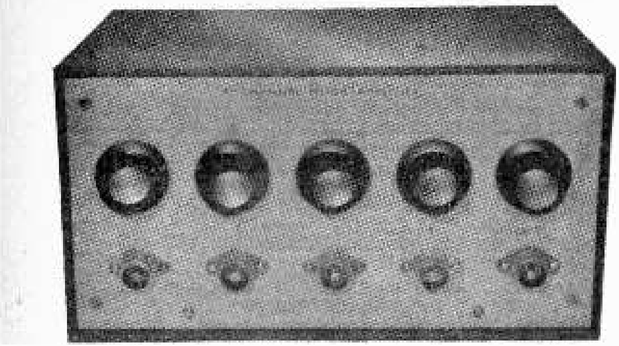
But Mr. N is more concerned with the advertisers. He worries about Swish not washing whiter than white noise. He forgets that we are conditioned to the blandishments of the adman and don't believe half of what we read, hear and see. Has he thought of the awful possibilities—the unsuspecting reader who buys and builds a kit that doesn't work, then offends the local litter-laws by throwing it out of the window? Or the student who chucks up his butcher's apron for a correspondence course and electrocutes himself with a 9V battery.

Somewhere a heart beats more strongly because Messrs. Super-Fi have advertised their home video tape link. What a prospect this conjures up! All your favourite programmes canned while you are out shopping, for a paltry ten quid an hour—or, as the advertisers say piously, much less when the demand steps up. To follow the argument through, we ought to ask for video tapers to apply for some kind of licence.

Henry stands aghast. The thought of such electronic sins being committed all round appalls him. Perhaps it is as well the price of newsprint is rising—there will be less room per issue for policy-bending letters.



The dust carts have two-way radios



4-CHANNEL mixer/amplifier

F. L. THURSTON

A DESIRABLE item in any audio enthusiast's list of "accessories" is a good quality mixer, to enable a number of inputs to be added together to give a single, complex, output signal. This four-channel mixer contains a 500mW power amplifier and makes the device very versatile and suitable for use either on its own as a multi-input, general purpose, power amplifier, or as a fairly conventional mixer capable of driving a speaker or a low impedance feeder line. Semiconductors are used in this high gain unit, which features good stability and quality with low noise and low inter-channel interaction.

BASIC DESIGN PRINCIPLES

A conventional "mixer" consists of some kind of combining circuit, followed by an amplifier which compensates for any attenuation which takes place in the adding process. In the unit we are considering here, an additional power amplifier "block" is provided so that the simplified block diagram of our unit is as shown in Fig. 1a.

Dealing first with the "mixer" part of the unit, a passive adder type is used, and is shown in basic form in Fig. 1b. Here, only two channels are shown; each input is applied across a variable resistor and a proportion of the input signal is tapped off at the slider and applied to a series circuit comprising either R1/R3 or R2/R3. Thus, the two input currents flow in the common resistor, R3. The output voltage developed across this resistor is proportional to the sum of the input signals. R3 may be made common to as many input signals as are required.

When this basic "mixer" circuit is redrawn as in Fig. 1c, it can be seen to be nothing more than a couple of potential divider circuits. The approximate values of input impedance, input-to-output attenuation, and inter-channel interaction can be established at a glance. Note that "worst case" values are shown, with VR1 and VR2 set for maximum sensitivity and with input 2 open circuit. In this case, the input impedance to input 1 is approximately 55kΩ, and, if 1 volt is applied, the attenuation will be such that 55mV will appear at the output, and inter-channel interaction will be such that 25mV will appear across input 2. Input impedance will vary with the setting of VR1, and will be at maximum (100kΩ) when VR1 is set for minimum sensitivity. The attenuation factor between VR1 slider and the output will be virtually constant.

The most important factor, as far as quality is concerned, is the inter-channel interaction factor, as this will cause distortion between the inputs if it is high. In practice, this factor will depend on the setting of VR2 and the source impedance of the signal connected to input 2. Typically, when 1 volt is applied to input 1 and zero input is applied across input 2, from a 1kΩ source, and both VR1 and VR2 are set for maximum sensitivity, only 0·22mV will appear across input 2 and interaction

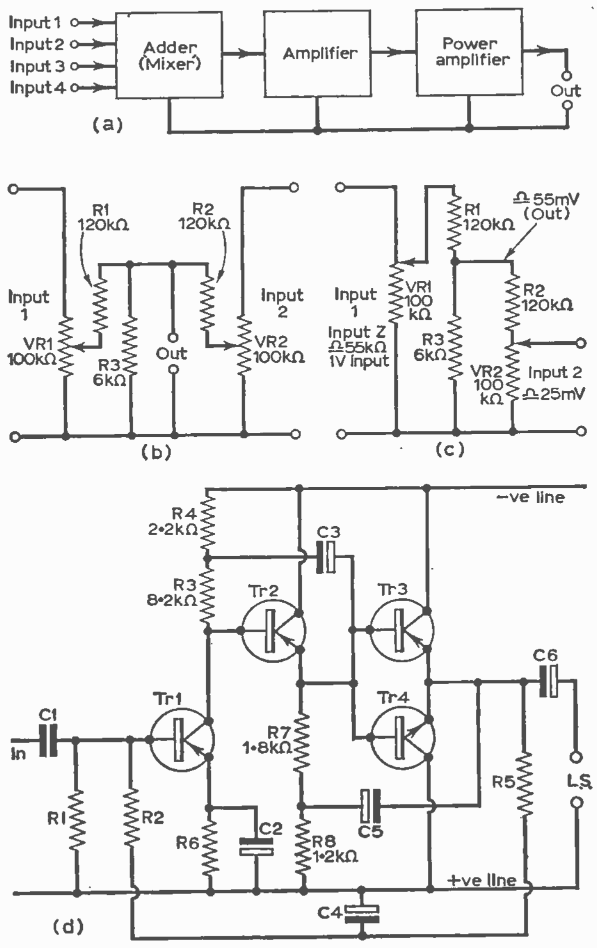
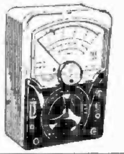


Fig. 1: 'a' block schematic of the mixer/amplifier; 'b' basic two-channel mixer; 'c' basic mixer re-drawn to show potential divider effect, with worst-case values; 'd' basic circuit of the amplifier section of the unit.

NEW MODEL 500. 30,000 o.p.v. With overload protection, mirror scale. 0/.5/1/2.5/10/25 / 100/250/500/1,000v. D.C. 0 / 2.5 / 10 / 25 / 100/250/500/1,000v. A.C. 0 / 50µA / 5 / 50 / 500mA. 12 amp. D.C. 0 / 60K / 6 Meg./60. Meg Ω. £8/17/6. Post Paid.



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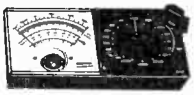

With automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts, D.C. and A.C. 0-500 µA, 10 mA, 250 mA. Current: 0/20 K, 200 K, 2 megohm. Decibels — 20 to + 22db. £5/10/0. P. & P. 2/6.

TE-900 20,000Ω VOLT GIANT MULTIMETER

6in. full view meter. 2 colour scale. 0/2.5/10/250/1,000/5,000V. A.C. 0 / 25 / 12.5 / 10 / 50 / 250 / 1,000 / 5,000 V. D.C. 0 / 50BA/ 110 / 100 / 500 mA 10 amp. D.C. 02K / 200K / 20 Megohm. £12/19/6. P. & P. 5/-.

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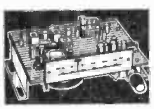

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6in. × 4in. × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 volt battery. Coverage 88-108 Mc/s. Ready built ready for use. Fantastic value for money. £6/19/6. P. & P. 2/6.

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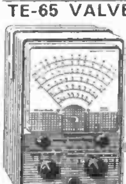

High quality instrument with 28 ranges. D.C. volts 1·5-1,500 v. A.C. volts 1·5-1,500 v. Resistance up to 1,000 megohms. 220/240 v. A.C. operation. Complete with probe and instructions, £15. P.P. 6/-. Additional Probes available: R.F. 35/-; H.V. 42/6.

