PRACTICAL WIRELESS

SEPTEMBER 1968

2/6

THE PYRAMID* SYSTEM

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2N753	4/6	BC109	5/6	OC45	4/-	ST140	4/-
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AC107	4/5	BSY28	4/6	OC73	5/-	XA124	4/6
AC126	4/6	BSY65	4/6	OC74	5/6	XA125	4/6
AC127	4/6	BSY95A	5/-	OC75	4/6	XB112	3/-
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AD140	8/6	GET874	4/6	OC81	4/-		
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ADT140	15/-	MAT101	8/6	OC81D	4/-		
AF114	6/6	MAT120	7/9	OC81DM	2/6		
AF115	4/5	MAT121	8/6	OC82	4/6		
		NKT403	10/-	OC83	5/-		
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SIGNAL DIODES

AF116	4/6	OC23	8/6	OC140	11/-	IN34A	4/-
AF117	4/6	OC26	7/6	OC169	4/6	OA5	3/6
AF118	4/6	OC28	8/6	OC170	4/6	OA70	2/-
AF119	4/6	OC35	8/6	OC171	4/6	OA79	2/-
ASY28	7/-	OC41	5/-	OC200	9/-	OA81	2/-
BC107	5/6	OC42	5/-	OC201	11/-	OA90	2/6
BC108	5/6	OC44	4/-	OC203	12/6	OA95	2/6

ZENER DIODES

OAZ200	12/-	OAZ204	8/6	OAZ208	6/6	OAZ212	6/6
OAZ201	10/-	OAZ205	8/6	OAZ209	6/6	OAZ213	6/6
OAZ202	8/6	OAZ206	8/6	OAZ210	6/6	OAZ227	15/-
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STC. 1 WATT SERIES 5%
2.4/2.7/3/3.9/4.3/13/16/18/20/30/33 volt, **5/-** each.
Z series. All voltages from 3.9–50 volt. 250 mW, **2/6** ea.
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SILICON POWER DIODES

60 P.I.V. 290 MA 2/-	6 AMP 5/6
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400 P.I.V. 3 AMP 7/6	200 P.I.V. 7 AMP 15/6
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ADMIRALTY B.40 RECEIVERS

Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, band-pass filter, noise limiter, crystal controlled B.F.O., calibrator. I/F. output, etc. Built-in speaker, output for phones, Operation 150/230 volt A.C. Size 19½ x 13½ x 16in. Weight 114 lb. Offered in good working condition. **£22.10.0.** Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s-700 Kc/s., **£17.10.0.** Carr. 30/-.

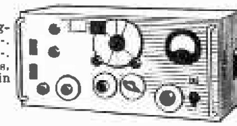
POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1000/1500/2500 or 5000 ohms, **14/6.** P. & P. 1/6.
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, **21/-.** P. & P. 1/6.
100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms, **27/6.** P. & P. 1/6.

AVO CT.38 ELECTRONIC MULTIMETERS

High quality 97 range instrument which measures A.C. and D.C. Voltage. Current, Resistance and Power Output Ranges D.C. volts 250mV–10,000V. (10 meg Ω–110 meg Ω iuput). D.C. current 10µA–25 amps. Ohms: 0–1,000 meg Ω A.C. volt 100mV–250V. (with R.F. measuring head up to 250 Mc/s). A.C. current 10µA–25 amps. Power output 50 micro-watts–5 watts. Operation 0/110/200/250 A.C. Supplied in perfect condition complete with circuit lead and R.F. probe. **£25.** Carr. 15/-.

MARCONI TEST EQUIPMENT



Ex-Military reconditioned. **T.F. 144G Standard Signal Generators.** 85 Kc/s–25 Mc/s, **£25.** Carr. 30/-.
T.F. 885 Video Oscillator. 0–5 Mc/s. **£45.** Carr. 30/-.
T.F. 195M. Beat Frequency Oscillator. 0–40 Kc/s, 200/250 v. A.C. **£20.** Carr. 30/-. All above offered in excellent condition fully tested and checked.
T.F. 1100 Valve Voltmeter. Brand new, **£50.**
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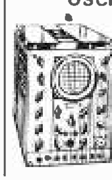
AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM/C.W./F.M. Incorporates precision dial, level meter, precision attenuator 1µV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. **£45.** Carr. 20/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

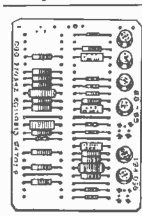


An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. **£22.10.0.** Or complete with all accessories, probe, leads. lid, etc. **£25.** Carriage 30/-.

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid.
High quality construction. Input 230V. 50–60 cycles.
Output full variable from 0–260 volts. Bulk quantities available.
1 amp.—**£5.10.0**; 2·5 amp.—**£6.15.0**; 5 amp.—**£9.15.0**;
8 amp.—**£14.10.0**; 10 amp.—**£18.10.0**; 12 amp—.**£21.0.0**;
20 amp.—**£37.0.0.**

PRINTED CIRCUITS



Five assorted printed circuit boards with transistors, diodes, resistors, condensers, etc. Guaranteed minimum 20 transistors. Ideal for experimenters. 5 boards for **10/-.** P. & P. 2/-.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.

Model 47A **£9.19.6**
Model 7 **£13.10.0**
Model 8 **£18.**
P. & P. 7/6 each.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2 pF–2,000 mFd 2 ohms 200 meg-ohms. Also checks impedance, turns ratio, insulation, 200/250V A.C. Brand New **£17.10.0.** Carr. 7/6.

ARF-100 COMBINED AF-RF SIGNAL GENERATOR

AF. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P **HIGH IMP. 21V** P/P600Ω 3·8V P/P. **TF** 100Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation, Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V A.C. **£30.0.0.** Carr. 7/6.

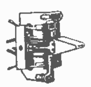
T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10 / 30 /100/300V. R.M.S. 4cps.–1·2Mc/s. Decibels -40 to +50 dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. **£17.10.0.** Carr. 5/-.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240V. A.C. Brand new with instructions. **£15.0.0.** P. & P. 7/6, S.A.E. for details.

T.M.C. 1000 SERIES KEY SWITCHES



Brand new with knobs as follows:

1 way, 2 c/o **7/6**; 1 way, 2 c/o 2b, **7/6**; 1 way 4 c/o, **8/-**; 2 way, 3m., 3m, **8/6**; 2 way, 2 c/o, 2 c/o, **8/6**; 2 way, 2 c/o, 4 c/o, **10/-**.
Post extra. Quantities available.

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.

500 W.	**£3.10.0**	P. & P. 6/6
1,000 W.	**£5.10.0**	P. & P. 7/6.
1,500 W.	**£6.10.0**	P. & P. 8/6.
3,000 W.	**£7.10.0**	P. & P. 12/6.
7,500 W.	**£15.10.0**	P. & P. 20/-.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms, 200/250V A.C. Supplied brand new and guaranteed with instruction manual and leads, **£16.10.0.** Carr. 7/6.

DUBILIER NITROGEL CONDENSERS

Brand new, 8 mfd. 800V. **8/6**— P. & P. 2/-; 2 mFd. 5,000V., **42/6.** P. & P. 5/-.

LUCAS 20/0/20 AMMETERS

Brand new boxed. Suitable car-motorcycle. **12/6.** P. & P. 2/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

0–25 Kc/s. Output 5K or 500 ohms. 200/250 V. A.C. offered in excellent condition. **£12.10.0.** Carriage 10/-.

HANSEN SWR BRIDGES

52 ohm **69/6** P. & P. 3/6

SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

An extremely high quality oscilloscope with time base of 10Q/sec. to 20 m/sec. Internal Y amplifier. Separate mains power supply 200/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. **£8.19.6.** Carriage 30/-.

COSSOR DOUBLE BEAM OSCILLOSCOPES

Type 1035. General purpose. A.C. Coupled. Type 1049. L.F. D.C. Coupled. **£35** each. Carr. 30/-.

R.C.A. AR88 SPEAKERS

8in. 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available brand new and boxed with leads. **59/6.** Carr. 7/6.

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Also see oppos. page

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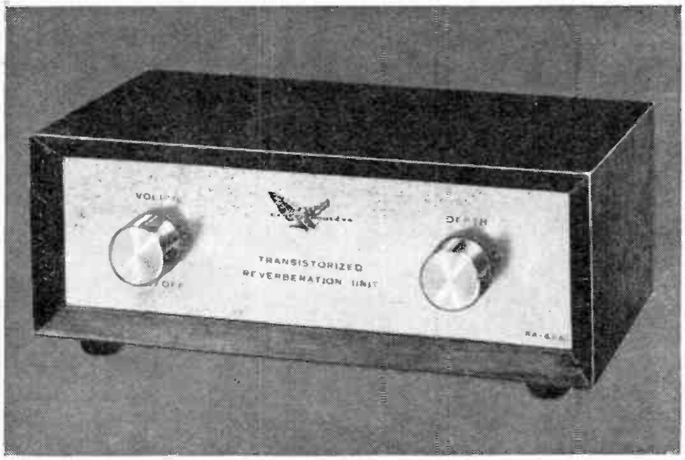

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How would you like to start with a simple amplifier, say, and add to it until it became a fully stereo twenty watt amplifier with FM tuner and facilities to take the most sensitive low output pickups ever made? With **Martin Audiokits** it's easy, for with these superbly engineered all-transistor prefabricated units, success is built in from the start and you build to your own preferred plan. IT'S A MONEY SAVING SCHEME, TOO.

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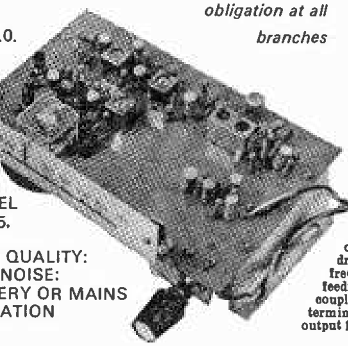
PW.9

Transistorised FM Tuner

CALLERS WELCOME — Demonstration without obligation at all branches

SAVE £2.10.0.



MODEL A1005.

HIGH QUALITY: LOW NOISE: BATTERY OR MAINS OPERATION

This beautifully compact 6 transistor machine (size 6 x 4 x 2½in.) will give quieter, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise freq. changer. Smooth 2 gang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.F. stage giving ample output for all quality amplifiers.

REDUCED PRICE DUE TO HUGE SALES

£6.19.0

(3 FOR £19)

STEREO DECODER

Model A1005M. Simple instructions to convert any FM tuner. Max input 100 m volts. Power supply 8–14 volts. Mains or batt. (5mA at 12V.) Output 1·5 x input. 4 transistors (2 each) 2SB-202; 2SB-186. 7 idiodes IN34 (six) IN60

SAVE 34/- **5 Gns.**

Keen offer if purchased with A1005 tuner making STEREO TUNER 11 gns.

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GUARANTEED TOP QUALITY

Mullard Matched Output Kits OC18D and 2-OC81 **12/6**

R.F. Kits OC44, OC45 (2) 3 transistors. **11/-**

AF102	17/-	GET115	8/6	OC35	12/6
AF114	6,6	GET116	10/-	OC44	4/-
AF115	6/-	MAT121	8/6	OC45	3/6
AF116	6/6	OA5	3/-	OC71	4/-
AF117	5/-	OA10	6/-	OC72	5/-
AF127	6/-	OA79	2/6	OC73	7/6
AF186	16/-	OA81	2/6	OC74	7/6
BC107	7/6	OA90	2/6	OC81	5/-
BSY65	5/-	OA95	2/6	OC81D	4/6
FXA143	7/-	OA202	3/6	OC82D	5/-
GET111	8/6	OC19	19/6	OC170	5/6
GET113	4/-	OC26	6/-	OC171	6/-

SILICON RECTIFIERS

Guaranteed performance. Top Makes. Tested 250v. working.

100mA (3 for 6/6) **2/9** — 500mA (3 for 12/6) **5/-**

BARGAIN PARCELS

Including variable condensers, i.f. coils, loudspeaker plug/sockets, knobs, pots, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we now pack them in several sizes—be amazed—try one now.

3 lbs. (post 3/-) 9/-
7 lbs. (post 5/-) 17/6
14 lbs. (post 6/-) 29/-

Jason KITS

FANTASTICALLY POPULAR

★ TAPE ★

We offer yon fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports TRY ONE AND PROVE IT YOURSELF.

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3in.	150ft.	2/3	3in.	225ft.	2/9
4in.	300ft.	4/6	4in.	450ft.	5/6
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Double Play			**Triple Play**		
3in.	300ft.	4/-	4in.	900ft.	13/-
4in.	600ft.	8/-	5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	5¾in.	2,400ft.	34/-
5¾in.	1,800ft.	19/6	7in.	3,600ft	44/-
7in.	2,400ft.	27/-	**Quadruple Play**		
			3in.	600ft.	8/6

Postages 1/- reel.
Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE. *Large tape stocks at all branches*

STEREO PORTABLE CABINETS

Latest black and silver metal finish. Consisting of centre cabinet size 16½in. x 13in. x 8in. deep with lift up lid together with two 10 x 6 speaker cabinets which clip on ends of main cabinet size 4½in. x 13in. x 8in. making overall size of 25½ in. x 13 in. x 8 in. High quality chrome fittings. Will take almost any autochanger or tape deck. Approx. half price at **£3.19.0**

Ditto, but less chrome, takes 7 x 4 speaker. **£2.19.9**

MONO PORTABLE CABINETS. B.S.R. tape deck or single record player, new, attractive finish, half price. **19/6**

AUTOCHANGE PORTABLE CABINETS. As used on 18 gns. record player. Due to fortunate purchase we offer complete with motor board and all fittings. at only **49/-**

PLEASE NOTE. *A wide range of cabinets to callers at all branches.*

100 HI-STABS 9/-
1% to 5% 100 Ω to 5 mΩ.
CO-AX, low loss, 6d. yd., 25 yds. 11/6; 50 yds. 22/-; 100 yds. 42/6. Plugs 1/3.

100 RESISTORS 6/6
SIZES—⅛–3 watt.
MICROPHONE CABLE. Highest quality. black, grey, white, 9d. per yard.

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Assorted 2 to 500 mfd 6 to 400 volt. LIST VALUE OVER £5.

50 TAG STRIPS 7/6
Mixed sizes 2 to 15 way.

25 POTENTIOMETERS 9/6 LIST
Including with switch, long and short spindle, pre-sets, log and lin. unused. 1k–2m Ω. VALUE APPROX. £4.