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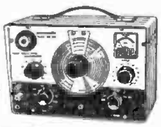

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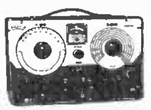

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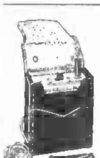

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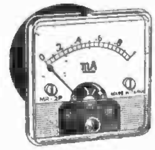

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		10mA	22/6	5A D.C.	22/6	50V A.C.	22/6
50µA	32/6	20mA	22/6	3V D.C.	22/6	150V A.C.	22/6
100µA	29/6	50mA	22/6	10V D.C.	22/6	300V A.C.	22/6
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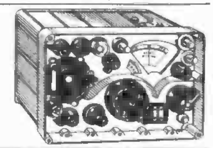

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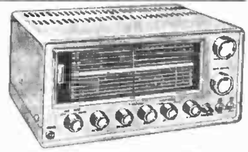

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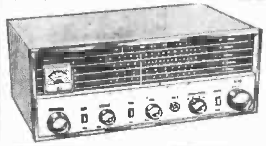

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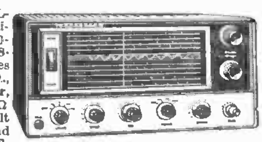

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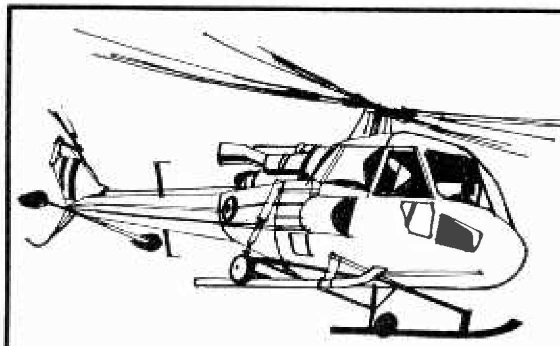

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2µF	9 volt	10µF	6 volt	64µF	16 volt
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2µF	150 volt	12·5µF	4 volt	100µF	10 volt
2·5µF	16 volt	12·5µF	40 volt	100µF	12 volt
2·5µF	25 volt	16µF	16 volt	100µF	15 volt
3µF	3 volt	16µF	30 volt	150µF	12 volt
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3µF	25 volt	20µF	3 volt	200µF	3 volt
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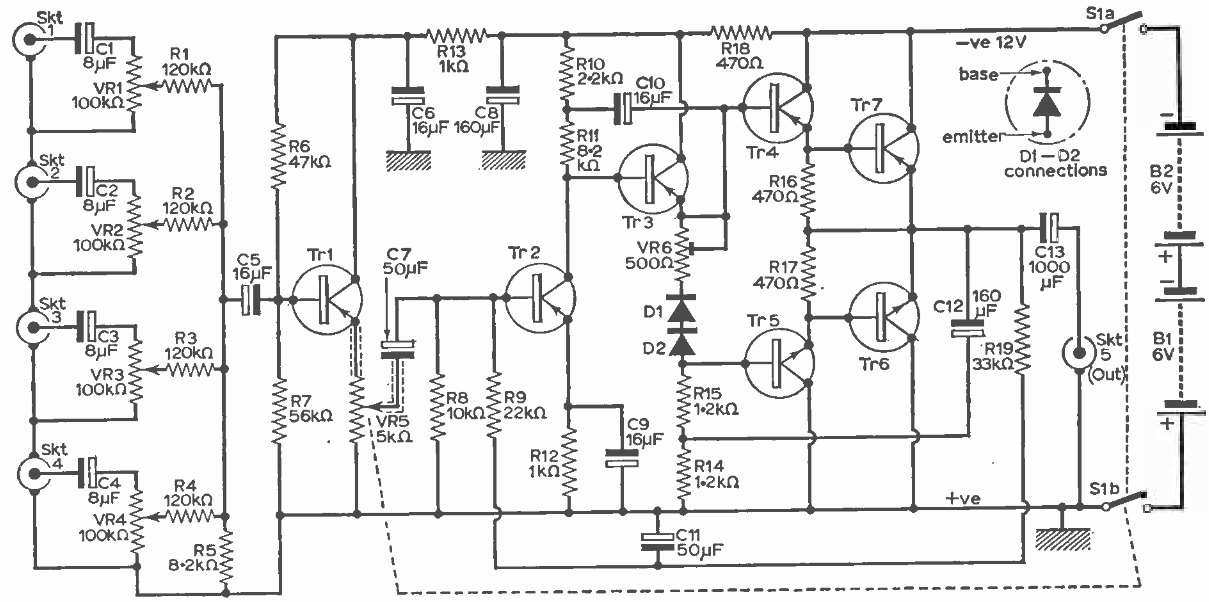


Fig. 2: Complete circuit of the four-channel mixer/amplifier. Note: the two diodes may be made from old p-n-p germanium transistors, see the inset in the top-right corner for connections.

will be negligible. The performance of this simple type of circuit can thus be seen to be "adequate", so the basic principles of the amplifier circuitry can now be considered.

The basic design requirements of the unit call for an amplifier with a very high degree of gain but with good stability and low distortion. Such an amplifier is, of necessity, rather complex; the basic principles of the amplifier are therefore best understood by first referring to the simplified circuit diagram shown in Fig. 1d. Here, the input signal (from the mixer) is connected via C1 to the base of Tr1, which is connected as a common emitter amplifier with its collector load split into two parts, R3 and R4. If the output from Tr1 collector were fed in the normal way to a following amplifier stage, the input impedance of this second stage would be effectively in parallel with Tr1 collector load and would thus reduce its effective value and hence lower the gain of Tr1. In Fig. 1d this problem is overcome by using emitter follower Tr2 as a buffer between Tr1 collector and the following stages, the amplified output from this "pair" being taken from Tr2 emitter. Since Tr2 has a high input impedance, Tr1 can be given a very high value of collector load, with consequent high overall gain.

In practice, the maximum usable value of Tr1 collector load is dictated by the d.c. and temperature stabilisation requirements of the circuit, and, in this particular application, the maximum usable

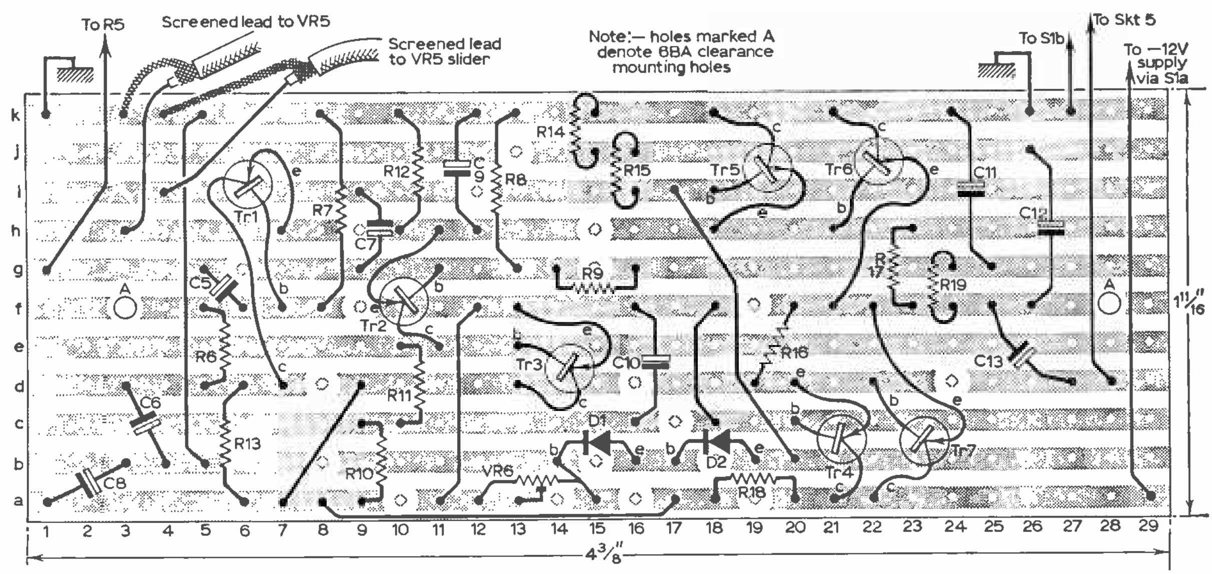
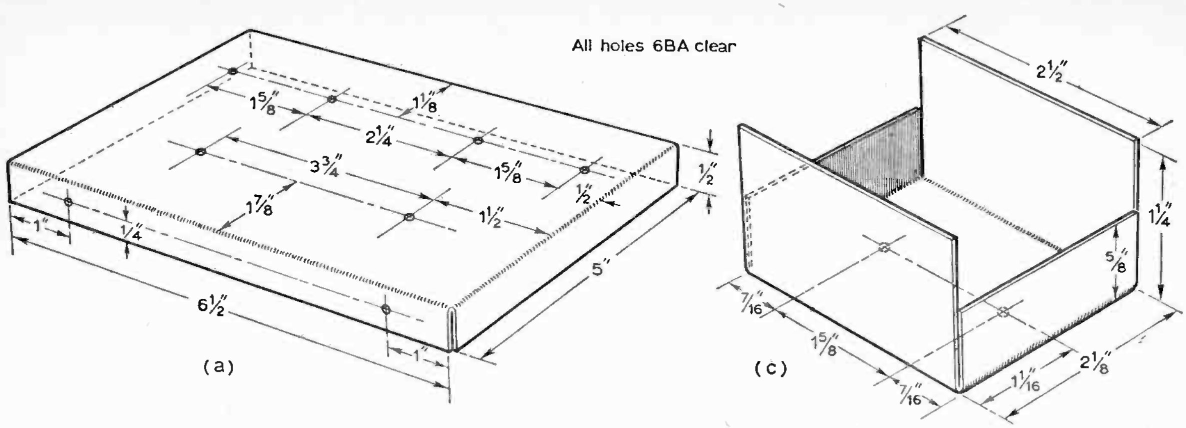


Fig. 3: Constructional data for the Veroboard panel. Care must be taken not to short the individual copper strips when soldering-in components.