CONNECTING WIRE 4/-
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★ GUARANTEED VALVES ★

BY RETURN OF POST—GUARANTEED 3 MONTHS

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 9d. 2–11 6d. per valve. Free over 12

1L4	2/6	6SJ7GT	6/6	30FL1	14/-	ECC40	10/6	EZ81	7/-	SP61	4/-
1S4	5/6	6SL7GT	6/6	30L15	16/-	ECC81	5/-	GZ32	10/-	TDD4	8/6
2D21	6/-	6SN7GT	5/6	30L17	15/-	ECC82	6/6	GZ34	10/-	U14/18	8/-
3Q4	7/-	6U4GT	12/-	30P4	14/-	ECC83	6/6	KT61	13/-	U25	15/-
5U4G	7/6	6V6G	5/-	30P12	12/-	ECC84	7/6	KT63	5/6	U26	16/-
5Y3GT	6/6	6V6GT	7/6	30PL1	15/-	ECC85	6/-	KT66	20/6	U35	13/6
5Z4G	7/6	6X4	4 6	30PL13	16/-	ECC88	8/6	KTW61	6/9	U37	19/-
5Z4GT	8/9	6X5G	5/6	30PL14	16/-	ECF80	8/6	KTW63	6/-	U191	14/-
6/30L2	13/-	6X5GT	6/6	35A5	11/-	ECF82	7/6	MU14	8/-	U281	8/6
6AK5	5/6	7B6	11/6	35L6GT	8/6	ECH42	11/6	N37	10/6	U282	12/6
6AQ5	6/-	7B7	7/6	35W4	5/6	ECH81	7/-	N78	14/-	U301	13/6
6AT6	5/6	7C5	16/-	35Z5	9/6	ECL80	7/-	PC86	10/6	U404	7/6
6AU6	6/-	7C6	7/-	35Z4GT	6/9	ECL82	7/6	PC88	10/6	U801	20/-
6BA6	6/-	7H7	6/6	42	6/6	ECL83	10/6	PC97	8/6	UABC80	7/6
6BE6	6/-	7Y4	7/6	50L6GT	8/6	ECL86	9/-	PCC84	6/9	UAF42	9/6
6BH6	7/6	10C1	9/-	80	8/6	EF39	7/-	PCC85	7/-	UB41	9/6
6BJ6	7/6	10C2	12/-	185BTA	20/6	EF40	9/6	PCC88	12/-	UBC41	9/6
6BR7	10/-	10F1	9/6	807	9/6	EF41	10/6	PCC89	11/-	UBC81	8/6
6BR8	9/-	10F9	9/6	955	3/6	EF42	7/6	PCC189	11/-	UBF80	7/6
6BW6	12/6	10LD11	10/-	956	3/-	EF80	5/-	PCF80	7/6	UBF89	8/-
6BW7	12/-	10P13	12/6	CL33	17/6	EF85	7/-	PCF82	6/6	UBL21	11/-
6C4	4/-	10P14	12/6	CY31	8/6	EF86	8/6	PCF86	9/6	UCC84	9/-
6C9	11/-	12AT6	5/6	DAF91	5/-	EF89	7/-	PCF805	14/-	UCF80	9/6
6F1	7/6	12AU6	5/6	DAF96	7/6	EF91	4/-	PCL82	7/9	UCH21	11/-
6F6G	5/6	12AU7	6/6	DF91	3/9	EF183	7/-	PCL83	9/9	UCH42	11/6
6F13	6/6	12AX7	6/6	DF96	7/6	EF184	7/-	PCL84	8/6	UCH81	7/6
6F14	9/6	12BA6	5/6	DK91	6/6	EL32	5/-	PCL85	9/9	UCL82	9/-
6F15	9/6	12BE6	5/6	DK92	8/6	EL33	13/-	PCL86	9/6	UCL83	10/6
6F23	12/6	12JTGT	7/6	DK96	8/6	EL34	12/6	PL36	12/-	UF41	9/6
6F24	12/6	12K7GT	6/6	DL92	5/9	EL41	9/9	PL81	9/-	UF42	9/-
6J5G	4/6	12K8GT	8/6	DL94	7/-	EL42	10/6	PL82	7/6	UF80	8/-
6J5GT	5/6	12Q7GT	6/6	DL96	8/3	EL81	9/-	PL83	7/-	UF85	8/6
6J7G	5/-	14S7	17/6	DY86	7/-	EL84	7/6	PL84	7/6	UF86	9/-
6J7GT	8/6	19AQ5	5/6	DY87	7/6	EM80	7/6	PY31	7/6	UF89	7/6
6K7G	3/6	20D1	9/-	EABC80	7/-	EM81	8/6	PY32	9/9	UL41	11/6
6K7GT	5/6	20F2	9/6	EAF42	9/-	EM84	8/-	PY33	10/6	UL84	7/9
6K8GT	8/6	20L1	15/-	EB41	6/-	EM85	11/-	PY80	6/6	UM80	7/-
6L1	9/6	20P3	12/-	EB91	3/6	EM87	10/-	PY81	6/6	UU9	7/6
6L6G	9/6	20P4	15/-	EBC33	8/6	EY51	8/-	PY82	6/6	UY41	8/-
6L18	7/6	25L6GT	7/-	EBC41	10/6	EY86	8/6	PY83	6/6	UY85	7/-
6LD20	7/6	25Z4G	7/6	EBC81	7/9	EY88	8/6	PY88	8/6	VR105	7/6
6P25	13/-	30C15	14/-	EBF80	7/6	EZ40	9/-	PY800	9/-	VR150	7/6
6Q7G	6/6	30C17	14/-	EBF83	8/-	EZ41	9/-	PY801	9/-	X66	7/6
6Q7GT	8/9	30F5	14/-	EBF89	7/6	EZ80	6/6	PZ30	8/6		

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Carr. & Ins. 12/6

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMISCOPE, BRIMAR, FERRANTI TYPES PROCESSED IN OUR OWN FACTORY

	6 Months	12 Months
12in.	£2. 0.0	£3. 0.0
14in.	£2.10.0	£3.10.0
15-17in.	£3. 5.0	£4. 5.0
19in.	£3. 5.0	£4. 5.0
21in.	£3.15.0	£5.15.0
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Post: 1 lb. 1/6, 1½ lb. 2/6, 2 lb. 2/9, 4 lb. 3/3, 6 lb. 4/-, 14 lb. 5/6.

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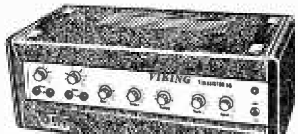
VIKING AMPLIFIER

50 WATT AMPLIFIER



An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS
4 electronically mixed channels, with 2 inputs per channel, enables the use of 8 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets.

SENSITIVITIES AND INPUT IMPEDANCES
Channel 1 4mV at 470K } These 2 channels (4 inputs) are suitable for
Channel 2 4mV at 470K } microphone or guitars.
Channel 3 200mV at 1m } Suitable for most high output instruments
Channel 4 200mV at 1m } (gram, tuner, organ etc.).
Input sensitivity relative to 10w output.

TONE CONTROLS ARE COMMON TO ALL INPUTS
Bass Boost +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s.
Treble Boost +11dB at 15 KHz/s. **Treble Cut** −12dB at 15 KHz/s.
With bass and treble controls central −3dB points are 30 Hz/s and 20 KHz/s.

POWER OUTPUT
For speech and music 50 watts rms. 100 watts peak.
For sustained music 45 watts rms. 90 watts peak.
For sine wave 38·5 watts rms. Nearly 80 watts peak.
Total distortion at rated output 3·2% } at 1KHz/s
Total distortion at 20 watts 0·15% }
Output to match into 8 or 15 ohms speaker system.

Price
27 gns
P & P 20/-

NEGATIVE FEED BACK 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES** Adjustable from 200–250v A.C. 50–60 Hz/s. A protective fuse is located at the rear of unit.
VALVE LINE UP Double purpose ECC83 x 3, EL34 x 2 and GZ34.

FOUR *PLUS* FOUR *Stereo Amplifier*

A superb high quality, yet inexpensive stereo amplifier. Due to the great demand we are now able to offer this precision made instrument at a fantastically low price. The high quality, reliability and styling has been maintained in spite of its low price.

SPECIFICATIONS
Elegant styled cabinet (sizes 16" wide 5" high 8½" deep) in black rexine and woodgrained sides. Brushed aluminium front panel with contrasting black / silver knobs.

CONTROLS
Stereo/Mono switch. Gram/Aux switch. Volume left. Volume right. Treble (cut and lift). Bass (cut and lift). Separate on/off switch. Neon pilot indicator.

INPUTS AND OUTPUTS
(per channel)
Gram, aux, tape out and speaker out. A switched mains socket is also provided at the rear of unit. Employs Mullard valves throughout. ECC83 and 2 x ECL86 with a metal bridge rectification.

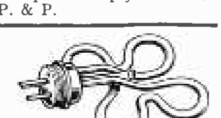
TECHNICAL SPECIFICATIONS
Gram sensitivity 40mV at 1 KHz. Aux sensitivity 50mV at 1 KHz. (Sensitivities are given for rated output). 4 watts r.m.s. (8 watts r.m.s. in monaural position). Output matches into standard 3 ohms speaker system. Suitable 10" x 6" speakers are available at 29/6 each, plus 5/- p. & p. Bass control at 100 Hz lift + 9dB cut − 10dB. Treble control at 10 KHz lift + 8dB cut − 13dB. Total harmonic distortion 0·35% at 3 watts and 2% for rated output at 1 KHz. Negative feedback 13dB at 1 KHz. Mains supply 220–250V A.C. 50–60 Hz.

Price
13 gns
P & P 15/-

SPEEDEX the SPEED CONTROLLER for ELECTRIC POWER DRILL

infinitely variable electronic speed controller for your electric power drill. Varies the speed of all power tools (up to 600W) between 12 r.p.m. and maximum r.p.m.
Instantly adjustable with simple single control overriding switch for instant maximum speed. Simply connected into lead of power tool. Only **25/-** plus 3/6 P. & P.

GEC KETTLE ELEMENT



3,000W WITH AUTOMATIC EJECTION
200/240v. Size of hole required 1 1/16"
List Price **32/-**. Our PRICE
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POCKET MULTI-METER

Size 3¼ x 2¼ x 1⅜in Meter size 2¼ x 1⅜in 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.

CYLDON U.H.F. TUNER

Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4½ × 5½ × 1¼in. Complete with circuit diagram. **35/-** p. & p. 3/6

THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13¼ x 8 1/16 x 4½ inches. By famous manufacturer. List Price £7. Our price **69/6** plus 3/6 P. & P.
Similar speaker to the above without tweeters in 3 and 15 ohm **39/6** plus 3/6 P. & P.

600 mW FOUR TRANSISTOR AMPLIFIER

Features N.P.N. and P.N.P. complementary symmetrical output stage, 2¼" x ⅞" x ⅞" Speaker. Output impedance 12 ohms frequency response 3dB points 90 c/s and 12 Kc/s. Price **19/6** plus 1/- P. & P. 7 x 4" Speaker to suit, **13/6** plus 2/- P. & P.

2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7" x 4¼" x 1⅞". Frequency response 100 c/s—10 Kc/s Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0** plus P. & P. 3/6. Suitable 8" x 5" 10,000 line high flux speaker, **18/6** plus 2/- P. & P.

NEW TRANSISTORISED SIGNAL GENERATOR

Size 5¼ x 3½ x 1¼in. For IF and RF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. **49/6** P. & P. 3/6.

FIRST QUALITY P.V.C. TAPE

5¾"	Std.	850ft.....	9/-	5"	L.P.	850ft.	..10/6
7"	Std.	1200ft.....	11/6	3"	T.P.	600ft.	..10/6
3"	L.P.	240ft.....	4/-	5"	T.P.	1800ft.	..25/6
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.

THE RELIANT 10W SOLID-STATE HIGH QUALITY AMPLIFIER

SPECIFICATIONS
Output—10 watts RMS Sine-wave
13 watts RMS Music-power
Output Impedance—3 to 4 ohms
Inputs—1.-xtal mic 10mV
2.-gram/radio 250mV
Tone Controls—Treble control range ± 12dB at 10KH2
Bass control range ± 13dB at 100H2
Frequency Response—(with tone controls central) Minus 3dB points are 20H2 and 40KH2. Signal to Noise Ratio—better than —60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input— —220 —250V. A.C. Size of chassis—10" × 3¾" × 2". A.C. Mains, 200-250V. For use with Std or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram. and mike. Built and tested. 8" × 5" speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P. **PRICE £5.5.0** plus 5/- P. & P.

LESLIE TREMOLO SPEAKER UNIT

Model 10C3. Made in U.S.A. by Electro Music Corp., Pasadena, Calif. Complete with 8" 6 ohm Heavy Duty Loud Speaker. (Larger Speaker may be fitted without major structural change). Dimensions: baffle size 18¼" × 19". Rotor size 15". A.C. mains 110-220-240 50 c/s. suitable for organs. **PRICE £30** plus £2 P. & P

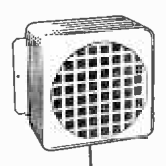
50 WATT POWER AMPLIFIER

Manufactured by Livingstone Labs. at a cost price of £90. In two units, Amplifier size 15½" × 9" × 7". Heat sink size 14½" × 9" × 4". Output into 15 ohm Speaker. Transistors—eight OC28s. Two 2G374. Sensitivity 1V. RMS at 6K input impedance. Power Response 5H2–15KHZ (50 watts). Ideal for Tannoy Systems or organs where constant use is essential. **PRICE 28**gns. plus £2 P. & P.

ANTI-THIEF CAR BURGLAR ALARM

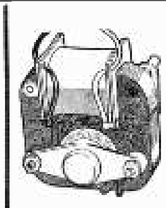
The Melguard Safermatic consists of an electrical device housed in small metal box 4" × 2" × 1½", which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches, and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12V operation. List price 79/6, our price **29/6** plus 2/6 P. & P. Full easy-to-follow instructions supplied.

EXTRACTOR FAN



AC Mains 230/250 v. complete with pull switch. Size 6" x 6" x 4". Price **27/6** plus 5/- P. & P.

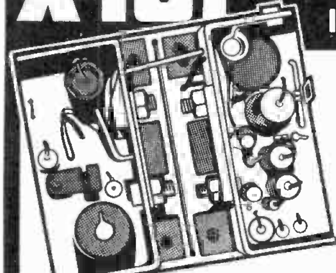
AC MAINS MOTOR



1400 R.P.M.
230/250v

PRICE
9/6
P. & P. 3/-

X101 10 WATTS (RMS) SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Its great versatility ranges from: A simple intercom. to a modern HI-FI STEREO AMPLIFIER (2 are required for Stereo).

The X101 is a brilliant new addition to our highly successful range of products. Its professional performance and advanced solid-state circuitry techniques ensures reliability, combined with high fidelity reproduction at AN UNBEATABLE PRICE.

SPECIFICATIONS

R.M.S. Power Output: 13 W (music power), 10 W (Sine Wave).
Sensitivity: for rated output 1 mV into 3 K ohms load.
Frequency Response: minus 3dB points are 20 Hz and 40 KHz.
Total Distortion: at 1KHz for rated output 1·5%, for 5 W output 0·35%.
Output Impedance: 3 ohms (3–15 ohms may be used).
Supply Voltage: 24 V D.C. at 800 mA (6–24 V may be used) output at 14 V D.C. supply with 3 ohms speaker. 7 watts.
Size: 2½" x 3" x 1⁹/₁₆".

The fully comprehensive instruction manual does not only show the basics, such as circuit diagram and connections, but also gives practical easy-to-understand detailed information about the X101. Standard equalisation networks are given for most types of conventional inputs. They include: Tape Head, Mag. P.U., Xtal P.U., Tuner, Mic. etc.

Built & Tested **49/6** + 2/6 p. & p.

Control assembly: (Including resistors and capacitors).
1. Volume: PRICE 5/-. 2. Treble: PRICE 5/-.
3. Comprehensive bass and treble: PRICE 10/-.
The above 3 items can be purchased for use with the X101.

POWER SUPPLIES FOR THE X101

P101 M (for mono) p. & p. 2/6 **35/-** P101 S (for stereo) p. & p. 2/6 **42/6**

PR 101/M A HIGH QUALITY MONAURAL PRE-AMP & CONTROL UNIT

Particularly suitable for use with the X101 if a ready-built, comprehensive, multi-input system is desired.

CONTROLS

Selector Switch, Tape Speed Equalisation Switch (3¾ and 7½ i.p.s.), Volume, Treble, Bass, 3 position scratch filter and 3 position rumble filter.

SPECIFICATION

Sensitivities for 200 mV output at 1 KHz.

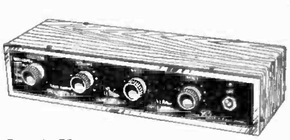
Tape Head: 3 mV (at 3¾ i.p.s.) **Radio:** 100 mV
Mag. P.U.: 2 mV **Aux.:** 100 mV
Cer. P.U.: 80 mV
Tape/Rec. Output: 100 mV
Equalisation for each input is correct to within ±2dB (R.I.A.A.) from 20 Hz to 20 KHz.
Tone Control Range: Bass ±13dB at 60 Hz
Treble ±14dB at 15 KHz
Total Distortion: (for 200 mV output) < 0·02%
Signal Noise: > −60dB
Supply Voltage: 24 V D.C.

79/6 plus 2/6 p. & p.

A STEREO VERSION (PR101/S) WILL BE ANNOUNCED SHORTLY

The CLASSIC HIGH QUALITY SOLID-STATE AMPLIFIER (MONO)

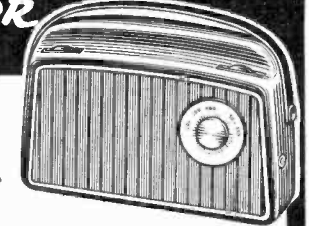
SPECIFICATION



Switched inputs for: Tape Head, Mag. P.U., Cer. P.U., Radio and Aux.
Mains Input: 220–250V A.C. 50 Hz.
THE CLASSIC IS THE COMBINATION OF THE ABOVE DESCRIBED ITEMS (X101, P101/M AND PR101/M) ON ONE COMMON CHASSIS: ITS PERFORMANCE AND SPACE-AGE STYLING MAKE IT THE IDEAL CHOICE FOR THE VALUE-CONSCIOUS HI-FI ENTHUSIAST.
Size 12½in. long, 4½in. deep, 2⅜in. high.
Teak finished case.

p. & p. free **8 gns**

NEW! THE Dorset TRANSISTOR PORTABLE RADIO



CAN BE USED AS BABY ALARM

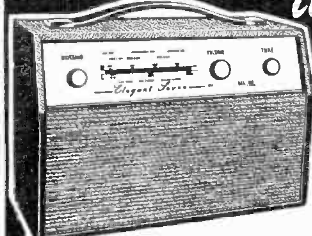
600 milliwatt solid state 7 transistor plus diode and thermistor. Completely modulised high quality portable radio featuring complementary NPN and PNP output stage. The comprehensive easy-to-follow drawings supplied make this the easiest-ever transistor radio set of parts, with the following features:

5gns. plus 7/6 postage and packing. *Circuit and parts list 2/6 free with parts.*

- Simple connections to only 6 tags on the R.F./I.F. module, 3 I.F. stages, osc. coil and 3 transistors which with their associated components are completely wired.
- Only 4 connections on the A.F. module to complete the 4 transistor 600 milliwatt solid state amplifier.
- Pre-aligned R.F./I.F. module built and tested.
- A.F. module built and tested.
- Fully tunable over M.W. and L.W. bands. M.W. 540–1640 Kc/s (557–183 metres). L.W. 150–275 Kc/s (2000–1100 metres).
- Intermediate Frequency 470 Kc/s.
- Sensitivity: M.W. at 1 Mc/s 10 microvolts plus or minus 3dB. L.W. at 200 Kc/s 40 microvolt plus or minus 4dB.
- High Q internal ferrite rod aerial on both wavebands.
- Class 'B' modulised output stage with thermistor controlled heat stabilisation. Class 'B' output stage ensures long battery life. Current drain is proportional to the output level. Total current drain of the receiver under no signal conditions is 10–12 mA. At reasonable listening level 20–30 mA.
- Extension sockets for car aerial input, tape recorder output (Independent of volume control) and External Speaker.
- All components (except speaker) mount on the printed circuit board. Easy-to-follow instructions. Size of cabinet 12in. long 8in. high and 3in. deep.
- Finger-tip controls.

Special Offer—Power Supply Kit to purchasers of Dorset Portable Radio parts incorporating mains transformer, rectifier and smoothing condenser, AC mains 200/250V output 9V 100mA, 9/6 extra.

ELEGANT SEVEN Mk III COMBINED PORTABLE and CAR RADIO



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

SPECIAL OFFER

£4.9.6

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

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

★ De luxe wooden cabinet size 12½" x 8¼" x 3½".
★ Horizontal easy to read tuning scale printed grey with black letters, size 11½" x 2".
★ High 'Q' ferrite rod aerial.
★ I.F. neutralization on each separate stage.
★ D.C. coupled push pull output stage with separate A.C. negative feedback.
★ Room filling output 300mW.
★ Ready etched and drilled printed circuit board back printed for foolproof construction.
★ Fully comprehensive instructions and point-to-point wiring diagrams.
★ Car aerial socket.
★ Fully tunable over medium and long wave. 168–535 metres and 1250–2000 metres.
★ All components ferrite rod and tuning assembly mount on printed board.
★ 5" P.M. speaker.
★ Parts list and circuit diagram 2/6, free with parts.

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Latest STEREO TAPE RECORDER, STR-1

Fully portable—own speakers

Kit £58.0.0. P.P. 10/6

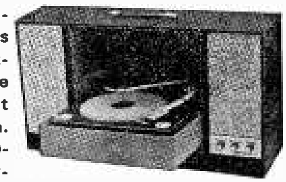
Ready-to-Use £70.6.0. P.P. 10/6

FOR THIS SPECIFICATION

$\frac{1}{4}$ track stereo or mono record and playback at $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ips. Sound-on-sound and sound-with-sound capabilities. Stereo record, stereo playback, mono record and playback on either channel. 18 transistor circuit for cool, instant and dependable operation. Moving coil record level indicator. Digital counter with thumbwheel zero reset. Stereo microphone and auxiliary inputs and controls, speaker/headphone and external amplifier outputs . . . front panel mounted for easy access. Push-button controls for operational modes. Built-in stereo power amplifier giving 4 watts rms per channel. Two high efficiency 8 x 5in. speakers. Operates on 230V a.c. supply.

Versatile recording facilities. So easy to build—so easy to use.

Latest Portable Stereo Record Player, SRP-1

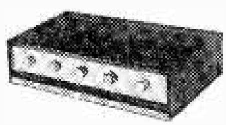


Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250V ac mains operation. Overall cabinet size $15\frac{3}{16}$ x $3\frac{7}{8}$ x $10\frac{1}{4}$in.

Compact, economical stereo and mono record playing for the whole Family—plays anything from the Beatles to Bartok. All solid-state circuitry gives room filling volume.

KIT £28.6.0 incl. P.T. **Ready-to-Use £35.4.0. P.P. 10/6**

Latest STEREO AMPLIFIER, TSA-12



12 x 12 watts output.

Kit £30.10.0 *less cabinet.* P.P. 10/6

Cabinet £2.5.0 extra

Ready-to-Use £38.0.0. P.P. 10/6.

FOR THIS SPECIFICATION

17 transistors, 6 diode circuit. ± 1 dB, 16 to 50,000 c/s at 12 watts per channel into 8 ohms. Output suitable for 8 or 15 ohm loudspeakers. 3 stereo inputs for Gram, Radio and Aux. Modern low silhouette styling. Attractive aluminium, golden anodised front panel. Handsome assembled and finished walnut veneered cabinet available. Matches Heathkit models TFM-1 and AFM-2 transistor tuners.

Full range power . . . over extremely wide frequency range. Special transformerless output circuitry. Adequately heat-sinked power transistors for cool operation—long life, 6 position source switch.

High-performance CAR RADIO, CR-1

Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

8 Latest semi-conductors (6 transistors, 2 diodes) For 12 volt positive or 12 volt negative earth systems. Powerful output (4 watts). Pre-assembled and aligned tuning unit. Push-button tone and wave change controls. Positive manual tuning. Easy circuit board assembly.

Instant operation, no warm-up time. Tastefully styled to harmonise with any car colour scheme. High quality output stage will operate two loudspeakers if desired. Can be built for a total price.

KIT (less speaker) £12.18.6 incl. P.T. P.P. 4/6.

Ready-to-Use £19.12.6 P.P. 4/6 8 x 5in. Loudspeaker £1.10.0 extra.

RADIOS for Luxury Listening

"OXFORD" PORTABLE UXR-2

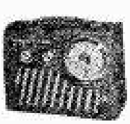
Oxford

This De-Luxe, 7 transistor, 3 diode portable radio covers long and medium wave-bands with an easy-tune dial and uses battery-saving circuitry to ensure longer life and more hours of listening pleasure. Choice of Brown or Black real leather case.

KIT £15.10.0 P.P. 6/–

Ready-to-Use £17.10.0 P.P. 6/-

PORTABLE UXR-1



UXR-1

This luxury 6-transistor, 1 diode receiver covers long and medium wavebands. Its robust case is now available in real brown leather or choice of colours: Navy blue, coral pink, lime green (please state second choice).

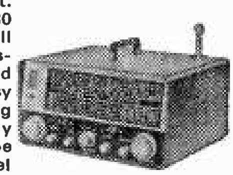
KIT £12.8.0 colour case. P.P. 4/6

Ready-to-Use £14.8.0 P.P. 4/6

KIT £13.8.0 real leather. P.P. 4/6

Ready-to-Use £15.10.0 P.P. 4/6

"Mohican" General Coverage Receiver, GC-1U



Powerful 10 transistor, 5 diode circuit. Tunes 580 to 1550 kc/s and 1·69 to 30 Mc/s in five bands. Bandspread on all bands. Fixed-aligned ceramic IF trans-filters for best selectivity. Pre-assembled and aligned 'front-end' for fast, easy assembly. Built-in 6 x 4in. speaker. Tuning meter for pin-point tuning. Completely self-contained for portability—can be operated on 230 volt AC with Model UBE-1. Kit £2.17.6 extra.

Kit £37.17.6. Ready-to-Use £45.17.6. P.P. 10/6.

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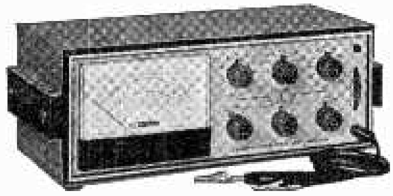
(Available in ready-to-use or kit form)

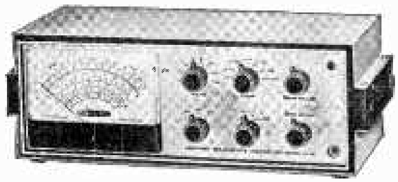
The newest and most practical innovation in electronic instrumentation is the exciting new ultra-functional styling format from Heath.



Kit IM-25 — **£48.10.0**
Ready to use — **£59** P.P. 7/6

New Solid-State, High-Impedance Volt-Ohm-Milliammeter . . . IM-25

● 9 AC and 9 DC voltage ranges from 150 millivolts to 1500 volts full scale ● 7 resistance ranges, 10 ohms centre scale with multipliers x1, x10, x100, x1k, x10k, x100k, and x1 meg . . . measures from one ohm to 1000 megohms ● 11 current ranges from 15 μA full scale to 1·5 A full scale ● 11 megohm input impedance on DC ● 10 megohm input impedance on AC ● AC response to 100 kHz ● 6in. 200 μA meter with zero-centre scales for positive and negative voltage measurements without switching ● Internal battery power or 120/240 VAC, 50 Hz ● Circuit board construction for extra-rugged durability.



Kit IM-16 — **£28.8.0**
Ready to use — **£35.8.0**
P.P. 6/-

New Solid-State Volt-Ohm-Meter . . . IM-16

● 8 AC and 8 DC ranges from 0·5 volts to 1500 volts full scale ● 7 ohm-meter ranges with 10 ohms at centre scale and multipliers of x1, x10, x100, x1k, x10k, x100k, and x1 megohm ● 11 megohm input on DC ranges, 1 megohm on AC ranges ● Operates on either built-in battery power or 120/240 VAC, 50 Hz ● Circuit-board construction.

Kit IP-17 — **£37.4.0**
Ready to use — **£46** P.P. 10/6

IP-27 not illustrated, but similar in styling.

New Variable Control Regulated High Voltage Power Supply . . . IP-17

● Furnishes 0 to 400 volts DC at 100 mA maximum with better than 1% regulation for 0 to full load and ± 10 volt line variaton ● Furnishes 6 VAC at 4 amperes and 12 VAC at 2 amperes for tube filaments ● Provides 0 to —100 volts DC bias at 1 milliampere maximum ● Features separate panel meters for continuous monitor for output current and voltage ● Terminals are isolated from chassis for safety ● High voltage and bias may be switched "off" while filament voltage is "on" ● Modern circuit board and wiring harness construction ● 120/240 VAC, 50 Hz operation.

New Improved Version of the Famous Heathkit Solid-State, Voltage-Regulated, Current-Limited Power Supply . . . IP-27

● New zener reference ● New improved circuitry is virtually immune to overload due to exotic transients ● 0·5 to 50 volts DC with better than ± 15 millivolts regulation ● Four current ranges 50 mA, 150 mA, 500 mA and 1·5 amperes ● Adjustable current limiter: 30 to 100% on all ranges ● Panel meter shows output voltage or current ● "Pin-ball" lights indicate "voltage" or "current" meter reading ● Up-to-date construction ● Unequalled performance in a laboratory power supply.
Kit IP-27 £46.12.0. Ready to use £55. P.P. 9/-.

FULL SPECIFICATION ON ANY MODEL AVAILABLE ON REQUEST

New Solid-State Volt-Ohm-Meter, IM-17

● Just right for the home owner, boater, model builder, hams, sophisticated enough for even radio and TV servicing ● Solid-state circuit ● FET input ● 4 silicon transistors, 1 diode circuit ● 4 AC voltage ranges ● 4 DC voltage ranges 4 ohm ranges. 11 megohm input DC, 1 megohm input AC, 4½in. 200 μA Meter ● Self powered ● Rugged polypropylene case with self cover and handle. Storage space for own flex leads. PCB construction.

Kit £12.12.0. Ready to use £17.10.0. P.P. 4/6.

DAYSTROM LTD., Dept. PW-9, GLOUCESTER | **PLEASE USE COUPON ON LEFT FOR ENQUIRIES**

SENSATIONAL VALUE IN HIGH FIDELITY STEREO SYSTEMS

Consisting of (1) Garrard Mk II SP25 4-speed Turntable with Pick-up. Heavy 12in. turntable, hydraulic lowering device and many other features inc. Plug in P.U. head. Fitted CS90 P.U. Cartridge. Ready wired on plinth. Fitted plugs for instant use. (2) Super 30 Amplifier fully wired and fitted in cabinet. (3) Pair of Stanton Loudspeaker Units. Extremely attractive cabinets finished Satin Teak Veneer. Tinted Perspex 'hinged' cover. Performance comparable with equipment at twice the cost. Substantial saving on package deal.
Special inclusive price **72 Gns.**
Terms: Dep. £21.12.6 and 12 mthly pymts of £5. Total £81.12.6 Send S.A.E. for leaflet. Also 'Plan 3' with Goldring Transcription Unit and Shure P.U. Cartridge. 82 Gns.

Inc. Garrard SP25 MkII Player Unit (with heavy cast turntable) on plinth ready wired, with plugs and fitted Goldring CS90 high compliance ceramic cartridge with diamond stylus. Assembled TA12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. Total for above saving £9. Special Price **47½ Gns.** Carr. 35/-
Perspex cover 59/9 extra.
Terms: Dep £8.7 and 9 mthly pymts £5.3 (total £54.14).

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy cast construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range. Impedance 3 or 15 ohms. Please state choice. Response 40-18,000 c.p.s. Exceptional performance at low cost.

HF501	5"	10W	59/9	HF120	12"	15W	69/9
HF801D	10"	8-10W	59/9	HF120D	12"	15W	79/9
HF811D	8"	10W 4 gns.		HF126	12"	15W	89/9
HF100D	10"	15W £5.19.9		HF126D	12"	15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS

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

DORSET Size 16 x 11 x 9in. Response 45-18,000 c.p.s. Rating 8-10 watts. Fitted Audiotrine HF800D speaker. Impedance 3 or 15 ohms. **£7.10.0** Inc. Carr.

STANTON IIIS Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815 speaker with roll rubber surround and 15,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet Response 30-20,000 c.p.s. Impdnce 3 or 15 ohms. Gives smooth realistic sound output. **16 Gns.**

GLOUCESTER Size 25 x 16 x 10in. 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. **12½ Gns.**

INTEREST CHARGES REFUNDED

on Credit Sales settled in 3 months.

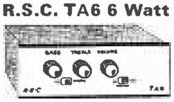
EXTENSION LOUDSPEAKERS 29/9

Cabinet size 12 x 8 x 5in. Attractive Grey Lizard Skin finish. Fitted high flux 4-5 watt. 6½in. 3 ohm speaker.

E.M.I. MAINS RECORD PLAYER TURNTABLES

4 Speed, with P.U., T/O Cartridge. Limited number. Mail Order only. Mono 79/9. Stereo 89/9.

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER



200-250v. AC mains operated Frequency Response 30-20,000 c.p.s. –2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm speakers. Max. sensitivity 5mV. Fully enclosed enamelled case. 9½ x 2½ x 5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6
Or factory built with 12 months guarantee. Post Paid 8 Gns. **6 Gns.**

RECORD PLAYING UNITS

Ready to plug into Amplifier or Tape Recorder. **RP2** Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus, plinth and cover. Normally approx. £26. **22 Gns.**

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Normally approx. 32 gns. Carr. 15/- ONLY **27½ Gns.**

AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. **59/9** Available with clear Perspex cover as ill. Inc. Carr. **£5.15.0**
Perspex cover sold separately at 59/9. Limited number of covers slightly damaged but repaired by makers. 39/9

PHONE AMPLIFIERS

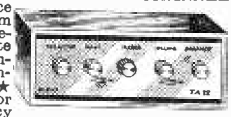
Speak and listen with both hands free. Standard dry battery operated. **59/9**

RECORD PLAYING TURNTABLES COMPLETE

Fully wired. Fitted phono plugs and mounted on baseboard. Substantial saving on normal prices. Garrard SP25 MkII with Goldring CS90 Cartridge. **17½ Gns.**
Goldring GL68 with CS90 Cartridge .... 23 Gns.