(b)

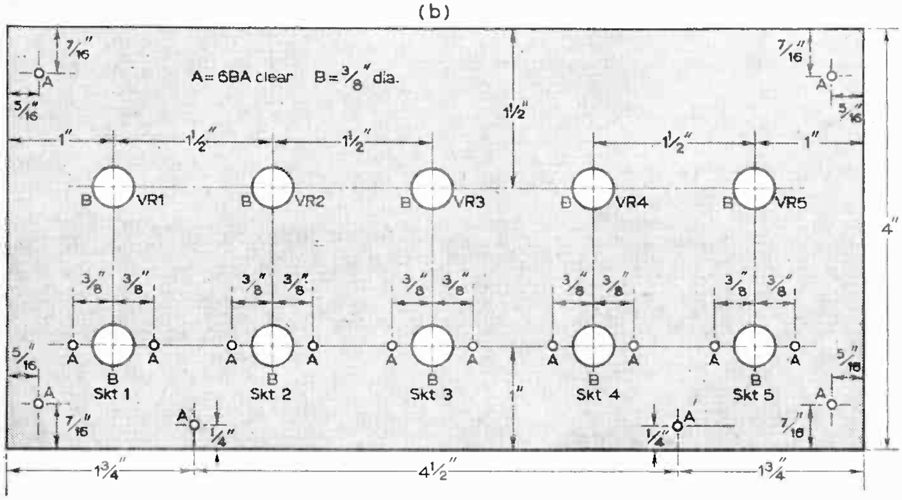


Fig. 4: Metal-work data. 'A' shows the main chassis; 'B' the front panel; and 'C' the battery holder. Two battery holders are needed for this unit.

value is set at about 10kΩ. It is possible to increase the effective value of the collector load without changing its real or d.c. value; referring to Fig. 1d, the signal at the emitter of Tr2 is of the same form and phase as the signal at Tr1 collector, but these two signals are effectively isolated from one another by the impedance transformation action of the emitter follower. In the diagram, Tr1 collector load is split into two parts, R3 and R4, and the signal appearing at Tr2 emitter is fed via C3 to the R3-R4 junction. Thus, when an input signal is applied to Tr1, similar a.c. signals appear at both ends of R3 and very little signal current flows in this resistor, which reacts as a high impedance, even though its resistive value is fairly low. In practice, the effective value of R3 may be increased to ten times its real value, giving consequent high gain. This technique of increasing the effective value of a resistance is known as "Bootstrapping".

The output signal at Tr2 emitter is direct coupled to the bases of Tr3 and Tr4, which are wired as a compound connected p-n-p/n-p-n emitter follower pair, giving unity voltage gain but a very low (virtually earth) output impedance, which is fed to the external speaker via C6. As in the case of Tr2, the Tr3-Tr4 emitter followers give an output that is of the same phase and form as their input signal (from Tr2 emitter), but the two signals are effectively isolated from one another by impedance transformation; the output signal from Tr3-Tr4 is therefore used to Bootstrap the R7-R8 emitter load of Tr2, and to increase the effective input impedance of Tr2 and indirectly further increase the effective value of the collector load of Tr1.

The input impedance of an emitter follower is given (approximately) as the emitter load, R_L, times the β of the transistor, so that, in Fig. 1d, the effective value of the emitter load of Tr2 is dictated by the βs of Tr3 and Tr4 and the impedance of the speaker. The effective value of Tr1 collector load is dictated by this value times the β of Tr2. Since all impedance levels are interdependent throughout the circuit, the design automatically gives an optimum performance with whatever transistors are used.

The output transistors can be given a very high β by replacing the two individual transistors by Darlington or Super-Alpha-Pair connected transistors, in which case the effective collector load of Tr1 becomes so high that, on the prototype, voltage gains of 500 to 1,000 times are obtained when using a 15Ω speaker.

Note that direct coupling is used throughout the amplifier, and that the base-bias to Tr1 is obtained from the Tr3-Tr4 output via R1, R2, R5, so that a d.c. negative feedback loop is set up which fully stabilises the working points of all transistors used in the circuit. Also note that all signals from Tr1 collector onwards are in anti-phase with the input signal, so that any stray feedback will be degenera-

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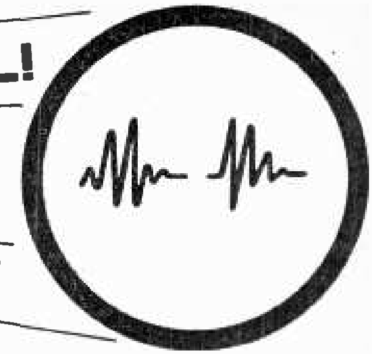

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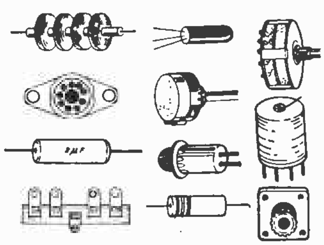

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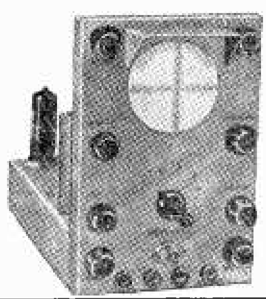

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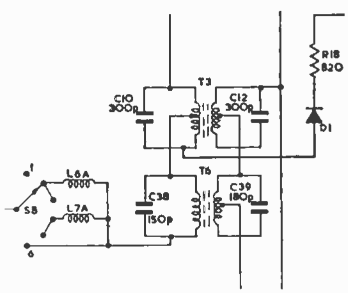

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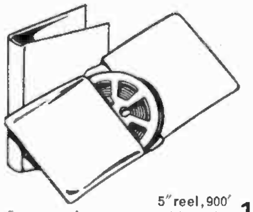

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7B7	7/-	DAF96	6/-	EF80	4/9	PCF806	11/6	UBL21	9/-	OC75	5/9
7C5	9/6	DCC90	7/-	EF85	5/-	PCL82	6/9	UC92	5/6	OC81	3/6
7C6	6/9	DF33	7/9	EF86	6/3	PCL83	8/6	UCC84	7/9	OC81D	3/6
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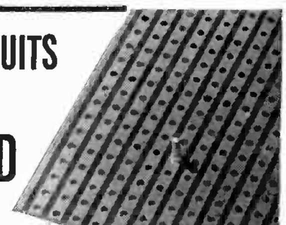

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tive, rather than regenerative, and very good circuit stability is thus obtained. Having cleared up the main details of the circuit, the final version of the completed unit can now be considered.

HOW THE CIRCUIT WORKS

The full circuit diagram of the completed unit is shown in Fig. 2. Here, the four inputs are applied to the variable resistors, VR1—VR4 via the co-axial sockets Sk1—Sk4 and the blocking capacitors C1—C4, and the input currents are added in R5 via R1—R4. If the output of the mixer, taken from across R5, were fed directly to the input of a common emitter amplifier the comparatively high input capacitance of the transistor would be effectively in parallel with R5 and would result in an increase in attentuation at the higher frequencies. This is overcome by feeding the output of the mixer to the base of emitter follower Tr1, which has a very low input capacitance.

The signal tapped off from the slider of VR5, the volume control, is fed, via C7, to the base of the common emitter amplifier, Tr2, which has its collector load, R10—R11, "Bootstrapped" from the emitter of Tr3 via C10. The amplified signal at the emitter of Tr3 is fed to the base of the p-n-p Darlington-connected emitter follower pair Tr4/Tr7 and to the base of the similarly connected n-p-n pair, Tr5/Tr6. Diodes D1 and D2, and VR6, in the emitter of Tr3, are used to apply a degree of temperature compensated base-bias to the output transistors and so minimise any cross-over distortion which might otherwise occur. The very low impedance output at the emitters of Tr6/Tr7 is fed to the output socket, Sk5, and thence on to the external speaker, via C13. Bootstrapping is applied from Tr6/Tr7 emitters to the R14—R15 emitter loads of Tr3 via C12. Overall d.c. negative feedback is achieved via R8, R9, R19; decoupled via C11.

A 12 volt battery supply is used, and an output power of well over 0·5 watt is available when feeding a 15Ω speaker.

CONSTRUCTION

For ease of construction, the major part of the circuitry is wired up on a small piece of Veroboard. Start construction by cutting the panel to size, as shown in Fig. 3a, and breaking the copper strips where indicated. Now drill the two small mounting holes, to clear 6BA screws, where shown, and cut back the copper around them to eliminate risk of short circuits when the panel is secured to the main chassis.

Now solder all components, shorting links, and leads in position on the panel as shown in Fig. 3b. Note that all components, other than R7 and R13, are mounted vertically. Insulated sleeving should be used where there is any danger of short circuits occurring. Before attempting to fit VR1 in place, reduce the width of the three mounting legs, with the aid of a small file, so that they fit easily in the holes in the Veroboard. Particular care should be taken to ensure that all electrolytic capacitors are connected with the polarities shown. Heat shunts should be used when soldering all semiconductors in place.

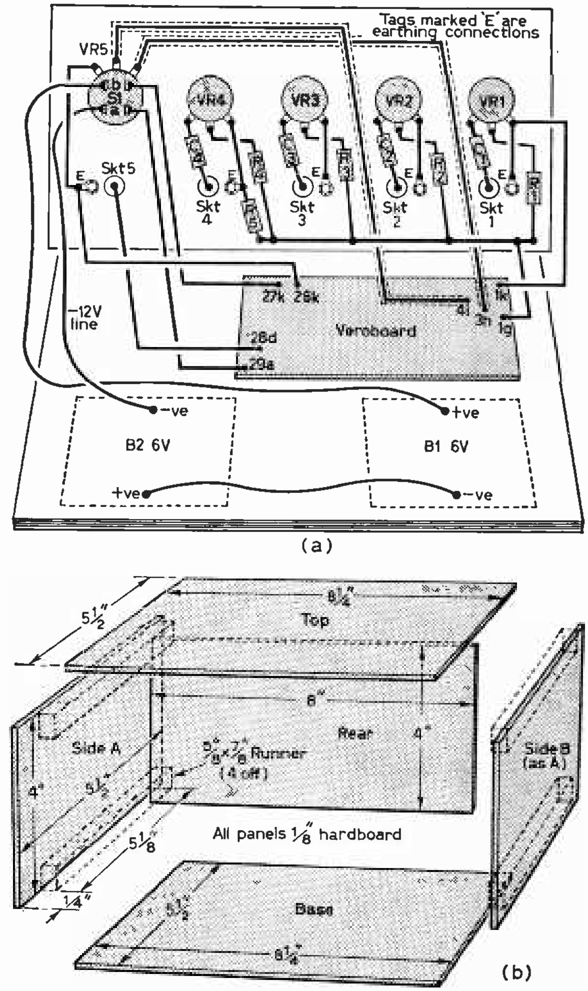


Fig. 5: 'a' shows the wiring details and 'b' cabinet details.

If preferred, D1 and D2 can be made from any scrap p-n-p germanium transistors, providing that the base-emitter junctions are intact, by cutting off the collector leads and soldering the resulting "diode" in place as shown.

When the assembly of the Veroboard panel is complete, double-check all wiring and make sure that no short circuits are occurring between the copper strips. If satisfactory, the circuit can now be given a functional check. Temporarily connect VR5 in place, set VR6 for minimum resistance, short the input to ground, and connect a 12 volt supply to the unit, taking care to monitor the supply current; the unit should draw about 8mA. Now connect a 15Ω speaker to the output, and check that there is no appreciable increase in mean current. If satisfactory, an input can be connected from a tuner, etc., and a functional check carried out; VR6 should be adjusted to give negligible cross-over distortion consistent with a low no-signal mean current, which should work out at about 10 to 12mA.

If the performance of the circuit is satisfactory, it should be run at fairly high volume for a few minutes, to make sure there is no tendency to thermal runaway. If there is any tendency to runaway, the two output transistors (Tr6 and Tr7) should be fitted with heat sinks. Once these tests have been completed, the rest of the unit can be constructed.

Make up the main chassis, from light gauge aluminium, as shown in Fig. 4a, and cut and drill the front panel, from a medium gauge aluminium, as shown in Fig. 4b. If a battery supply is to be used, cut and drill and bend the two battery holders, from light gauge aluminium, as shown in Fig. 4c; the batteries are held in place by friction. Before assembling these components, carefully cover the outer face of the front panel with Fablon or a similar self-adhesive decorative plastic material; a material with a light wood-grained finish was used on the prototype. Cut away the surplus Fablon with a sharp knife. Now secure the five sockets, Sk1 to Sk5, and the five variable resistors, VR1 to VR5, in place on the front panel. Next, bolt the front panel to the main chassis, and wire up as shown in Fig. 5a. When wiring up is complete, secure the Veroboard panel to the main chassis by passing two 6BA screws through the Veroboard and the chassis, using the mounting holes provided, and interpose two small rubber grommets between the chassis and the panel to act as spacers/insulators.

The main construction can now be completed by bolting the two battery holders in place. The two batteries should now be fitted in place and the unit given a final and complete functional check. The cabinet can now be made up, as shown in Fig. 5b. This is an easy assembly to make, the sides, top, base, and rear being simply cut from hardboard and screwed or nailed to four short lengths of wood which hold the unit in a box shape. When the cabinet has been assembled, smooth off all rough spots with a file or sandpaper, and then cover the complete job with Fablon or a similar self-adhesive decorative plastic. Finally secure the mixer/amplifier chassis in place with the aid of four small wood screws passed through the holes in the corners of the front panel, then mark the front panel with transfers or pressure sensitive lettering. ■

★ components list

Resistors:

All ½ watt, 10% carbon, except where otherwise stated.

R1–R4 120kΩ, 5% hi-stab
R5 8·2kΩ
R6 47kΩ
R7 56kΩ
R8 10kΩ
R9 22kΩ
R10 2·2kΩ
R11 8·2kΩ
R12 1kΩ
R13 1kΩ
R14 1·2kΩ
R15 1·2kΩ
R16 470Ω
R17 470Ω
R18 470Ω
R19 33kΩ
VR1-VR4 100kΩ variable
VR5 5kΩ variable with built-in on/off switch (S1)
RV6 500Ω skeleton pre-set

Capacitors:

All sub-min. 15VW electrolytics

C1 8μF
C2 8μF
C3 8μF
C4 8μF
C5 16μF
C6 16μF
C7 50μF
C8 160μF
C9 16μF
C10 16μF
C11 50μF
C12 160μF
C13 1000μF

Semiconductors:

Tr1 2G403 or NKT675
Tr2 2G403 or NKT675
Tr3 2G374 or NKT274
Tr4 2G374 or NKT274
Tr5 2N1304 or NKT713
Tr6 2N1304 or 2N1306
Tr7 2N1305 or 2N1307
D1, D2 OA70 (see text).

Miscellaneous:

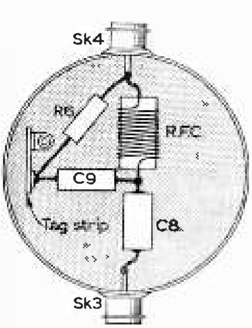
Sk1–Sk5=Coaxial sockets. B1–B2=6 volt, type DT1 batteries. Veroboard, wire, sleeving, screened cable, nuts, screws, grommets, aluminium sheet, Fablon, etc. 15 ohm speaker.

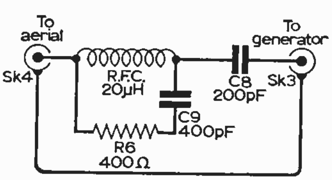
DUAL FUNCTION SIGNAL GENERATOR

—continued from page 119

in other types is the provision of an external socket to which the grid of the r.f. oscillator may be directly switched. Since the oscillator is of the two terminal type, oscillations may be set up in external coils without the use of tappings or separate feedback coils. What is perhaps more important is that oscillations may be set up in screened coils. Generally the presence of a screening can precludes the use of the more conventional grid dip oscillator technique. The author has found this facility to be of particular value when the resonance frequency of an unknown i.f. coil is required.

Let us suppose that an i.f. transformer in a receiver is suspect. The transformer is temporarily disconnected and one section connected via a short length of cable to the external socket of the generator. After switching the generator to this external coil, the signal emitted by the generator is picked up on a receiver. Let us assume that the i.f. transformer has a nominal resonant frequency of 470kc/s. A receiver set to the medium waveband will give a response in the neighbourhood of 940kc/s (319m), which is the second harmonic of 470kc/s. Although no account has been taken of the inevitable stray circuit capacitances, a response in this region is almost certain proof that at least one section of the transformer is functioning satisfactorily. The remaining section may be tested similarly. In the foregoing example it has of course been assumed that the i.f. transformer has its own built-in tuning capacitors. Further valuable uses to which the generator may be applied are coil matching and capacitor testing, details of which are given in the October 1964 issue of PRACTICAL WIRELESS. ■





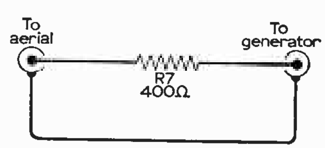


Fig. 5 (left): Layout of dummy aerial.

Fig. 6 (top right): Circuit of dummy aerial.

Fig. 7 (bottom right): Simplified dummy aerial.