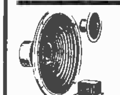
R·S·C TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL



Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 30-20,000 c.p.s. –2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise – 70dB ★ Sensitivities (1) 300mV (2) 50m V (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams and instructions. Factory built with 12 mth gntee 15 GNS. Or Deposit £4.16.0 and 9 mthly pymts. 29/- (Total 17 GNS.). **12 GNS.** Carr. 7/9
Teak finish cabinet as above 3 Gns or as in stereo system 4 Gns.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

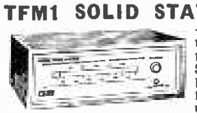


Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.**
Or Senior 15 watt inc. HF 126 15,000 line Speaker 6 Gns. Carr. 6/6 Carr. 5/9

HI-FI 'SPEAKER ENCLOSURES

Teak veneer finish Modern design, Accoustically lined and ported.
JE8 Size 16 x 11 x 9in. Gives pleasing results with any 8in. Hi-Fi 'speaker. Carr. 7/9 **4 Gns.**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Carr. 7/9 **£4/19/9**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24 x 15 x 10in. **5 Gns.**
SE12 For excellent performance with 12in Hi-Fi 'spkr and Tweeter. Size 25 x 16 x 10½in. **6 Gns.**

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER



Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.** Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.

★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 silicone Planar Transistors. ★Designed for standard 80 ohm co-axial input. Visually matching 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. A quality product at half the cost of comparable units. Stereo version, all parts 18 gns. Assembled 22½ gns. Carr. 10/-.

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

SOLID STATE CONSTRUCTION
SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST

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.
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 10Kc/s. NEG FEEDBACK: 52dB.
BASS CONTROL: +17dB to –15dB at 50 c/s. HUM LEVEL: –75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·1%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 3½ Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

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
CONTROL: 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. 15/- **19½ Gns.**
Unit factory built 27 Gns. or deposit £6.2.0 and 9 monthly payments 56/3. (Total £31.8.3). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £6.2.6 and 9 monthly paymts 64/- (Total £34.18.6). *Send S.A.E. for leaflet.*

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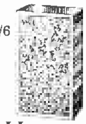
SHEFFIELD 13 Exchange Street (Castle Market Bldgs.) (Half-day Thursday) Tel. 20716

THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size, only ★ Response 30-20,000 c.p.s. Impedance 15 ohms. ★ Performance comparable with units costing over £40. Complete Kit **18 Gns.** Carr. 12/6



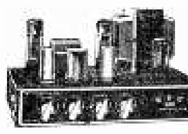
Consists of (1) 12 in. 20 watt Bass unit with cast chassis. Roll rubber surround for ultra low resonance, powerful 2in. diam. pole pieces and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5 in. high flux middle range 'speaker. (4) High efficiency tweeter. (5) Measured weight of woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions. DEMONSTRATIONS AT ALL BRANCHES.

R.S.C. STEREO/20 HI-FI AMPLIFIER

PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL, SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. Frequency Response: ±2dB 30-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 20 millivolts max. Harmonic Distortion: 0·2% ★Four-position tone compensation and Input Selector Switch. ★Stereo/Mono switch. ★Neon panel indicator. ★Handsome Perspex Frontplate. ★Separate Bass and Treble controls. Output transformers are high quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts. point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 mths' gntee 19gns. Or Dep. £4.10.0 and 9 monthly payments £2 (Total £22.10.0). *Send S.A.E. for leaflet.*

14 Gns. Carr. 12/6

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. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. 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 with point-to-point wiring diagrams and instructions. Carr. 12/6 **13 Gns.** Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months' guarantee for 16 gns. TERMS: Deposit £5.14.0 and 9 monthly payments of 28/9 (Total £18.12.9). Send S.A.E. for leaflet.

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 allowing mixing of "mike" and gram, etc. etc. High sensitivity. 5 valves—ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. FOR BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c/s. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic PUs, all types "mikes". For Musical Instruments such as String Bass, Electronic Guitars, etc. Size approx. 12 x 9 x 7 in. For AC mains 200-250v. 50 cps. Output for 3 and 15 ohm spkrs. Send SAE for leaflet. **9 Gns.** Full instructions and point-to-point wiring diagrams. Carr 11/6 (or factory built 12 Gns.) Twin handled metal cover 25/-. TERMS ON ASSEMBLED UNITS. Deposit 87/6 and 9 monthly payments of 22/- (Total £14.5.6).

RSC A11T TRANSISTORISED VERSION of above complete kit 9 Gns (Assembled 13 Gns)

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

An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape

★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes" Bass and Treble controls.

49½ Gns. Carr. 30/- or dep. £7.17.6 and 9 monthly payments of £5.10.10. (Total 55 gns.). Send S.A.E. for leaflet. Also B20 Bass inc. 15in. 25w.Spkr. 29½ gns. G15 inc 12in. 20w. Spkr. 19½ gns.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BMI An all-dry battery eliminator. Size 5½x4½x2in.approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or assembled 59/11.

SELENIUM RECTIFIERS | F.W. (Bridged)

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

R.S.C. MAINS TRANSFORMERS

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

MIDGET CLAMPED TYPE 2½ × 2⅝ × 2¼in.
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.

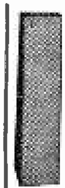
CHARGER TRANSFORMERS 0-9-15v. 1½a. 13/11; 2½a. 16/11; 3a. 18/11; 5a. 21/11; 6a. 25/11; 8a. 31/11

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 5,000Ω or 7,000Ω to 3Ω .. 7/9
Push-Pull 8 watts EL84 to 3Ω or 15Ω 11/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15Ω 21/9
Push-Pull EL84 to 3 or 15Ω 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 15Ω 29/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15Ω ... 55/9

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

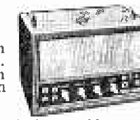
R.S.C. COLUMN SPEAKERS



R·S·C HI-FI CENTRES LTD.

Covered in two-tone Rexine/Vynair. ideal for vocalists and Public Address. 15 ohm matching. Type C48, 25-30 watts. Fitted four 8in. high flux 7watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **15 Gns.**
Type C412, 40 watts. Fitted four 12in. 12,000 line 10watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0). **22 Gns.**

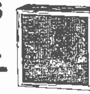
30 WATT HI-FI AMPLIFIER



for Guitar, Vocal or Instrumental Group

A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Peak rating 60 watts. Latest valves. Strong Rexine covered cabinet with handles. Attractive black/gold perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Deposit 3 gns. and 9 monthly payments of 39/8 (Total £21). **18 Gns.** Carr. 12/6

12in. HIGH QUALITY LOUDSPEAKERS



In Teak veneered or Rexine covered Cabinets
10 Watt 12,000 lines 3 or 15 ohms **5 Gns.** 20 Watt 12,000 lines 3 or 15 ohms **8 Gns.**

LOUDSPEAKERS

Limited number of heavy duty units at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available over £8.

12in. 10 watt HIGH FLUX	12in. 20 watt DUAL CONE	12in. 30 watt DUAL CONE	15in. 30 watt DUAL CONE
59/11	£5.15.0	Normally appr. £13 £6.19.9	Normally appr. £15 9 gns.

FANE 'POP' 100 LOUDSPEAKER

18" 100 Watt POST FREE
Fantastic power handling. Guaranteed 2 years. **19 Gns**

R.S.C. GRAM AMPLIFIER KIT. 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**

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**

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

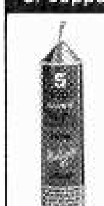
A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and most "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feedback 15dB. For A.C. mains 200-250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions. **£4.17.9**

HIGH QUALITY 8" x 3" LOUDSPEAKERS 10000 Gauss 3 ohm only **12/9**

ERSIN **Multicore** 5 CORE SOLDER

for quick, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required. Ersin Multicore Savbit Alloy also reduces wear of copper soldering iron bits.



SIZE 5 HANDY SOLDER DISPENSER

Contains 10 ft. coil of 18 s.w.g. Ersin Multicore Savbit Alloy. 2/6 each.

SIZE 15 SOLDER DISPENSER

Contains 21 ft. coil of 60/40 Alloy, 22 s.w.g. Ideal for small components, transistors, diodes. etc. 3/- each.

SIZE 12

Ideal for home constructors. Contains 90 ft. of 18 s.w.g. Ersin Multicore Savbit Alloy on a plastic reel. 15/- each.

BIB MODEL 8 WIRE STRIPPER AND CUTTER

Strips insulation cleanly and quickly, fitted with unique 8 gauge wire selector. Plastic handles. 9/6 each.

From Electrical and Hardware shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

PRACTICAL WIRELESS

VOL 44 No 5

issue 739

SEPTEMBER 1968

TOPIC OF THE MONTH

Politics in P.W.

AFTER reading a certain leader, a reader fired off a broadside headed "Keep Politics out of P.W." Another, signing himself "Member of the Labour Party", obliquely suggested that we are in cohorts with the Tory Party. These, as similar missives that arrive from time to time, are just plain daft.

Politics with a capital P do not interest us. But we *are* concerned with the things that politicians do, or do not do, that affect radio. Without being pompous, it is our duty to speak out against acts or non-action detrimental to amateur radio, whether due to organisations, individuals, or politicians, whether they are Conservative, Labour, Liberal, Communist or East Finchley Nationalists!

We are not always right but we reserve the privilege of saying what we think. To deny this freedom of expression because it might upset political diehards is manifestly absurd. The "solidarity" we sometimes hear about really means blind faith, but we prefer to face facts.

We argued that pirate radio stations were anarchic; they have now been scuttled. We campaigned for an end to the ludicrous walkie-talkie situation; legislation now exists. We poked fun at the GPO for their gaff about morse speeds; action has been taken. Years ago we prodded the Government about local radio stations; they have now started up. We were almost the only periodical to spot the inherent dangers of Clause 7 of the Wireless Telegraphy Act; this situation was subsequently remedied. We even spoke out on mail order trading; while everything is not ideal, things have improved and due to the controversy we heard many constructive viewpoints from both customers and suppliers.

We will therefore *keep* politics in P.W., if this definition means pointing the editorial finger impartially and objectively at anything detrimental to the hobby. In the process we will, no doubt, upset political fanatics, ornithologists, taxidermists, gasfitters, the Society for This, the Committee for That and the League for The Other. Only one thing worries us—the letters of protest we are sure to get from the East Finchley Nationalists!

W. N. STEVENS—*Editor*.

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

OCTOBER ISSUE WILL BE PUBLISHED ON SEPTEMBER 6th

All correspondence intended for the Editor should be addressed to : The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 36s. per year to any part of the world.

NEWS AND COMMENT...

WALKIE-TALKIES

Unaware of the ban on manufacture and import of certain radio transmitters, a number of British travellers have bought walkie-talkies abroad and, on return to this country, have had the sets detained by Customs. The ban has applied from 1 April, 1968, and no exceptions are allowed which do not have Post Office authority.

Any use of radio in this country must have a licence and the Post Office will not licence walkie-talkies using frequencies around 27Mc/s because they are liable to interfere with authorised radio services. The Post Office are quite adamant that it will not authorise manufacture or import of transmitters which cannot be legally used here. Apart from the ban, the maximum penalties for illegally using a radio transmitter were increased last year.

Make sure before you buy a set that you can get a licence for it. If in any doubt contact the Post Office Radio and Broadcasting Dept., Armour House, St. Martin's-le-Grand, London, E.C.1.

RADIO RALLIES

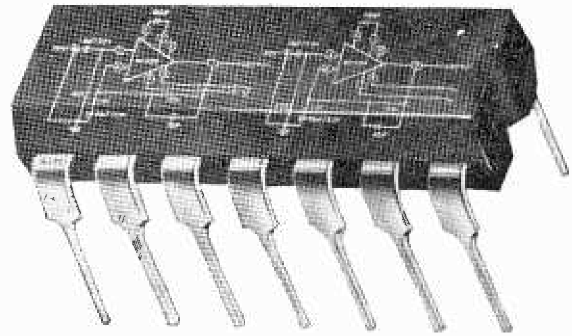
Gilwell Park in Essex was the venue of the R.S.G.B. National Mobile Rally on 23rd June. The top photograph shows the 2-metre talk-in station situated in the corner of a barn.

The lower photograph shows the topband talk-in station, GB3USA, at the A.R.M.S. Rally at R.A.F. Mildenhall held on 30th June.

This superb rally was attended by thousands, many of whom were mobile stations. Attractions included a huge trade show, "train" rides for the children, and an American Air Force band.

Highlight of the rally was a brilliant display by the Royal Air Force Aerobatic Team—The Red Arrows. Well done chaps, you were just great.

INTEGRATED STEREO PREAMP



A dual preamplifier, designed for high fidelity amplification of low-level stereo signals, has been announced by Motorola Semiconductors Ltd. Called the MC1303P, the monolithic device features a short-circuit-proof design, and the output leads can be shorted without harming the device. Channel separation is claimed as 60dB min. at 10kc/s with less than 0·1% total harmonic distortion. Minimum open loop voltage gain is 8,000.

I.R.E.C.E.

Don't bother to look it up, it stands for the International Radio Engineering and Communications Exhibition (the R.S.G.B. "do") which will be held this year at the Royal Horticultural New Hall, Greycoat Street, Westminster, London, S.W.1. Dates for your diary are 2 to 5 October.

The Diplomatic Wireless Service will be exhibiting for the first time, and another new trend will be a series of four lectures on "Communications Equipment", "Single Side Band", "Aerials" and "Communication Research and Developments". These will take place on the Thursday and Friday, with Saturday being reserved for all Armed Forces general meetings. A manufacturers' Silver Plaque will again be awarded, and some lucky visitor will win a brand new communications receiver. There will also be awards for the best home-constructed equipment.

The Exhibition is to be opened by the Postmaster-General. This might be the time for telling us just what is happening about this "Beginner's" Licence?

The three "Practicals"—Wireless, Television and Electronics—will again be taking a stand and members of the staff look forward to meeting readers.

S.S.S.S.

Standing for Super Stable Signal Source, and referring in this instance to the BBC's 200kc/s transmitter at Droitwich. This has long been used as a standard frequency reference by amateurs, professionals and industry. Since 1965 the long-term stability has been within ±5 parts in 10^{10}, and with the use of automatic frequency correction has been kept within 1 part in 10^{10}.

The frequency control source is now a rubidium gas cell standard provided by the National Physical Laboratory. This has a day-to-day stability of better than 1 part in 10^{11} and the frequency will be maintained within ±2 parts in 10^{11} of nominal referred to the caesium beam frequency standard at the National Physical Laboratory.

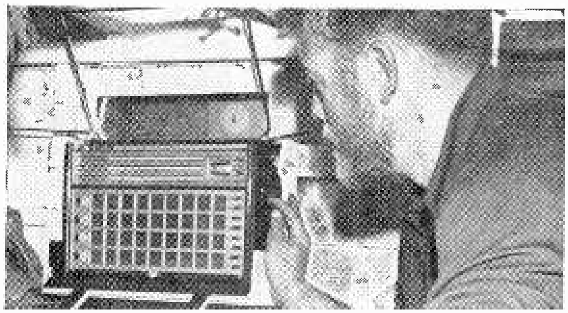
NEWS AND COMMENT...

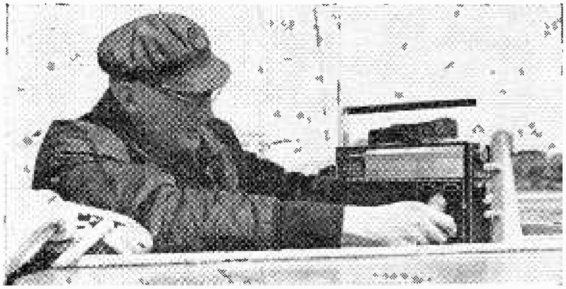
DIAL-A-COMPUTER

An advanced data communications system which enables computers to communicate internationally over normal switched telephone lines, and makes it possible for data to be fed into a computer in another country, or even another continent, was shown at the British Engineering Exhibition in Copenhagen recently by the Marconi Company.