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CV102	1/-	ECC83	6/-	EZ80	5/6	PCF86	8/-
CV103	4/-	ECC84	5/6	EZ81	4/6	PCF802	9/6
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CV4015	7/-	ECC91	4/-	F/6063	4/-	PCL81	9/-
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D41	6/-	ECH81	5/-	G50/2G	5/-	PCL86	8/-
D61	6/-	ECH83	7/6	G180/2M	15/-	PEN25	4/6
D77	3/3	ECL80	6/-	GM4	45/-	PEN46	3/-
DA30	12/6	ECL82	6/3	GTE175M	7/-	PEN200A	3/-
DAF96	6/-	ECL83	10/-	GU50	25/-	PFL200	17/6
DD41	4/-	ECL86	9/-	GZ32	10/-	PL36	9/-
DET5	8/-	EF36	3/4	GZ34	10/-	PL38	16/-
DET20	2/-	EF37A	7/-	HK54	22/6	PL81	7/-
DET25	15/-	EF40	8/-	HL2K	2/6	PL82	6/6
DF73	5/-	EF50	2/6	HL23	6/-	PL83	6/-
DF91	3/-	EF52	6/-	HL23DD	5/-	PL84	6/6
DF92	3/-	EF53	4/6	HL41	4/-	PL500	13/6
DF96	6/-	EF55	8/-	HVR2	9/-	PM24A	5/-
DK92	8/-	EF71	7/6	K3A	60/-	PT15	13/-
DK96	6/6	EF72	5/-	KT8C	22/-	PT25H	7/6
DL92	4/-	EF73	5/-	KT32	8/-	PT25M	7/6
DL93	4/-	EF74	4/-	KT44	5/9	PX4	14/-
DL94	5/9	EF80	5/-	KT63	4/-	PX25	12/6
DL96	7/-	EF81	6/-	KT66	16/-	PY33	8/6
DL810	8/-	EF85	4/6	KT67	25/-	PY80	5/6
DY86	7/6	EF86	6/6	KT71	5/-	PY81	5/6
E80F	23/-	EF89	5/-	KT76	8/6	PY82	5/6
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new books

> Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in **heavy** type should be quoted.

HOW TO LISTEN TO THE WORLD
Published by World Publications.
184 pages. 8¼ x 5¾in. Price 26s.

THIS is a new edition of a well established favourite. For those who have the previous edition there is little extra to be gained from purchasing this one. However, if you are a beginner and have had your appetite whetted by "PSE QSL" in the March PRACTICAL WIRELESS you will be helped considerably by this book.

Every aspect of DXing is covered both in theory and practice, and there are separate chapters on listening to various continents. For those with specialised interests there are chapters on learning languages by radio, listening to satellites and television DXing.

A good feature of the book is that every chapter is written by either a leading DXer or member of a short wave station's staff with the result that some good down-to-earth facts emerge. One slight disadvantage stems from this though in that inevitably there is a certain amount of overlap between chapters.

One disappointing feature is that the section How to write a report in Portuguese or Spanish is not in the latest edition. Even so a good buy for the beginner.—*JMG.*

NEWS FROM AROUND THE WORLD 1967
Published by O. Lund Johansen Ltd.
36 pages. 8¾ x 6½in. Price 15s.

ONE of the fascinations of owning a short wave receiver is that when a new world trouble spot appears one can listen to the news from the spot. Alternatively you can hear the news from the various power centres and compare. To do this you need to know quickly when the country concerned has a news broadcast in a language you can understand and this is where this publication from the World Radio TV Handbook stable comes in with its listings of news broadcasts by both country and language.

For the DXer the book has a second use as an aid to the identification of stations. Whatever the language you can always tell the news broadcast. Reference to this book will show the stations transmitting news at the time concerned with the result that a process of elimination will enable the station to be identified.

One word of warning; although the times of news broadcasts are unlikely to vary greatly during the currency of this book the frequencies will. So don't pay too much attention to the frequency listings given.—*JMG.*

HANDBOOK OF APPLIED MATHEMATICS
By E. E. Grazda, M. E. Jansson and W. R. Minrath.
Published by D. Van Nostrand Co. Ltd., 46 Victoria Street, London, S.W.1. 1,119 pages. Size 7¾ x 5¼in. Price 80s.

THERE can be no doubt that the authors of this book have given value for money. In over a thousand pages they have covered a wide variety of fields. The problem is that if one recommends this book, to precisely whom can it fairly be offered. Starting with a general treatment of the various sections of mathematics the authors continue for the remaining 800-odd pages with the application of mathematics to various professions. For example, separate chapters are devoted to—Plumbing, Carpentry and Building, Brickwork, Print Shop, Accounting just to mention a few. For the layman it's a bit high up. The table headed "Coefficients of Transmission (U) of Pitched Roofs" might well prove too much for a lay-handyman. On the other hand for the expert in a particular field, when he has read his chapter he will have another eight or nine hundred pages which are not applicable to his work.

As a person interested in mathematics as a whole, I found this book extremely interesting, and for those whose interests are parallel it would be a very useful addition to the bookshelf. Perhaps a better title would be "Applied Mathematician's Delight".—*DLG.*

ABC's OF ELECTRONIC TEST EQUIPMENT
By Donald A. Smith. Published by Foulsham-Sams Technical Books. 96 pages. 8½ × 5½in. Hard covers. Price 16s.

IF you buy your instruments ready-made, a book on applications will appeal more than this slim volume. If you are a kit-building enthusiast, the information given by a reputable kit firm should be more than adequate for your needs. There is little here to augment it, despite a neat plug for Heathkit in the preface. To whom then, should this book appeal? Perhaps the best way to expound is to describe its contents and leave readers to judge.

Chapter 1, predictably, describes the meter movement. Chapter 2 explains the Volt-Ohm-Milliameter, and the following chapter the basic design of the valve voltmeter. There is no mention of the later types of transistor millivolter or high impedance meters and it seems obvious that this book has not been revised since the original publication in 1963. Transistor testers receive a very perfunctory treatment and valve testers are hastily skated over.

Perhaps the greatest disappointment is Chapter 6, where a description of signal tracers does not include a single buildable circuit, nor any sensible details of the use of this very handy instrument. The chapter on oscilloscopes is longer, and more fundamental, but reveals very little practical circuitry and virtually no practical application.

Vital specifications are hardly mentioned at all.

Of all things to find in a purported instrument book, we find Battery Eliminators in Chapter 8. With modern regulated and transistorised power supply units, this chapter is something of an anachronism, just as the final chapter, on signal generators, has not reached the state of considering f.m. generators, wavemeters and other modern necessities.

The author is an electronics development engineer in instrumentation and his aim has been to give those intending to service electronic equipment a 'thorough understanding of test and measuring instruments'. It is a mystery why the publishers did not allow him the space to do so.—*HWH.*

Catalogue Received

G. W. Smith & Co. (Radio) Ltd., 3—34 Lisle Street, London, W.C.2 have just published their first comprehensive Catalogue of Electronic Components and Equipments. It contains over 150 fully illustrated pages and lists items ranging from relays to table lamps and communications receivers to zener diodes and amateur equipment.

The cost of the Catalogue is 5s. plus 1s. postage, but discount coupons included in the Catalogue enable the cost to be retrieved with purchases.

G. W. Smith carry the complete Lafayette range and are agents for Codar, Partridge Aerials, TW Electronics, Green, and Contactor Switchgear. They offer after-sales service and spares for all imported radio equipment shown in their Catalogue.

KEYING THE TEN-FIVE TX

—continued from page 103

"C.W." and apply power to the transmitter. After a suitable warming up period has elapsed rotate the Function switch to "Net" whereupon the stabiliser should glow. Check the current as monitored by the externally connected testmeter; this should be in the range of 15-20mA. Check that V1 is oscillating and that drive is available.

Connect a dummy load to the transmitter aerial socket (Sk3) and rotate the Function switch to "Transmit". Load up to approximately 8W. Check the current reading monitored by the external meter and compare it with the earlier reading; if the two readings differ adjust the value of R9 slightly in an attempt to make them equal each other. In the prototype this necessitated making R9=4·7kΩ.

Later, the external meter may be removed and pin 7 of the OA2 tube returned direct to chassis. The meter should then be set to read 0-250V d.c. when a reading taken from between the R4/Ry junction and chassis should be 150V at both the "Net" and "Transmit" positions of the transmitter Function switch.

When these tests have been satisfactorily carried out the dummy load may be replaced with the station aerial and after adjusting the transmitter in the usual way a call may be put out in either c.w. or phone modes. It will then be found that the 10W maximum input available under phone conditions can be increased to approximately 15W of c.w. on "80" metres. ■

NEW BARGAINS

MOVING COIL METER. 2½in. flush mounting 5-0-5mA centre zero. 25/- each.
MOVING COIL METER. 2½in. flush mounting 250-0-250 micro amps, centre zero. 29/6 each.
50 OHM 50 WATT WIRE WOUND POT-METER. 8/6 each.
1 MEG MINIATURE. Pot-meter Morganite standard, ¼in. spindle 1/- each. 9/- per dozen.
1 MEG MINIATURE. Pot-meter Morganite pre-set screwdriver control. 9d. each. 8/- per dozen.
PRE-SET 100K by Welwyn with intrical bakelite knob. 1/- each. 9/- per dozen.
100K POT-METER. Miniature type with double pole switch and standard ¼in. spindle, by Morganite. 2/- each. 18/- per dozen.
25K POT-METER Standard size with double pole switch by Egan with full length ¼in. spindle 3/- each. 36/- per dozen.
BLANKETSTAT GLASS. Enclosed, normally closed circuit will open should blanket overheat. 4/6 ea.
THERMAL RELAY. Can be used to delay the supplyof HT while heaters warm up, or will enable 15 amp. loads to be controlled by miniature switches or relays. Regular list price over £2 price 7/6 each.
SIEMENS HIGH SPEED RELAY. Twin 1000 ohm coils. Platinum points changeover contacts—Ex equipment. 8/6 each.
ELECTROLYTIC CONDENSER. 500MF. 50 v working. 5/- each. 48/- per dozen.
FOOTSWITCH. Two snap-action switches in metal box with flex lead. Ideal to control tape-recorder, dark room lamp, etc., 18/6, plus 2/9 postage and insurance.
TOGGLE SWITCH BARGAIN. 10 amp. 250 v. normal one hole fitting 2/9 each, or 30/- per dozen.
ELECTRIC LOCK. 24 v. coil, but rewindable to other voltages. 4/6 each.
COMPRESSION TRIMMERS. Twin 100 pF. 1/- each. 9/- per dozen.
MINIATURE RELAY. American make. 630 ohm coil. 20/30 volt operation. 2 pole changeover. 3/- each. 30 per dozen.
PRECISION WHEATSTONE BRIDGE. Opportunity to build cheaply. 100K wire wound pot. 15 w. rating, only 5/-.
SHEET PAXOLIN. Ideal for transistor projects. 12 panels each 5in. x 8in. 5/-.
3in. PM LOUDSPEAKERS. 3 ohm, 12/6. 80 ohm, 13/6.
TRANSISTOR FERRITE SLAB AERIAL with medium and long wave coils, 7/6 each.
SLIDE SWITCH. Sub miniature double pole changeover. 2/- each. 18/- per dozen.
MAGSLIPS (Selsyns). American made transmitter and receiver. 27/6 each. post 4/6 for any one or the pair.
Vacuum Cleaner Flex. Non-kinkable ribbed rubber, most pliable but very tough. 24/36 Cores. Normally 1/9 per yard, offered at £3 per 100 yard coil, post and insurance 8/6.
Sub-Miniature Silicon Diodes. General purpose type with gold-plated leads, 1/- each, 10/- per dozen.

MINIATURE WAFER SWITCHES

	Number of Positions				
	2	3	4	6	12
1 pole	3/6	3/6	3/6	3/6	3/6
2 pole	3/6	3/6	3/6	3/6	
3 pole	3/6	3/6	3/6		
4 pole	3/6	3/6			

Any 12 switches ordered together 40/-.

SEMI-CONDUCTOR BARGAINS

Type No.	Price	Type No.	Price	Type No.	Price
2N1727	15/-	MAT101	8/6	OC71	3/6
2N1728	10/-	MAT120	7/9	OC72	5/-
2N1742	25/-	MAT121	8/6	OC75	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
ACY17	8/6	OA79	2/6	OC81	5/-
ACY18	5/6	OA81	2/6	OC81D	5/-
ACY19	6/6	OA85	2/6	OC82	5/-
ACY20	5/6	OA90	2/6	OC83	5/-
ACY21	6/-	OA91	2/6	OC84	6/-
ACY22	4/6	OA200	3/3	OC139	8/6
AF114	7/-	OA202	4/3	OC140	12/6
AF115	6/6	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	15/-	OC200	9/-
AF118	10/-	OC26	7/6	OC201	12/6
AF139	12/6	OC28	15/-	OC202	13/6
AF186	17/6	OC29	17/6	OC203	12/6
AFZ12	15/-	OC35	12/6	OCP71	15/-
ASZ21	15/-	OC36	15/-	ORP12	8/6
BC107	14/6	OC42	6/6	ORP60	5/-
BY100	4/6	OC44	4/-	SB078	6/6
BYZ13	7/6	OC45	8/6	SB305	8/6
MAT100	7/9	OC70	4/-	SB251	10/-

SILICON RECTIFIERS

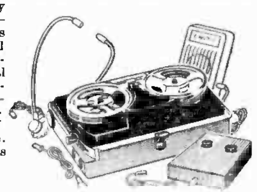
Tested and guaranteed

750mA.	100v.	1/3	1 Amp.	100v.	3/-
	200v.	1/6		200v.	4/-
	400v.	3/6		400v.	6/-
3A	100v.	3/6			
	200v.	5/-	10 Amp.	100v.	9/6
	400v.	7/6		200v.	12/6
	600v.	9/6		400v.	14/6

Sub-miniature glass encased—only approx ⅜in. long wire ended.
750mA 50v. 1/6 100v. 2/6
200v. 4/6

CASSETTE LOADED DICTATING MACHINE

Battery operated and with all accessories. Really fantastic offer a British made £31 outfit for only £6.19.6 brilliantly designed for speed and efficiency—cassette takes normal spools drops in and out for easy loading—all normal functions—accessories include:—stethoscopic earpiece—crystal microphone has on/off switch—telephone pick-up—tape reference pad—DON'T MISS THIS UNREPEATABLE OFFER—SEND TODAY £6.19.6 plus 7/6 post and insurance. Footswitch 18/6 extra. Spare Cassettes at 7/6 each, three for £1.



NOUGHTS AND CROSSES MACHINE. This machine, described in Sept. '65, is impossible to beat and will provide endless fun at home and considerable attraction (and profit) at charity do's and fetes, etc. It employs 19 switches and 9 bulbs and these and the other components necessary to make this are available. Price £4.10.0, post and insurance 3/6.

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to max. Full power at all speeds by fingertip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 2/6 post and insurance.

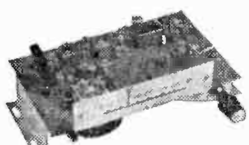
TWO NEW KITS

Multi-purpose Audio Switch, 5 transistors and all other components to make this ingenious unit described in last month's issue—only 48/6d. plus 2/9d. post and ins.

Analog Computer, all parts including centre zero galvonometer, perspex cursors, 8in. dials, to make the unit described in last month's issue. Available at 39/6d., plus 2/9d. post and ins.

THIS MONTH'S SNIP

An assortment of radio panel bulbs, all made by the famous Philips company. Their cost if bought retail would exceed 30/-. Offered as a parcel for 10/- post free. Parcel comprises 12 x 6·3V, ·3A; 6 x 12V, ·1A, 6 x 24V ·05A; 6 x 12V, ·6A, 6 x 6·3V ·1A. All M.E.S. cap.



F.M. TUNER

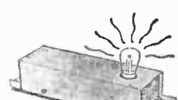
of exceptional quality, giving really fantastic results with virtually no noise. Suitable for mains or battery operation. 6 transistors—three IF stages—double tuned discriminator. Complete, new, and built up all ready to work on chassis. Size 6 x 4 x 2in. with tuning scale and slow motion drive. A £12.12.0 tuner for only £8.10.0.

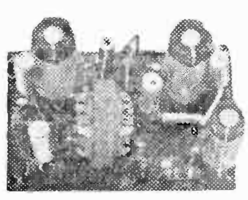
SOLID STATE IGNITION

Big things are claimed of Electronic ignition systems and if you would like to try for yourself a circuit was described in "Practical Electronics" (Sept., 1966). This requires a silicon controlled rectifier, four transistors and other components available as a kit. Price £6.15.0, post free.

OZONE AIR CONDITIONER

For removing smells and generally improving oppressive atmosphere. In neat hammer finish box. Uses Philips ozone lamp and mains unit. Lamp easily replaceable. Only 39/6 plus 6/6 carr. and ins.



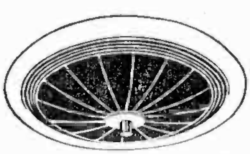


750mW TRANSISTOR AMPLIFIER

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed-back loops—sensitivity 5 m/v. Price 19/6. Post and insurance 2/6. Speakers 3in. 12/6, 5in. 13/6, 6 x 4in. 14/6.

NOW *INSTANT START*

CIRCULAR FLUORESCENT



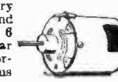
Brings sunshine into your home. 150 watts of light but uses only 40 w. Beautiful fittings with glass, non-plastic centre, fluorescent tube and choke control. Made by Philips. Regular price £4.15.0. Special budget price 69/6, plus 8/6 c. and ins. Please state colour of glass centre, white, pink, blue, red, black, yellow or cream. Also whether plug into lamp holder or ceiling mounting model. 80 watt model (normal start), 99/6. 10/- carr. & ins.

MAIN TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500 mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers. Zener diode and instructions. Real snip at only 14/6, plus 3/6 postage.

9 VOLT PRECISION MOTOR

Intended for driving battery operated tape recorders and record players. Laminated, 6 Pole armature with Brush Gear and rapid start switch. Normally 25/-. Our Price 7/6, plus post and insurance 1/6.