The system, known as Marconidata, enables data to be transferred directly into a computer at any point which can be reached by telephone. Errors due to noise and interference are virtually eliminated by the system, which will detect and correct all but about 1 in 10,000,000, equivalent to transmitting the entire works of Shakespeare twice, with only one letter in error. Now you know why examiners are against people creeping out and making telephone calls during exams!

ALL AT SEA





Sailing long distances single-handed seems to be catching on fast these days. The most recent activity in this field was the transatlantic race. Strangely enough the radio gear used, particularly receivers, is not unduly specialised and most of the sets used are readily available to the public.

The two photographs show the receivers used on two of the boats. The top one shows South African Bruce Dalling at the "wheel" of his Philips Transworld f.m./a.m. portable. This covers long, medium, v.h.f., plus four shortwave bands. Bruce was using a fifty-foot stainless steel vertical aerial to keep in touch with civilisation.

The lower photograph is of Eric Willis here seen massaging the controls of his receiver—a Hallicrafters CR50 covering 185–400kc/s; 535–1605kc/s; 2–5·2Mc/s; 5·2–15Mc/s and 108–135Mc/s. It also boasts separate meters for battery monitoring and signal strength. Messrs. Electroniques stock the CR50.

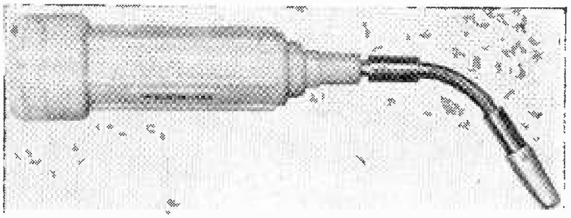
64 DOLLAR QUESTION

Only score 2 if you thought it was a maggot's kneecap under a microscope. Score full marks if you said it was a Clinton Prodlite. The makers inform that it will fit most 2-cell (2½–3 volt) torches and although only one-eighth of an inch in diameter, it encloses a high efficiency long life lens bulb. The Prodlite provides illumination at otherwise inaccessible spots. It is available in two standard lengths, Model A, 5½in. long, and Model B, 9in. An insulating sleeve for optional use is supplied free with each Prodlite.

A special switch handle is also available enabling the Prodlite to be used from an external power source.

Further information may be obtained from The Clinton Laboratory, 43 Broomhall Place, Sheffield, S10 2DG.

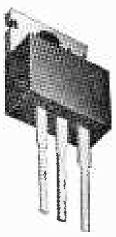
F.T. SPANNER



We weren't quite sure either but apparently it's a flexible torque spanner marketed by Ward Brooke & Co. Ltd., Avionics Division, Loudwater, near High Wycombe, Bucks. The units employ a unique mechanism which combines a ball bearing flexible driver shaft with a ratchet system, constructed of nylon to provide constant friction characteristics and obviate the risk of slipping. It is housed in a fluted nylon handle which helps ensure that the tool is tough enough to withstand all forms of handling. A chart is available giving the recommended loadings when torque spanners are employed on stud or screw materials having an ultimate tensile strength of not less than 40 tons/in.².

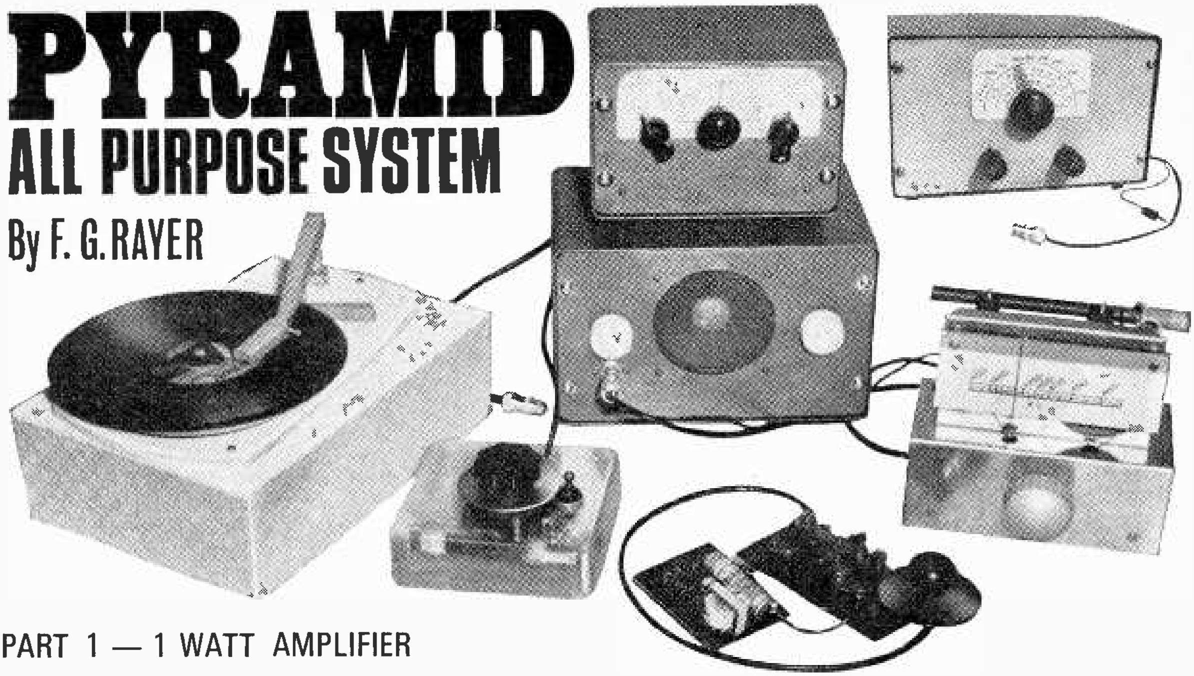
The overall length of the standard F.T. Spanner is about 6½ inches and is available in socket sizes from 10BA to 4BA and 4–40 to 8–32UN.

NEW TRIAC



RCA Great Britain Ltd. has extended its thyristor and triac range by introducing a new low-cost 8A triac with a moulded silicone encapsulation, the TA7365. This is a gate-controlled full-wave device with three horizontal leads to facilitate mounting on PC boards. Full-wave control of a.c. loads as in motor speeds, light dimmers, heater controls and power switches are some of its applications.

PYRAMID
ALL PURPOSE SYSTEM
By F. G. RAYER



PART 1 — 1 WATT AMPLIFIER

THIS set of equipment consists of a high-gain 4-transistor amplifier, with battery and loudspeaker, into which can be plugged various accessory units. A very versatile set of equipment is thus easily built up, according to the user's needs.

The amplifier can furnish up to 1-watt output, which is easily sufficient for such purposes. Accessory units include the following:

DIODE TUNER. This is extremely simple, but allows excellent reception of local stations.

MORSE OSCILLATOR. This unit is for code practice; or for monitoring outgoing c.w. transmissions by rectifying r.f. to provide its operating current.

SUPERHET TUNER. Using a ferrite rod aerial, this employs three transistors and a diode in a medium wave circuit, and provides a large selection of transmissions.

RECORD DECK. This is battery operated, 33/45 r.p.m., to allow playing records with the amplifier.

TRANSISTOR T.R.F. TUNER. This is a straightforward unit with 2-gang tuning, for use when a superhet tuner is not required, and when a simple diode tuner does not give adequate results.

S.W./M.W. SUPERHET TUNER covering 515kc/s—15Mc/s (580—20 metres) in three switched bands.

There is, of course, no need that all the accessory units be constructed. A tuner only might be required, with possibly facilities for record playing later. Or the most important interest might be in code practice, the amplifier also serving for radio reproduction later.

Amplifier Circuitry

This is shown in Fig. 1, and has enough gain for a crystal pick-up and the other units. D.C. operating conditions of each stage are independent of other stages, and this proves to be one of the most straightforward arrangements, avoiding some of the difficulties occasionally arising with directly-coupled and similar circuits.

VR1 is the volume control, operating with any unit plugged in. VR2 is a tone control, and will be found quite useful. Tr1 is a high-gain low noise amplifier, followed by the driver Tr2. Tr3/4 is the output pair, and output can be up to about ½-watt without heat sinks, or 1-watt with the sinks described. Negative feedback over driver and output stages improves quality of reproduction, and is by R10.

Battery, loudspeaker and amplifier are in a single cabinet, and the case listed is 8 × 5 × 5in., giving a professional finish to the equipment, and taking a 3½in. loudspeaker.

External Connections

A coaxial socket is used for all inputs, with the inner lead for the audio circuit, and the outer brading for the positive line or earth return. The transistor tuners also need a negative supply of around 6V, and this is obtained by inserting a plug in the negative socket provided. This method was used instead of a multi-way connector because the negative supply is not always required. It is also cheaper.

The coaxial input and negative socket are on the amplifier panel, rather than behind, for quick changing of accessory units.

Construction

Constructors who feel they would welcome some general guidance should note that these details apply in a similar way to the other units, described later.

Components are mounted on a $\frac{1}{16}$in. thick paxolin

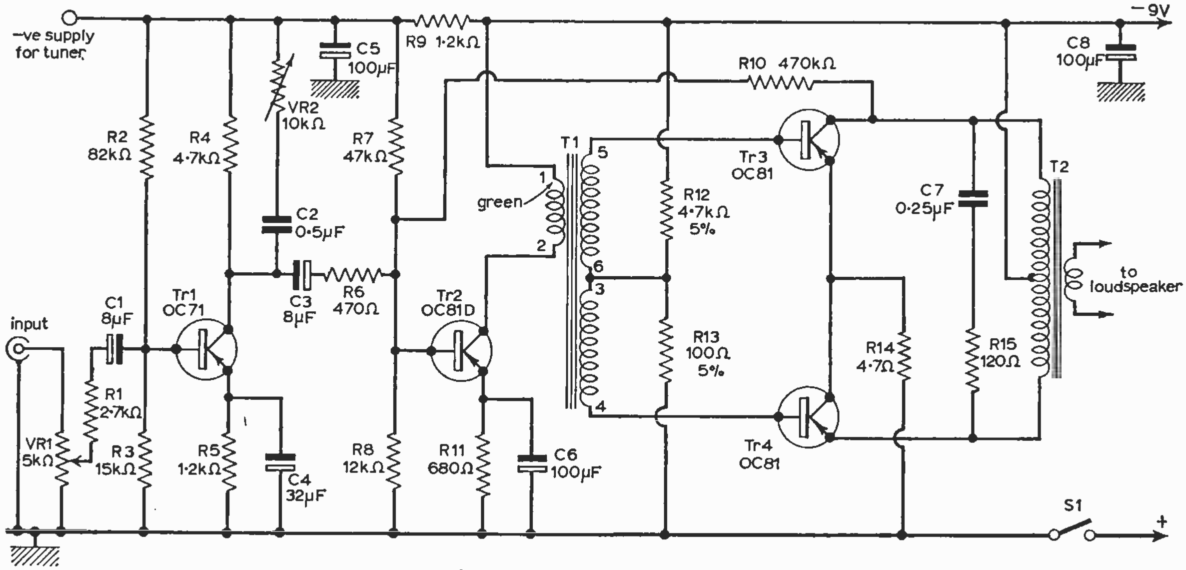


Fig. 1: Circuit of the Pyramid amplifier.

panel (Fig. 2). This is afterwards turned over, and wired on the other side. The panel should be prepared by drilling as many holes as possible, before mounting any components. Guide lines can be scratched with a straight-edge and sharp tool. A $\frac{1}{16}$in. or $\frac{5}{64}$in. drill is most suitable for the wires from resistors, capacitors and transistors. Where 6BA bolts are used for mounting and other purposes, holes can be $\frac{1}{8}$in. or $\frac{9}{64}$in. If a few holes are missed, these can be done carefully later.

The wire ends of resistors and capacitors are bent over to pass through the holes. Sharp right-angled bends should not be made immediately against the component body. Resistors and non-electrolytic capacitors (such as C7) may be placed in either way, but electrolytic capacitors (C1, C4, C5, etc.) have positive and negative ends, which must be located as shown.

In Fig. 1, all resistors except R12 and R13 are 10 per cent, so have silver bands in addition to the three bands showing the value. R12 and R13 are 5 per cent, so have gold bands.

The driver transformer T1 has a green spot to identify tag 1. Tags pass through holes, emerging as in Fig. 3. Leads soldered on hold the transformer in position. Other driver transformers should give similar results, but as leads or tags will probably be in different positions, wiring data must then be taken from the maker's leaflet.

T2 is bolted in place. Leads from it also pass through the paxolin. Alternatives of similar type should be satisfactory. T1 and T2 should be of correct ratio and type for Tr2, and Tr3/4, with a 2/3 ohm speaker. If to hand, it is feasible to use other transistors and the transformers for them, such as OC71 driver, and 2 × OC72 output. Power output would be reduced, but should be adequate. R7, R8,

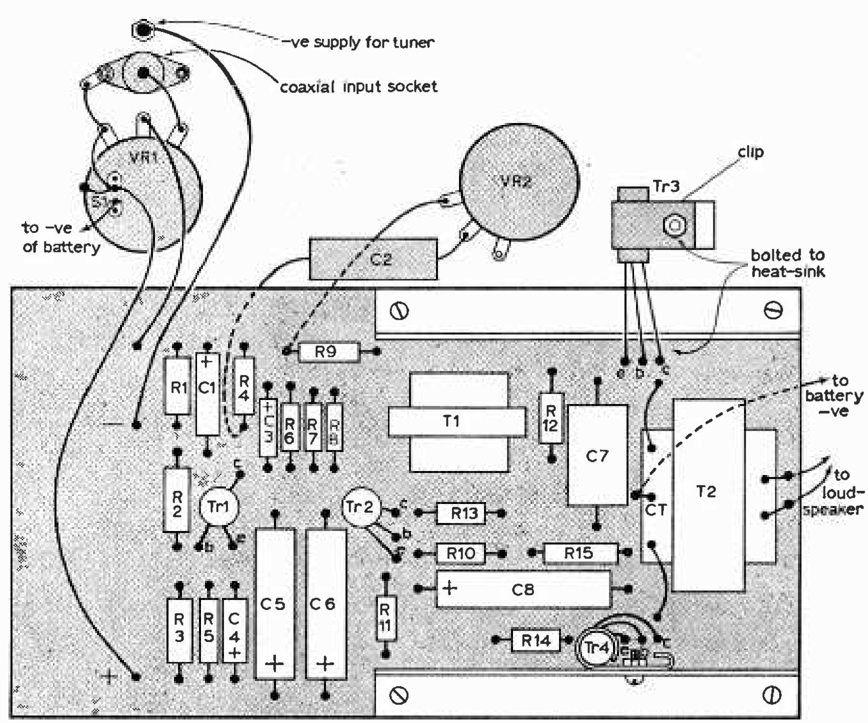


Fig. 2: Component layout.

R11, R12, R13 and R14 should then be chosen to suit the transistors.

Heatsinks

These are 16 s.w.g. aluminium, approximately 3in. × 2in., a flange being bent to bolt as in Fig. 2. Tr3 and Tr4 are placed in transistor clips, bolted to the sinks. The values given allow operation up to 500mW without heatsinks, and this is often adequate. For the maximum output of 1-watt, the sinks are essential, and R12 is 2·2kΩ, R13 39Ω, and R14 3·3Ω.

Wiring

Underside connections, Fig. 3, are most readily made with 26 s.w.g. or similar quite thin tinned copper wire. Add insulated sleeving where necessary. Connections are soldered quickly with a correctly heated iron, and the projecting ends of resistors etc. snipped off.

If pieces of sleeving about ⅜in. to ½in. long are put on the transistor wires, this will prevent them touching each other, and hold the transistors at a suitable height. It is helpful to identify these leads with coloured sleeving. For example, *red* for collector, *green* for emitter, and base wires *bare*.

The transistor leads need not be cut as short as possible, and a little extra length reduces chances of overheating the transistor. These connections are soldered rapidly—it should only be necessary to apply the iron for a second or two. Remove it immediately the joint is made.

Feedback

If other transformers are used, leave the Tr3/4 end of R10 disconnected. When the amplifier is first tested, set VR1 at minimum. Temporarily take a lead from the free end of R10 to Tr3 collector. If there is a slight reduction in background noise (or improvement in reproduction, if a signal is available) this is correct, and is soldered. Should oscillation occur, disconnect R10 at once and take it to Tr4 collector.

A metal panel is supplied for the case listed. This was changed to hardboard by drawing round the metal. The speaker aperture is the same diameter as the cone. The panel was given a single coating of quick drying "hammer" finish paint.

Two bolts securing the speaker also hold brackets, cut from scrap aluminium. These brackets support the amplifier near the top of the cabinet.

VR1, the coaxial socket, and negative socket are near the Tr1 end of the amplifier, Fig. 2. They are connected as shown, the metal case or bush of VR1 being earthed to the coaxial socket and positive line, as indicated.

VR2, with C2, occupies a position on the other side of the speaker. Connections are in Fig. 3. Also connect T2 secondary to the speaker, and solder on clips for a PP9 battery. The battery rests in the bottom of the case and its clips should not touch the metal case. If the clips have bare metal, the battery can be put in a cardboard box or tray.

★ components list

Resistors:

R1	2·7Ω	R9	1·2kΩ
R2	82kΩ	R10	470kΩ
R3	15kΩ	R11	680Ω
R4	4·7kΩ	R12	4·7kΩ 5%
R5	1·2kΩ	R13	100Ω 5%
R6	470Ω	R14	4·7Ω
R7	47kΩ	R15	120Ω
R8	12kΩ		
VR1	5kΩ log pot with switch		
VR2	10kΩ linear pot		

All ¼-watt 10% except where shown

Capacitors:

C1	8μF 6V	C5	100μF 12V
C2	0·5μF	C6	100μF 12V
C3	8μF 6V	C7	0·25μF
C4	32μF 6V	C8	100μF 12V

Semiconductors:

Tr1	OC71
Tr2	OC81D
Tr3/4	2 × OC81

Miscellaneous:

T1, Weyrad LFDT4; T2, Weyrad OPT1; 3½in. 2/3 ohm speaker; "Dinkicase" 8 × 5 × 5in., Electroniques; Paxolin; heat sinks; coaxial socket; socket; knobs; etc.

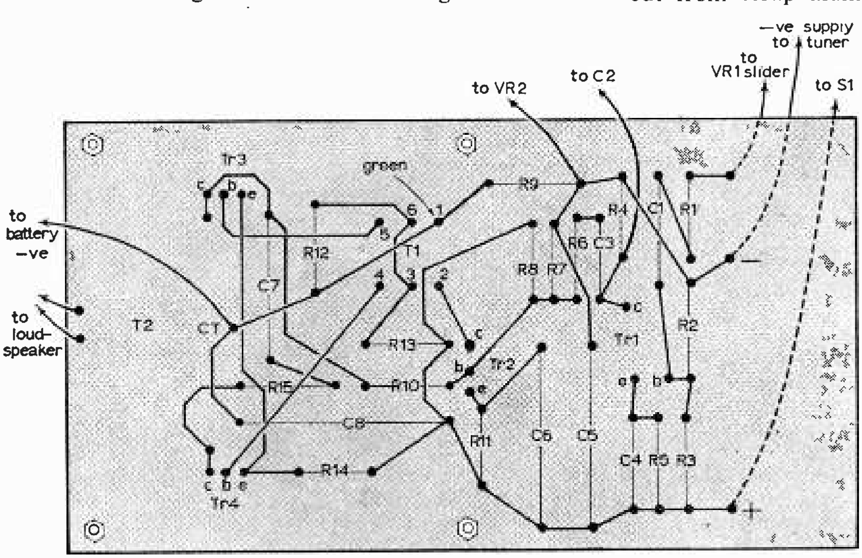


Fig. 3: Underside wiring.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

Passing R.A.E.

By reading and study of P.W. and constant listening to the intelligent discussions on the 80 metre Amateur band, I was able, without any school or correspondence course, to pass the Radio Amateur City and Guilds Certificate, and after some hard work I managed to pass the P.M.G. morse test at 15 words per minute.

How often have your readers written asking for an easy licence? Any average intelligent person can pass the necessary tests providing they are not lazy. I believe that those who complain about the technical and morse tests are too lazy to work for what they want. Possibly this is the result of the Welfare State! People get too much without any effort except making their mark if they are unable to read or write.—**W. Curtis** (*N. Ireland*).

Advert applause

After reading many letters of complaint that you have published in recent issues, I thought that you would like one complimentary one of your many advertisers from whom I recently made a purchase. Unfortunately the item proved faulty. This was returned by parcel post and within the space of eight days a new replacement was received by me without extra charge. —**E. Pilkington** (*Liverpool* 14).

★ ★ ★

Correspondence regularly appears complaining of actions of firms advertising in P.W. and P.E. I would like to say that I have been well treated by advertisers with whom I have communicated, often at their expense. For example, a well known Company sent transistor circuits and data airmail at a cost of £3 though their components are not available in New Zealand.

I have just received dry reed switches eight days after posting the order—therefore it often takes longer getting sterling as we are only allowed one 5s. British P.O. a day.—**K. McAllister** (*Auckland, 7 New Zealand*).

Poking fun

Various correspondents have commented on the charges made by advertisers in PRACTICAL WIRELESS, some a little heated and indignant.

The feeling of being charged a lot for a very little is by no means exclusive to the radio and electronics world and indeed after reading some of the letters, your readers seem to have been treated very well compared to myself on one particular occasion.

One jet of my automatic gas stove failed to ignite. I contacted the relevant authority requesting a man to call.

Two men arrived and one poked a match stick in an obscure hole, whereupon the ignition worked perfectly. The two men were in the house for approximately thirty seconds. For this I was charged 15 shillings. They didn't even leave the match!—**D. Gibson** (*St. Albans*).

Local pirates?

I consider that it is time that broadcasting, for the enjoyment of millions, should be removed from the sinister hands of politicians. Every time there is a change in government our entertainment changes.

Take, for instance, the problem of local broadcasting. The present government has made it quite clear they are anti-commercials and that the BBC are the only people capable of running a radio station. This is rubbish! What about the "pirates"?

As all your readers are probably aware the propagation of the v.h.f. spectrum is very restricted, and it is quite feasible to run 20 local stations in one area without interfering with the 20 stations in another area. What a waste for us all to have to wait for the BBC to have sufficient resources to open a station in our particular area.

Why not condense the 45% of the v.h.f. band allotted to the police, and open the rest to any organisation capable of running a properly maintained station commercially?

Imagine. A choice of 20 stations, the sober British mind boggles at the thought, but it is just a matter of doing what is best for the people who, after all, elect a government, instead of obeying an old fashioned ideal.—**P. Robinson** (*Sussex*).

Big brother's listening

After listening on the Amateur bands from 1·8Mc/s upwards I am truly amazed at some of the antics and comments observed.

I have always understood that the granting of a licence was to responsible people for their self-training and the advancement of their knowledge in radio.

One hears the most inane remarks at times, giggles, squeaks, and very often, particularly on 80 metres, long drawn-out conversations on things like the preparation of oriental dishes, warts—their causes and cures to name a few. Is this the experience of other s.w.l.'s? —**R. Meachim** (*London N.*12).

More letters on page 340

A meter placed in one battery connection should show a current of about 8mA to 12mA, with no signal, or at low volume. The current rises considerably when volume is increased.

If care is taken in construction, a fault is not very likely. Should a meter immediately show a very high current, switch off at once and look for a short-circuit. If the no-signal current is low, and reproduction is distorted, this is probably due to R12 or R13. R12 may be too high in value, or R13 too low. Also check that R14 is not, as example, 47Ω in error. On the other hand, should the no-signal current be rather high, R12 may be too low in value, or R13 too high. This depends somewhat on individual transistors, though results are generally satisfactory with 5 per cent resistors.

TO BE CONTINUED

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.

THE PHILIPS TAPE RECORDING BOOK
By Frederick Purves. Published by Focal Soundbooks. 239 pages, 7 x 4½in. Price 19s. 6d.

THIS is not a mere publicity handout; not a production devised specifically to boost the name of Philips. At least, in the hands of this experienced author it has become more than a mere exposition of Philips machines and accessories. Mr. Purves has managed to pack into this paperback what almost amounts to a treatise on tape recording techniques.

This is a revised and enlarged version of a book that originally appeared in 1962 and was reprinted in 1965 and has now gained a complete section. It must obviously have the most appeal to Philips owners, and should provide them with much direct advice, but it is also an excellent general guide. The first chapter describes how a tape recorder works, very briefly and simply. Then the theme is developed in Chapter 2, describing the various parts, including many hidden from the ordinary user. Mechanics and electronics are treated separately. Tracks are the subject in the third, and use of the tape recorder in the fourth chapters, then we proceed to some hints and tips on practical recording.

Replay is treated as a separate subject, and the tape itself receives a chapter on its own. Likewise, editing has fairly full treatment in a twelve-page chapter, with the next section describing the development from this, some tricks one can perform with the machine.

The tape recorder has worked its way into many spheres; industry, education, law, commerce, even politics are represented. Chapter 10 describes some of the ways the machine is used for specialist work. Accessories and connections have a very full treatment, quite rightly, and there is a short section on basic maintenance. But most important, from the engineer's and indeed the salesman's point of view is the last section of the book, which lists data on all the current and most of the latter-generation machines. This reviewer has found such collated data invaluable in his daily work: if only there were more of these collections for easy reference!

In short, this small book is likely to be of use to the average tape recorder user, the absolute beginner, and Philips owner, and even the practising engineer. What more could Mr. Purves do?—*HWH.*

THE TAPE RECORDER
By C. G. Nijsen. Published by Iliffe Books Ltd. 157 pages, 8½ x 5½in. Price 18s.

THIS is the second edition of a paperback that has already become a bookstall classic, even though it has to compete with many better rivals—mainly because of its reasonable price.

Written for the non-technical amateur, it attempts to pack far too much into its thirteen chapters. The inevitable result is a skimping of some information that might well have been expanded, for the sake of much that the average owner of a tape recorder may have been assumed to have learned already. Ample illustration, including 24 pages of plates and a fold-out showing the tape recorder in cross-section, with a sectional view of a record/play head and some track information on the reverse, makes the book an interesting read. As may be expected from its author and his helpers, illustrations, particularly the photographs, are wholly Philips in origin.

A chapter on cassette recorders has been added since the first edition, and several of the earlier errors tidied up. In fact, the book splits fairly neatly into two sections, the last six chapters providing much useful practical advice for the newcomer to tape recording, while earlier chapters deal briefly with principles, history and rather perfunctorily with some basic theory. Interesting chapters include those on making recordings and the use of the machine in education and the study of music. Sections of earlier chapters dealing with microphones, loudspeakers, accessories and connections and, surprisingly, acoustics, will be helpful to the beginner.

Altogether, despite its ambitious over-reaching, this book is good value for its cost. Certainly, it is not beyond the understanding of the enthusiastic amateur at whom it is aimed.—*HWH.*

BEGINNER'S GUIDE TO TRANSISTORS
By J. A. Reddihough. Published by George Newnes Ltd. 160 pages. 7½ x 5in. Price, 15s.

THIS new addition to Newnes series of Beginner's Guides provides a good, readable, introduction to the subject of transistors, dealing with how they work, the various types available and their applications.

The book is obviously designed for the younger reader who is becoming interested in electronics but serves equally well for any reader who wishes to brush up on his elementary theory. The author assumes that the reader starts off with negligible knowledge of the subject and accordingly begins with a brief account of the nature of electric currents before describing the principles of semiconductor devices.

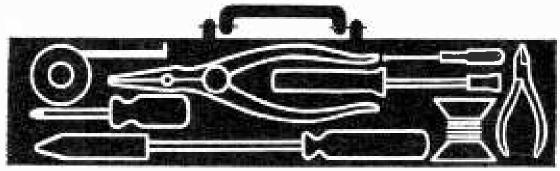
Having set the scene the author goes on to discuss basic transistor circuit and characteristics then gets down to the heart of the book which delves into the applications of transistors in a.f. circuits and then r.f. circuits, the latter taking in techniques used in television receivers.

Having covered most of the circuits used in domestic equipment such as radio sets, record players, etc., the text then branches out into the wider aspects of transistor applications. This section deals with the various types of multivibrator circuit, triggers, switches, logic circuits and so forth. The final chapters cover power supplies, integrated circuits and techniques for servicing transistorised equipment.—*DC.*

repairing radio sets

PART 6

H. W. HELLYER



That irritating crackling, often due to a poor connection, or an inadequate aerial/earth system resulting in a loss of signal, is not one of the easiest of troubles to trace . . .

THE final article of this series must perforce be a kind of summing-up. Between us, Gordon J. King and I have dealt with valved and transistorised receivers from the theoretical diagnostic, servicing and general maintenance angle. Inevitably, in a series of this sort, some points have had to be skated over rather briefly. Radio servicing is a wide field, daily growing wider: we can only hope to touch upon what we consider to be the important aspects.

One of these important subjects is undoubtedly the aerial. Judging by the odd lengths of wire one finds draped around picture rails, or dangling dejectedly behind an expensive radiogram, not enough trouble is taken with this item. Purchasing a costly v.h.f. radio and attempting to receive the benefits of interference-free broadcasting on a makeshift aerial is rather like running a hot-rod on paraffin. The first step towards good reception is capturing a clean, strong signal. Proper aerial formation and siting comes high on the list of priorities.

We are familiar with the concept of wavelength and frequency. We know that the higher frequencies have shorter wavelengths, and that an aerial of "correct" length to pull in Radio 2 is king-sized compared with the multi-rod array of a BBC-2 aerial. Modern television techniques have also impressed upon us the idea of directionality, and we know that this becomes more pronounced as the frequency rises, as do the effects of reflections, or "ghosts". As regards tuning and length, long-wave aerials, and many medium-wave types, are not sufficiently critical for us to bother. In general, we used to find that the longer and higher a piece of wire was strung, the better the reception. In these days of terrible impulsive interference—when everyone's refrigerator but ours makes a switching din like an approaching earthquake—we need to take more trouble, even with the domestic radio that is never tuned to anything but ennervating "pop".

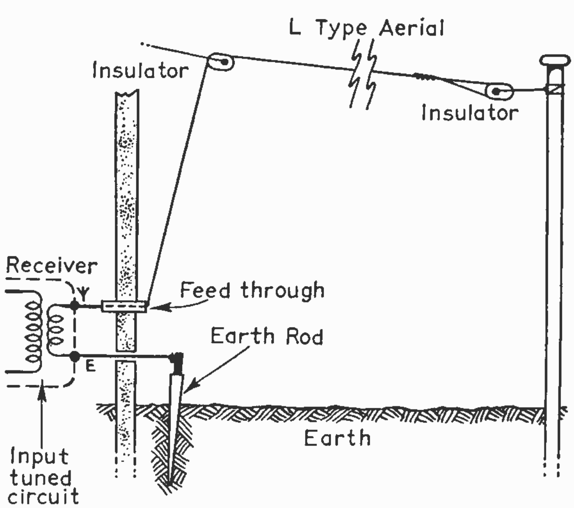


Fig. 26: Long-wire aerial is untuned, but has a natural frequency, the lowest frequency of free oscillation. But the natural wavelength is approximately 4½ times the electrical length of total aerial, including lead-in. Excess length of earth return detunes the aerial.

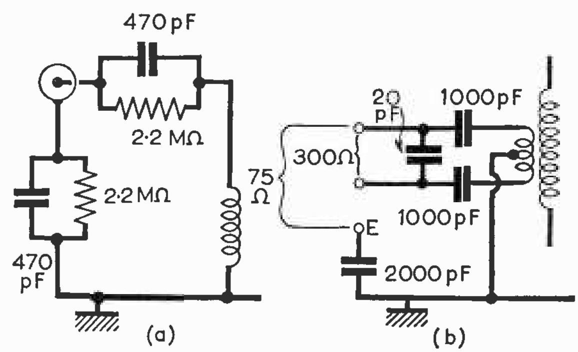


Fig. 27: (a) Isolating capacitors and discharge resistors are fitted in aerial input circuit of television receiver as protection. (b) F.M. aerial inputs may be tapped for balanced 300, or unbalanced 75 ohm feeder.

Although medium and long-wave aerials are generally "broad-tuned" for maximum pick-up of signals over a fairly wide frequency spectrum, each aerial has a "natural frequency", and if we want to get the best reception on a particular station, it is possible to improve matters by attention to this point.