SIMPLE RECEIVER FOR LOW VOLTAGE. A TRF transistor set powered from the Sun or a 1½ v. cell. Suitable for children or others who forget to switch off. 4 N.P.N. silicon transistor diode and all other components necessary to build this circuit described in "Wireless World," Oct., are available as a kit. Price 19/6, plus 2/6 post and ins.

PHOTO-ELECTRIC KIT

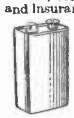
All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit. Laminated Boards and chemicals, Latching relay, Infra-red sensitive Photocell and Hood. 2 Transistors, cond., Terminal block. Plastic case. Essential data, circuits and P.C. chassis plans of 10 photo-electric devices including auto-car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warbling tone electronic alarm—projector lamp stabiliser, etc.; etc. Only 39/6, plus 2/-, post and insurance.

HI-FI SPEAKER BARGAIN

12in. High fidelity loudspeaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 29/6. With built-in tweeter 35/-. plus 3/6 post and insurance.

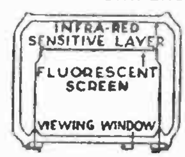
Multi Purpose Neon Test Unit

Robust, useful and instructive—tests insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and L.T. fault finder—kit comprises neon indicator—4-way wafer switch—ebonite tubes—resistors-condensers—terminals, etc. with diagram only 9/6, plus 2/- post and insurance.



PP3 Eliminator—play your pocket radio from the mains! Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. Only 6/6, plus 1/- post.

SNIPERSCOPE



Famous war-time "cat's eye" used for seeing in the dark this is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments. 7/6 each, post 2/-. Data will be supplied with cells, if requested.

HALF PRICE OFFER
G.E.C. 13A Switched Sockets

Suitable for ring mains, etc. like the modern fused plug surface or sunk (flush) mounting type 4/9 each. 54/- dz.

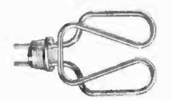
12v. INVERTER

Fully transistorised for operating a 20-watt fluorescent tube or other 20-watt mains device. Size 6ft. long by 1½ by 1½in. £3.10.0. Post and insurance 3/-.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control 10/- post free.

KETTLE ELEMENT



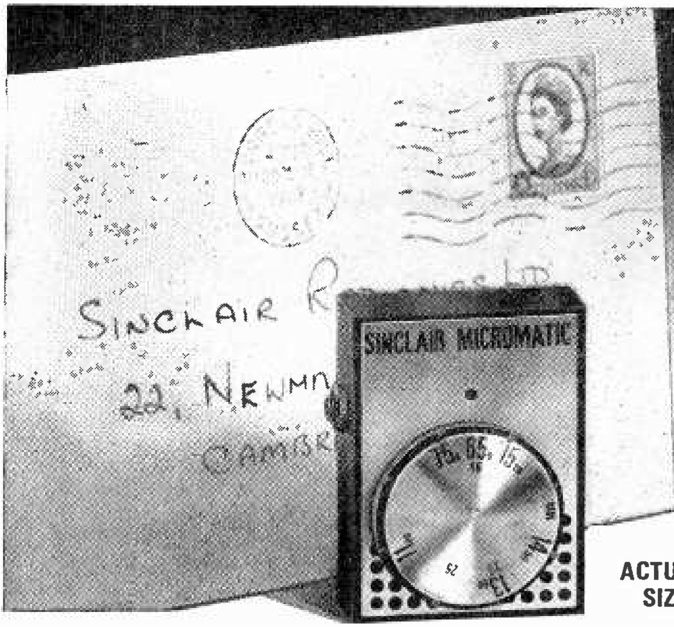
Made by famous "Best" company, suitable for most kettles. 1⅛in. dia. hole. 1500 watts. 230/250 v. Normally 30/- each. Our Price 15/- each.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free.

ELECTRONICS (CROYDON) LIMITED

(Dept. P. W.) 102/3 TAMWORTH RD., CROYDON, SURREY *(Opp. W. Croydon Stn.)*

also at 266 LONDON ROAD, CROYDON, SURREY



ACTUAL SIZE

The most remarkable letter we have so far received

P.O. Box 43, PAEKAKARIKI,
New Zealand.
27th February, 1967.

Thank you very much for the new Micromatic which arrived safely by Airmail. Our 13-year-old son is highly delighted. On the first evening he logged several New Zealand stations. These included our one and only "pirate", Radio Hauraki, stationed in the gulf of that name well over 400 miles north of here.

His biggest surprise was when 2CY, Canberra (10Kw) identified itself. Australia is more than 1,200 miles away! I tested the receiver within half a mile of 2YA and 2ZB (just north of Wellington). Selectivity remained perfect. Neither station swamped the other and the customary nul was evident when the ferrite aerial was end on to the transmitters.

In the metal coach of an electric train, the receiver functioned normally even under such noise producing conditions.

You have produced a radio receiver which has no equal. Its design size and performance are such that even you will not easily evolve a successor.

(Signed) Arnold S. Long

The original of this and countless other letters which enthusiasts send us can always be seen at our Cambridge offices.

SINCLAIR MICROMATIC

THE SMALLEST SET IN THE WORLD

- $1^{4}/_{5}'' \times 1^{3}/_{10}'' \times {}^{1}/_{2}''$
- NEW 6 STAGE CIRCUITRY
- AMAZING POWER AND RANGE
- BANDSPREAD
- IN KIT FORM OR READY BUILT

This British-made six stage transistor receiver is a fully fledged radio with all the features essential to reliable listening. It is smaller than anything you have ever used before, yet it gives good choice of programmes anywhere, is selective, powerful, dependable. When, after two or three months or so, the two batteries need replacing, new ones are easily obtainable from radio shops, Boots Chemists, etc. Good listening works out to under a halfpenny an hour. Whether you buy the MICROMATIC in kit form or ready built, you will be the proud owner of a most elegantly styled set brimful of power and ready to keep you in touch with the world wherever you are — in modern town buildings, travelling, walking or anywhere else. The well prepared instructions manual makes building an assured success, and as with all Sinclair products, the MICROMATIC is fully guaranteed built or in kit form.

A SUPERB SPECIFICATION

This is a 6-stage receiver in which 3 special transistors are used in newly developed circuitry having two R.F. stages, a double diode detector and a powerful three stage A.F. amplifier, the output from which feeds into a specially matched high quality lightweight earpiece. The MICROMATIC has its own built-in ferrite rod aerial and uses vernier type tuning over the medium wave band. A.G.C. counteracts fading from distant stations. The beautifully styled case is faced with an artist designed aluminium front panel of outstanding elegance, with aluminium tuning dial to match.

Complete kit in new "see-for-yourself" quick check pack, instructions and solder **59/6**

Built, tested and guaranteed with ear piece and batts. **79/6**

★ **Full service facilities available to all Sinclair customers**

USE THIS ORDER FORM FOR DELIVERY BY RETURN

SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Please send .... *for which I enclose cash/cheque/money order value* £........s........d.	NAME .... ADDRESS PW.6

Guarantee

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full at once and without question.

NEW - ENLARGED - IMPROVED

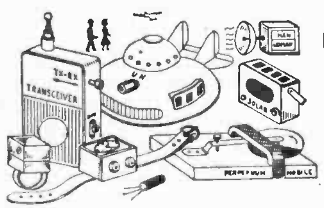
EXPERIMENTER'S PRINTED CIRCUIT KIT

BUILD 36 INTERESTING PROJECTS on a PRINTED CIRCUIT CHASSIS with PARTS and TRANSISTORS from your SPARES BOX

CONTENTS: (1) 2 Copper Laminate Boards 4½" x 2½". (2) 1 Board for Matchbox Radio. (3) 1 Board for Wristwatch Radio, etc. (4) Resist. (5) Resist Solvent. (6) Etchant. (7) Cleanser/Degreaser. (8) 16-page Booklet *Printed Circuits for Amateurs*. (9) 2 Miniature Radio Dials SW/MW/LW. Also free with each kit. (10) Essential Design Data, Circuits, Chassis Plans, etc. for building.

36 TRANSISTORISED PROJECTS

A very comprehensive selection of circuits to suit everyone's requirements and constructional ability. Many recently developed very efficient designs published for the first time, including 6 new circuits.



EXPERIMENTER'S PRINTED CIRCUIT KIT 8/6

Postage & Pack. 1/6 (UK)
Commonwealth:
SURFACE MAIL 2/-
AIR MAIL 8/-
Australia, New Zealand
South Africa, Canada

(1) Crystal Set with biased Detector. (2) Crystal Set with voltage-quadrupler detector. (3) Crystal Set with Dynamic Loudspeaker. (4) Crystal Tuner with Audio Amplifier. (5) Carrier Power Conversion Receiver. (6) Split-Load Neutralised Double Reflex. (7) Matchbox or Photocell Radio. (8) "TRIFLEXON" Triple Reflex with self-adjusting regeneration (Patent Pending). (9) Solar Battery Loudspeaker Radio. The smallest 3 designs yet offered to the Home Constructor anywhere in the World.