Remember that signals induced into long-wire aerials are relative to earth. For best results, there must be a good earth connection. A sensitive receiver will operate quite well with no more than a short length of wire to the aerial socket—it will always be better with a properly designed aerial and earth system. Although the capacitance of the receiver, between the chassis and the earth, or via the mains supply where this type of receiver is employed, acts as an earth return, this is very inefficient. Any aerial and earth system is part of a complete circuit which includes the input coupling coil —this is as true of the tuned television input circuit as of the simple ferrite rod aerial of your portable radio. Do not overlook the input coil when fault-finding. A loss of sensitivity can often be traced to an open-circuit or high resistance dry joint at this point.

Where a true earth is employed, this should be as short as possible, and of low impedance. A glance at Fig. 26 will show why this is. If we regard the whole system as a tuned circuit, we see that the earth return, if long, will act as a kind of auxiliary aerial. If it is low down, as it invariably will be, the tendency to pick up electrical interference is pronounced. There is signal loss across the length of earth return, because of its relatively high impedance. Shortening the earth, and using thick wire, reduces this impedance, and hence the signal loss. A high impedance connection at the earth connection itself will undo all the good work that foregoing precautions have secured. It is useless to wind a piece of earth wire around the nearest water-pipe; often little better to use the convenient third pin of the house-wiring system, which is connected for best electrical safety, not necessarily for most efficient radio reception. There may be quite a long run of wire between the actual socket and the point of earthing, even though this latter should—if the Electricity Board inspectors have done their job in their usual thorough way—be an effective true earth.

Best method of earthing is undoubtedly a direct line to a rod or plate buried in the soil outside the building. Earth rods can still be obtained—even if an enquiry arouses "old-fashioned looks". An alternative is an earth connection to a rising water-main pipe, but beware of the modern plumbing systems that incorporate lengths of plastic piping. Make sure the pipe really is a water main, coming up from the ground—and never connect to a gas pipe, or, indeed, within four to six inches of one.

If an a.c./d.c. set is being used, take great care about earth connections. As we have already noted, the chassis of such sets is connected to the neutral line of the mains supply. If the input wiring from the mains supply is reversed, or wrongly phased, it may be the "live" line that connects to the chassis. Fitting a direct earth can then result in—at the least—an almighty "bang". At worst, it will mean a windfall for your widow. If your a.c./d.c. set has no earth terminal, do not fit a direct earth to the chassis. An indirect earth, using a capacitor, of perhaps $0.001\mu F$, of high working voltage, is one solution, but not the best for radio reception. There is no true answer, except to do what the makers should have done in the first place, i.e., fit an isolating transformer.

Sealed tuning capacitor, with access to trimmer capacitors, in a pocket portable set.

There is a lot of misunderstanding about the safety aspect of aerials—especially among the women-folk, who imagine that an array on the chimney attracts the lightning like a witchdoctor's fetish conjures spirits. This is only true of a poor installation. Much of the mistaken thinking comes from the use of the term "lightning conductor" for the copper rod or other gewgaw we find fitted at the highest point of many houses. A better name for such a device would be a "discharge conductor", for its job is not to capture and "conduct" lightning —even the thick copper earthing strip to which it should be fixed would rapidly disintegrate under the resulting current—but to drain away the electrical charges in a stormy atmosphere *before* they build up into the intensity necessary for a lightning flash. The other reason that the misconception about aerials exists is that on occasions when a house is struck by lightning, it is usually the chimney that is the striking point. This is partly because it is the highest point, but also depends on the temperature. The internal temperature of the house is generally higher than the air around. From the chimney there will exude a stream of warm air, which gathers in a cloud, becomes to some extent ionised and easily conductive and attracts the lightning by offering an easy discharge path. The nearby presence of a properly installed rooftop aerial will help disperse the ionisation of the chimney cloud and will then help prevent lightning strikes, not attract them. Tell that to the missus!

AERIAL TROUBLES

The danger of the poor installation is that the mast and fittings are not always efficiently bonded to true earth. Parasitic elements and cross-booms can be taken care of quite simply by a direct earth wire connection to the mast, using thick earth wire, (large diameter copper). Normal method of ensuring added safety, especially to a television installation (although these remarks apply equally to the v.h.f. aerials we are discussing), is the provision of discharge resistors across isolating capacitors in the aerial circuit, see Fig. 27.

For some strange reason, aerials, once erected, tend to become as neglected as an urban back-yard. Signal loss caused by corroded joints in the cross-members of an aerial array can be severe. Aluminium makes a poor chemical ally to iron or steel, and the fixing screws often rust prematurely. The answer is an annual dismantling and treatment with protective paint—but very seldom do we find this done. At the least, the connecting points should be checked, wire ends scraped and brass or copper seating bushes polished. This takes little time and repays the attention handsomely.

Feeder cables warrant a regular inspection. Where flat twin feeder is used for v.h.f. installations, it is important that no pinching or scarring has taken place. The impedance matching (300 ohms with this type) depends on the preservation of spacing and on there being no unwanted earth contacts along the way. Much the same thing applies to coaxial, 75 ohm feeder, where pinching spoils the coaxial nature of construction, and earthing causes effective signal loops, and standing waves, which vary the required matching.

Danger points are at gutters and corners of windows, where movement due to wind and weather will cause chafing. If tile and gutter clips are not already in use, their fitting might be worth considering. On a fresh installation, or if there is sufficient spare length to modify an existing one, leave a small loop at the window entry to allow water to drip off, rather than be conducted through the entry hole to form puddles on the carpet which may get the dog a bad name. See Fig. 28.

Internal aerials hardly merit a mention. They should receive occasional attention, especially at joints where movement may have occurred. And the type which is fixed inside a cabinet, such as the foil strip f.m. aerial tacked around the inside of a radiogram, or the odd sprayed screening on the backing of a radio cabinet, need hardly any attention, except to ensure that when fixing screws are removed, they will be refixed securely.

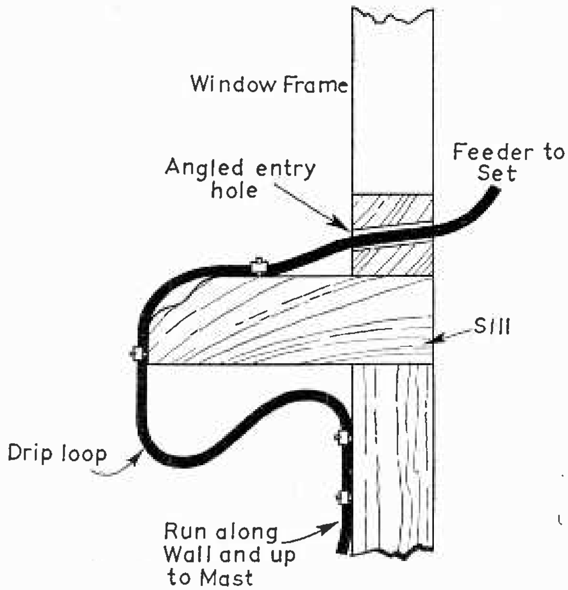


Fig. 28: When installing aerial cable, leave a drip loop outside entry point, and angle entry hole upwards, to avoid ingress of moisture.

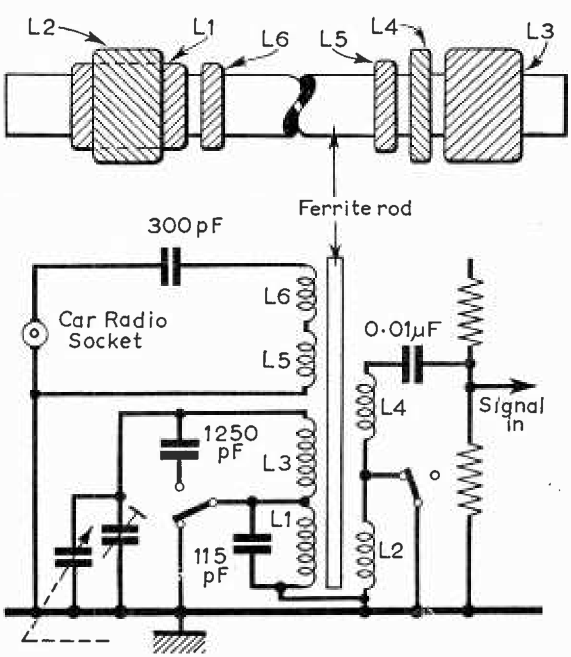
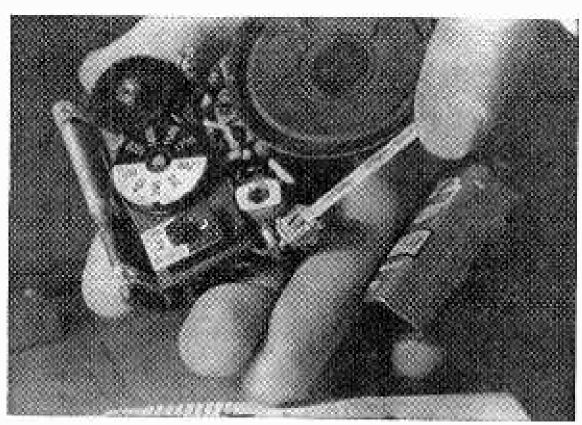


Fig. 29: Physical and theoretical layout of aerial coils as fitted in a conventional two-band transistorised radio. Note the coupling coil for car radio or external aerial connection.

The telescopic aerial of many a transistor radio is a source of trouble and noise. This is usually because of the various methods employed to connect the coupling coil to it. Spring clips are one popular device, and the danger here is that regular use can weaken the spring. The other type of fixing depends on a screw connection, generally at the base of the rod, and looseness here can cause crackles or obscure noises, as well as detuning, even when the aerial is not apparently in use. Unfortunately, the chromed steel or brass does not readily take solder, and some form of mechanical contact is needed. It pays to make the connection as permanent as possible when reparing, with some makeshift form of Jubilee clip, or similar device. A little copper gauze clamped under a home-made loop, which is bolted together to form a clamp, with a connecting tag under the bolt, is as good a method of connecting to such aerials as the original construction.

Ferrite rod aerials are our main concern. They are the most modern form of popular aerial, and surprisingly efficient. But the fine wire of the aerial coils is vulnerable, and often difficult to solder when an accident has occurred. Quite half the "loss of signal" jobs that are brought to the workshop turn out to be fractured rods or disconnected coil connections, and some can be very tricky to trace out and repair. For this reason, I have drawn out a typical aerial circuit and its practical coil connection layout, to show the physical routing of the coil wires. Note that the long-wave coil is a pile-wound type, which may be the honeycomb variety. On this, and on the smaller, longer medium-wave coil, one end is brought out from the inside of the coil, and sometimes at the underside of the former. It is in the perverse nature of things, that a fracture will occur in this lead. A great deal of patient "fishing" and delicate work with tweezers and a small soldering iron may be needed to rectify the fault.

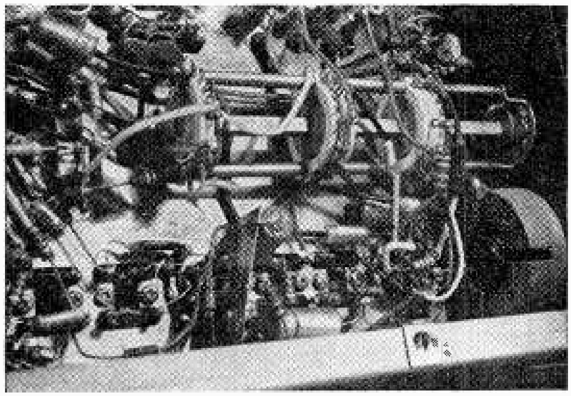
The position of the coils on the rod is important for correct tuning, and will affect the sensitivity over



View of small receiver, showing vulnerable points; aerial rod, tuning drive, slide type wavechange switch and rotary trimmer capacitor.

the appropriate band. Remember that many circuits employ both coils on long wave and only the medium wave coil on this band, so that reception on one band only can be a connection fault.

Broken rods are frequent offenders. Being of rather brittle material, ferrite rods will not withstand severe physical shock. But it should be remembered that they are non-conducting, high permeability ferrites, and not "metal" in the usual sense. This means that their continuity has to be magnetic, but not electrical, and if a clean fracture has occurred, the fault can be overcome by simply bringing the ends together again with a strong contact adhesive. There is no need to ensure a good electrical joint.



Multi-bank wavechange switch of the sealed ceramic variety. Although difficult to clean, this type does not suffer from the 'tracking' problems of the paxolin switch. Note the heavy 'fly-wheel' of the tuning drive in this a.m./f.m. tuner section.

Talking of electrical connections brings us logically enough to switches, without mention of which no series of this nature could be brought to a conclusion. They are the nightmare of many a service engineer, especially those mounted directly on—one might almost say "in"—a printed circuit board. Being the part of the set which receives the most frequent physical movement, it is always a likely cause of trouble. Some types of switch are so flimsy that repair work on them is practically impossible. Others still follow the robust, if clumsy-looking, style that we used to meet in the early valved superhets.

SWITCH CONTACTS

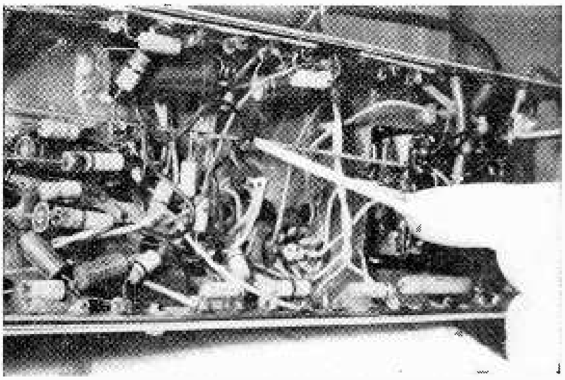
The simple type of switch consists of a bridge clamped in insulating material, sliding to connect with a pair of blades. The blades are soldered directly into the printed board; the slider rides in a bracket which is also soldered to the board. The principal cause of trouble is sideways movement of this bracket, either through damage, or by loosening of the soldered joints. This prevents the bridge from "making" cleanly and may cause it to butt against the blades, displacing them, aggravating the fault, sometimes rendering the whole switch beyond repair. Replacing one of these multi-contact slide switches is no joke. We have already dealt with the technique and need not repeat ourselves.

There should be little need, either, to dwell upon the replacement of the rotary-type switch. But a few words on prevalent faults may not come amiss. One of the bothers is a raising of the wiper section so that it forces the spring blade of a static section out of place. It needs only one clumsy twist, or a bit of grit in the switch to initiate this action. Then the spring action is lost, the switch becomes erratic, and bending the contacts back into place is a work of art. Another fault is loss of contact between the soldered section of some switch contacts and the spring blades themselves. This marriage of parts depends on a clamp rivet, and a little judicious soldering can remedy matters. But the utmost delicacy is needed.

Again, where the "ring" at the centre of some rotary switches is earthed—a common device in audio gear—and the connection has to be remade, a little blob of solder wandering past the limits of the ring can short against the stub ends of the reverse side of the switch contacts and cause intermittent faults as the switch is operated. This is a particularly difficult fault to trace unless one has met it before and is ready for it.

Switches that depend on a mechanical action, such as those with lever linkage, spring blade snap action, spring return, or a simple actuating lug, are all subject to the faults of wear. Insufficient switch travel, poor return action, intermittent contacts and other faults can result. The remedy is always to secure correct mechanical travel first, then complete the linkage and observe the switch travel before tackling the movement of the switch itself.