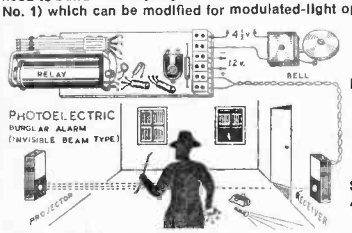
3 SUBMINIATURE RADIO RECEIVERS

Based on the "Triflexon" circuit. Let us know if you know of a smaller design published anywhere. (10) Postage Stamp Radio. Size only 1·62" x ·95" x ·25". (11) Wristwatch Radio 1·15" x ·80" x ·55". (12) Ring Radio ·70" x ·70" x ·55". (13) Bacteria-powered Radio. Runs on sugar or bread. (14) Radio Control Tone Receiver. (15) Transistor P/P Amplifier. (16) Intercom. (17) 1-valve Amplifier. (18) Reliable Burglar Alarm. (19) Light-Seeking Animal, Guided Missile. (20) Perpetual Motion Machine. (21) Metal Detector. (22) Transistor Tester. (23) Human Body Radiation Detector. (24) Man/Woman Discriminator. (25) Signal Injector. (26) Pocket Transceiver (Licence required). (27) Constant Volume Intercom. (28) Remote Control of Models by Induction. (29) Inductive-Loop Transmitter. (30) Pocket Triple Reflex Radio. (31) Wristwatch Transmitter/Wire-less Microphone. (32) Wire-less Door Bell. (33) Ultrasonic Switch/Alarm. (34) Seismic Car Alarm. (35) Quality Stereo Push-Pull Amplifier. (36) Light-Beam Telephone - "Photophone".

PHOTOELECTRIC KIT

BUILD 12 EXCITING PHOTOELECTRIC DEVICES

CONTENTS: 2 P.C. Chassis Boards, Chemicals, Etching Manual, Cadmium Sulphide Photocell, Latching Relay, 2 Transistors, Condenser, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation.



PHOTOELECTRIC KIT 39/6

Postage & Pack. 2/6 (UK)
Commonwealth:
SURFACE MAIL 3/6
AIR MAIL £1.0.0
Australia, New Zealand, S. Africa, Canada & U.S.A.
Also Essential Data Circuits and Plans for Building

12 PHOTOELECTRIC PROJECTS. (1) Steady-Light Photo-Switch/Alarm. (2) Modulated-Light Alarm. (3) Long-Range Stray-light Alarm. (4) Relay-Less Alarm. (5) Warbling-Tone Alarm. (6) Closed-Loop Alarm. (7) Projector Lamp Stabiliser. (8) Electronic Projector Modulator. (9) Mains Power Supply. (10) Car Parking Lamp Switch. (11) Automatic Headlamp Dipper. (12) Super-Sensitive Alarm.

OPTICAL KIT Everything needed (except plywood) for building: 1, Invisible-Beam Projector and 1 Photocell Receiver (as illustrated).
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infra-red filter projector lamp holder, building plans, performance data, etc. Price 19/6. Postage and Pack. 1/6 (UK).

LONG RANGE OPTICAL KIT 29/6 p.p. 1/6

Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 50 Radio, Electronic and Photoelectric Projects. Assembled.

Obtainable from your local supplier or direct from

"EXPERIMENTAL ELECTRONIC KITS"

Dep. YORK ELECTRICS, 333 York Rd., London S.W.11

The

SUPER 6

LONG & MEDIUM WAVE TRANSISTOR RADIO

A quality radio available as a kit or ready-built. The sparkling performance and superb finish of the completed receiver give you value equivalent to a £12.12.0 commercial model.
★ All new parts. ★ 6 transistors and diode. ★ 350mW output. ★ Superhet circuit ★ Ferrite rod aerial. ★ Weymouth Radio printed circuit board. ★ Component positions and references printed on back of board. ★ Nicely styled wooden cabinet 11 x 7½ x 3¼in. ★ Vinyl covered in various colours. ★ 6 x 4in. speaker giving good bass and treble response. ★ Full instruction booklet, 2/-. Free with kit. ★ I.f. frequency 470 kc/s. ★ Lining up service if required. ★ All parts supplied separately.
Write for list. S.A.E. COMPLETE KIT ONLY **£4.0.0** P. & P. 5/-
OR FULLY BUILT £6.7.6. Tax and Carr. Paid.

STEREO-AMPLIFIER 2 x 4 WATT

Valves ECC83, 2 x EL84, on printed circuit approx. 4 x 4in. Neg. feed back. Controls (vol. or tone) on separate panel, 6¼ x 2in. Separate power pack with rect., double wound mains trans., connection socket, etc. Supplied fully wired and tested with two O.P. transformers for 3-ohm speakers, only £5.10.0 (7/6 P. & P.). Two speakers, 8in., 3-ohm for 20/- each, post paid, if ordered with above Amp.

TAPE AMPLIFIER FOR MAGNAVOX TAPE DECKS — 2 or 4 TRACK

Chassis 12¼ x 5¼ x 4¼in. high. Plastic front panel "gold" finish—12¼ x 4¼in. 200-250 A.C. Record/Playback amp. switch; Off/On-Tone; Vol/Mic; Vol/Gram; Mic. Input; Gram. Input; Monitor; Speaker Sockets. Valves 6BR7; 12AX7; EM84; EL84; 6X4 Separate power pack. Complete amp. and power pack, £8.17.6. (6/- P. & P.). Rexine covered cabinet (tan) 15¼ x 17 x 9¼in. high with sloping front for amp; complete with two tweeter speakers, and special adapting brackets for Magnavox Deck—85/- (8/- carr.) 3 speed Magnavox 2 track tape deck £10.17.6; 4-track £12.15.0. Complete Recorders (with speed compensation) 2-track £29; 4-track £32 (carr. 25/-). Worth £10 more on normal retail prices.

GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, Hants.

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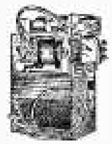

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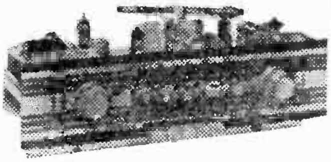

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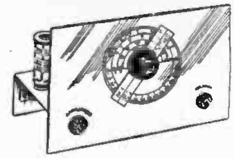

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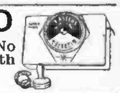

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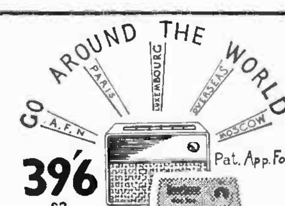

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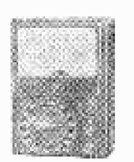

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A.C. and D.C. voltage ranges: 0-10-50-250-500-1000V.
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Resistance ranges: 100MΩ-1MΩ.
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PRACTICAL WIRELESS, JUNE 1967

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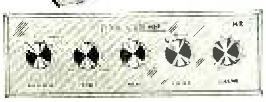

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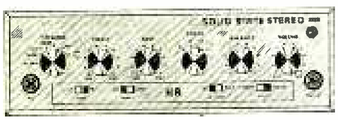

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MP3. Mono Preamplifier. All silicon low noise zener stabilised circuit. Full range of controls—fully equalised inputs for Xtal PU, DW/Xtal Mic, Radio Tuners, Tape Head and Preamp Replay. Supplied built and tested, on metal chassis, complete with front Grey/Silver panel, Aluminium Knobs and Handbook. Output 250mV. Supply 12 to 60 volts, 3mA. Overall size 9¾ x 1½ x 1½. **MP3 Price £6.19.6, p.p. 3/-.**

SP6-2. Mono/Stereo Preamplifier. Uses 8 Silicon/Germanium devices, Zener stabilised. Completely new low noise design. Full range of controls and filters. Inputs for Magnetic/Xtal/Ceramic Cartridges, Radio Tuners, Tape Preamp., microphones, Tape Head, etc. Record output socket. Supplied built and tested on metal chassis with Grey/Silver front panel and matching knobs. Complete with Input Sockets and Handbook. Output 250mV per channel. Supply 9 to 60 volts 4mA. Overall size 12 x 3½ x 3¼in. **SP6-2 Price £14.19.6, p.p. 5/-.**

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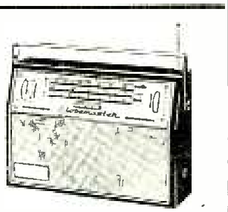

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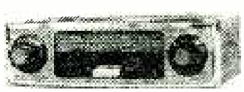

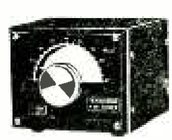

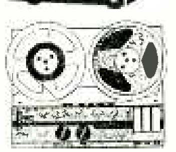

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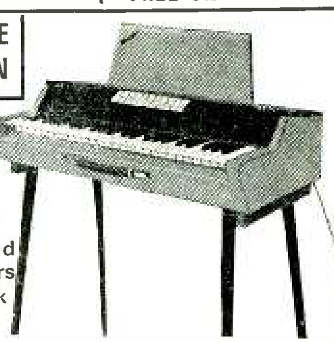

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