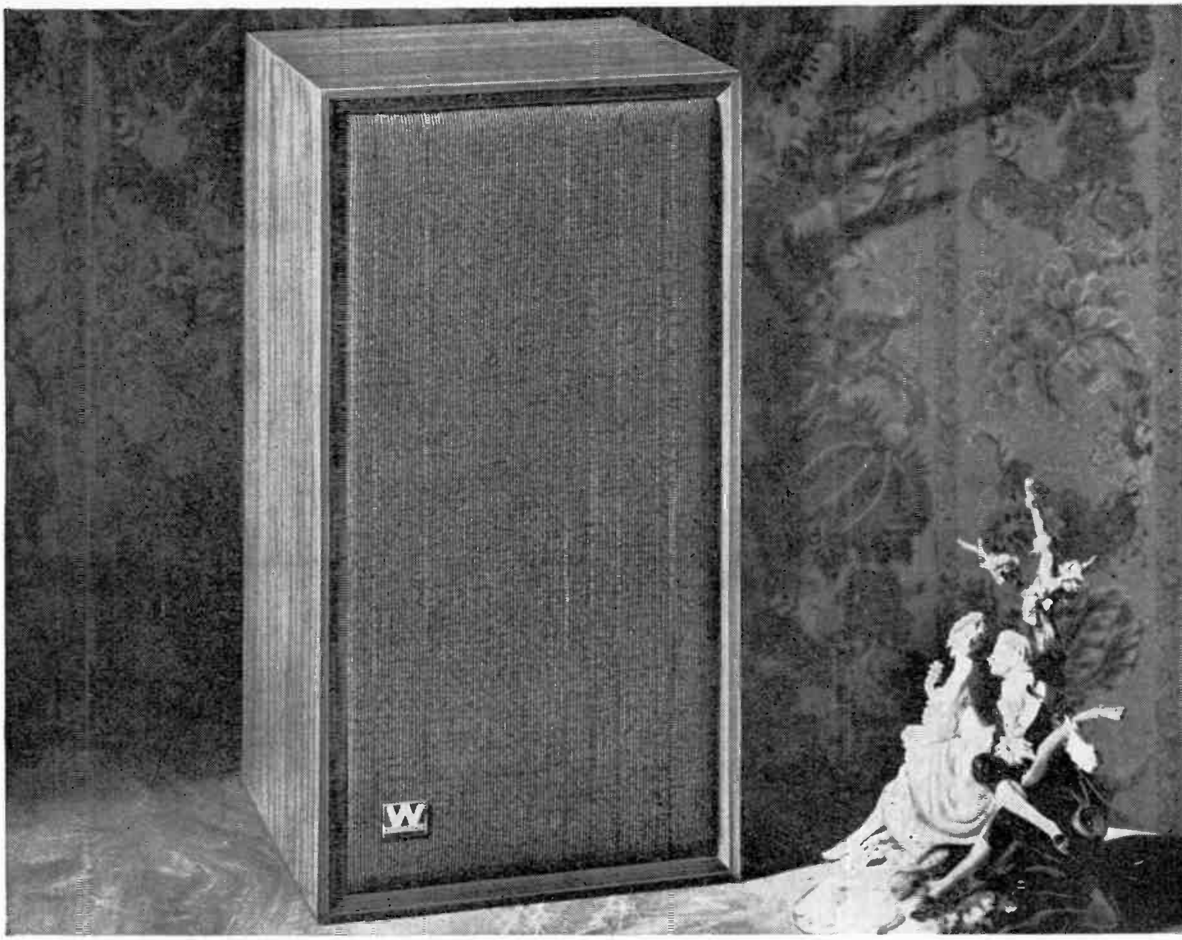
Switch cleaning we have also dealt with, but repeating that the latter-day aerosols, and modern switch-cleaners are great worry-savers can do nothing but good. Do not be tempted to a makeshift switch repair. This part takes an awful lot of punishment —be sure of it.



Earth connections are easy to trace where a common bus-bar is employed, but joints such as those indicated may be prone to looseness, and cause noise.

Another moving part that can be troublesome is the tuning drive itself. In many modern transistor radios the ganged capacitor is a sealed unit and faults here will demand replacement of the capacitor. But in others, open blades can be distorted by clumsy handling, dirt can find its way between blades, or at the contact points of the rotor wipers, causing odd noises. Routine cleaning is the answer to many of the problems.

In fact—to sum up the practical side of the whole series on radio repairs—common-sense cleaning and maintenance is more often the solution to problems than refined diagnosis and delicate fault-tracing. I feel sure Mr. King would agree with this conclusion, and join with him in hoping that the series has helped toward the easier handling of troublesome sets. ■



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WHARFEDALE

practically wireless commentary by HENRY

No. 48

Exhibitionism

AT the time of preparing this deathless epic the Radio Show looms up, now splintered into a multitude of taken-over hotels where manufacturers vie with each other to combine the intimacy of a domestic atmosphere with the opulence of high life. Sad to say, the domestic bit is too often a perch on the edge of a bathtub, between the gin bottles and the sales manager's dyspepsia tablets, where our intrepid reporter is avidly digging for exclusive news of the latest Superset contribution to "the art of listening in style".

This wish for secrecy has brought about some interesting contretemps over the years. Even now, dear old Ferrograph, sweating on the secrecy of a revolutionary new model of their "incomparable" tape recorder, have hidden it behind an advertising curtain. Only to find the gaff has been blown: first one magazine, then another, published a picture and those tantalising preliminary specifications that make enthusiasts itch to handle it.

How do you think these gems of pre-Show information come to us, Joe? Do you imagine a team of gaberdined reporters, fedoras pulled low over hawk-like features, drooping fags, bottomless gullets, etc., etc. Or has that idea of the Special Correspondent permeated yet?

Henry was once briefed to write his personal impressions on one Radio Show, with particular emphasis on its opening. Assiduously, he did his homework, reading up the BBC Yearbook, the catalogue of the three previous exhibitions, all the "top secret" handouts of the major manufacturers. On preview day, he broke all the sprint records in haring round the stands in search of titbits that other reporters may have missed. Privately he gloated over those layabouts in the Press Office who never ventured farther than the nearest bar.

Broke all sprint records

Opening day dawned, and the queues around Earl's Court sweltered in the heat or froze in that awkward corner where the Underground tunnel disgorges. Even the passport of a Press Card did not help Henry, for Mrs. H. and one of the little aspirates had to be shepherded in. So by the time the opening ceremony began, a perspiring Henry was jostling at the back of the crowd, straining to hear the bigwigs' choice deliveries. P.A. is not, repeat *not,* an exhibition strongpoint.

In something approaching despair, Henry repaired to the Press Room. There was almost as bad a congestion, for all the experienced technical journalists and Special Correspondents were huddled round a television set watching a closed circuit relay of the proceedings in comparative comfort. Some seemed to have nodded off to sleep. Yet next day the reports were concise and accurate. What they had not gleaned from the Press handouts they filled in with overheard snippets. Some had not stirred from their seats since the doors opened.

At a later date, Henry slogged for a whole afternoon round an Audio Fair, snarling at intruding chambermaids who wanted to turn down the hotel bed. His piece, dotted with technical scoops, was sub-edited out of recognition by the following week, by which time Messrs Superaudio had sprung a "late late" surprise with plug-in printed boards or upside-down sync or reflex feedback or some such wonder—which, of course, Henry had omitted to mention.

Snarling at intruding chambermaids

Henry no longer races to report exhibitions. That is a job best left to the experts. He goes to browse around the stands and get a general impression of what next season's sets will look like. He uses the excuse of a trip to Town to meet a few of his old Trade acquaintances. He might, if he is lucky, pick up a few brochures to mull over in the train on the way home.

Which is why Henry can even now write an "authoritative opinion" of the Radio Show. Whatever happens, it will be safe to say it was the same as last year.

G.W. HARDY'S portable KEYLESS ORGAN

PART THREE

TO conclude, the author discusses playing technique, and describes an audible warning device which will operate if the lid is closed, with the organ switched on.

We will first deal with the best method of using the wands. A small piece of cloth should be kept in the stowage compartment, as the plates will need an occasional rub along them, to make sure they are clean. Also before playing rub the wand contacts on the two pieces of felt provided in the stowage compartment, one piece at each end near the front. The author prefers to use the wand with the sustaining switch in the right hand. Always make firm contact with the plates. One uses the back half of the plates mostly with the right hand, and front half with the left hand. It is best to start with some simple tune in Key C until one gets used to the instrument. Practice with expression at low volume and with left and right hand alternately. Also with the switch on Wand 2 held closed with the forefinger. Do not forget that this switch is normally open, and no sound will come from the instrument until it is closed. If for convenience in playing one wishes to change hands and the sound to remain unbroken, just place the wand on the same plate, either can be removed, without a break in sound, as long as one or the other remain in contact.

With practice the facility of playing a melody by sliding the wand contact from one plate to another can be made use of—some tunes lend themselves to this. Legato playing is to be preferred, and is done by playing a note before removing the contact from the other plate. For instance to play a C scale in legato fashion place LH Wand on middle C, place RH Wand on D and afterwards lifting up LH Wand and placing on E, and in like manner through the scale or melody.

Now try the sustain switch, release the switch, the capacitor across it will now slowly discharge place the wand in contact with a plate there may be no sound or it may still be decaying, close the switch when it will cause the sound to quickly rise in volume. There is no contact click, but a fascinating quick build-up of the sound, release the switch and it will slowly decay, contact must remain firm with the plate all the time.

It is interesting to bear in mind that the sustain switch is still operative, even if only the LH Wand is in use. With practise many pleasing effects can be obtained, some not possible on a keyboard instrument.

A warning Device

It has been decided to fit a warning device on the instrument, in case it is closed up with the switch left on, a very easy thing to do. A simple double-pole on and off switch biased off, was made up as shown in Fig. 8. P/Bronze cut to ¼in. strips was used double to increase the spring pressure. The two springs have to close on the contacts together, so a piece of stiffish leather was cut to form a non-conducting bridge across the ends of the springs. The leather has some Bostik on the soft side, and the spring ends are scraped clean and Bostik applied, on being brought together a good union is assured.

The two short pieces of ¼in. square wood acting as stand-off pieces are drilled in the centre to take a screw to fix to the bottom. Before fixing, arrange a position between the side of case and the C Sharp plate for the plunger to work freely up and down, the bottom of the plunger to push on the leather. The switch is built on a small piece of the hardboard. When the switch is pressed down the sustain switch is closed and preamp operating, at the same time 4·5V is connected to a chosen plate screw under the plate board. Bottom C was chosen as being the handiest so a soldering tag was placed on the screw of that plate and nut fitted.

A small block of wood was drilled to make a ⅛in. plastic knitting needle an easy fit. The block was fixed to the inside left of case and another larger hole drilled in the contact plate to correspond with the hole in the guiding block. Connect wires as shown, and when finished pressure on the plunger will sound bottom C loudly. Now arrange that when the front half of the cover top is closed the plunger will push hard down on the contacts, and sound bottom C. ■

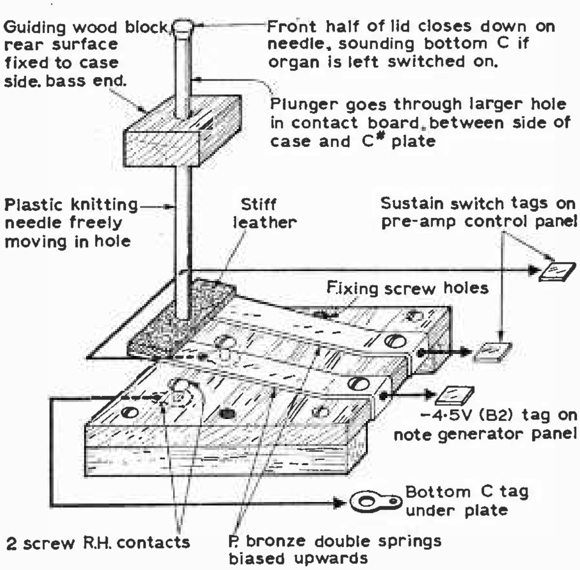

Fig. 8: Details of the warning switch

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EXPERIMENTERS CORNER

UNIVERSAL CONNECTOR FOR EXPERIMENTERS

K. RAINBOW

THE idea for this unit was conceived when the author was experimenting with some audio equipment and kept finding that the screened leads to be used seldom had the right plugs to fit the equipment. The unit was designed so that a connection can be made quickly, in one of many different ways, between four plugs and four sockets. Up to four different connections can be made at one time and the unit can also be used to join leads having a different plug and socket.

The circuit is obvious from the wiring diagram (Fig. 1) and is self-explanatory. It can be expanded or reduced to the reader's requirements, in fact if an extra plug and socket are intoduced there are 45 possible different connections! The wander sockets, 1-8, are interconnected using four short lengths of p.v.c. covered wire with wander plugs on the ends. Purists (like the author) may worry about the lack of screening but in fact in the prototype no trouble at all has been experienced due to hum pick-up. All the same the leads should not be made longer than is absolutely necessary to go from socket 1 to socket 5.

Construction

Because the author has two left hands the unit had to be housed as simply as possible. This was achieved using pieces of hardboard nailed on to wooden ends to form a simple box. The top is drilled as in Fig. 2 or to fit the components—the dimensions are really immaterial and the unit could be made much smaller if desired.

When all the components have been fitted, the screened wire is cut into approximately 1yd. lengths and the plugs are fitted. The other ends are passed through the top holes and knotted inside to secure them before wiring up.

Wiring up can be carried out with 22 s.w.g. tinned copper wire providing the connections are kept as short as possible to reduce the risk of hum pick-up. The wire can be sleeved if desired, but this is not necessary if the design of the prototype is followed. Figure 1 shows the wiring diagram of the underside. All that remains now is to test the unit by passing an audio signal and comparing the output with that given by a straight-through lead. When experimenting it is useful to remember that wander socket No. 9, which should be the black one, is connected directly to the screening.

The cost of this unit is low and depends on the proverbial junk box, but even if everything is bought new, the unit soon repays its cost in usefulness. ■

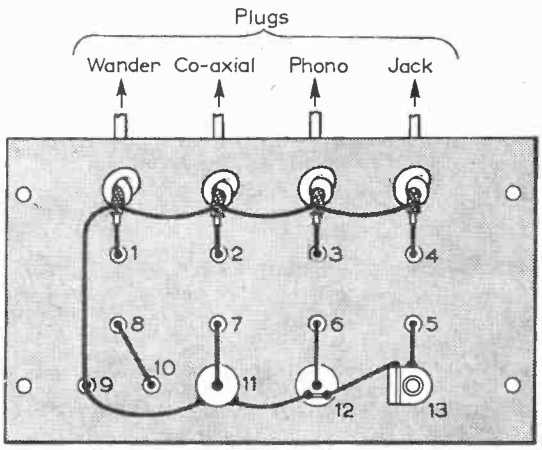


Fig. 1: Wiring diagram.

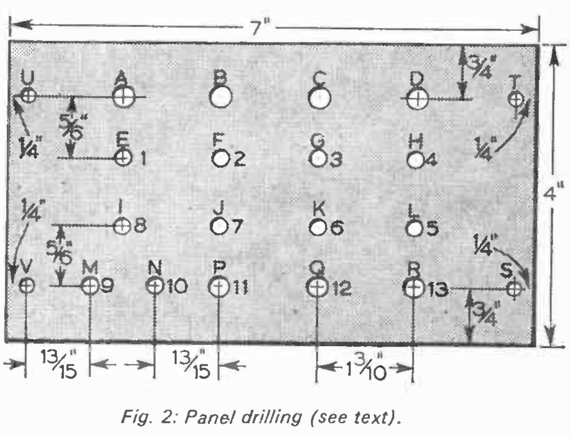
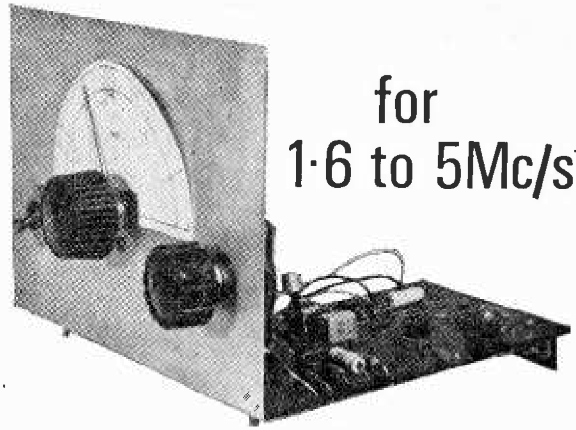


Fig. 2: Panel drilling (see text).

★ components list

1 jack plug; 1 jack socket; 1 phono plug; 1 phono socket; 1 coaxial plug; 1 coaxial socket; 9 red wander plugs; 9 red wander sockets; 1 black wander plug; 1 black wander socket; 4 yds. screened wire; 22 s.w.g. tinned copper wire; p.v.c. covered wire; hardboard; softwood; nails etc; 4 No. 6 woodscrews $\frac{1}{2}$ in.

REFLEX FRONT END



for 1·6 to 5Mc/s

by V. S. EVANS

REFLEX circuits have a reputation for being gimmicky and unstable. This one has proved reliable in various applications and the unit described should present no difficulties provided the layout is strictly adhered to and the coil wound exactly as detailed.

The output can be fed into a conventional transistor a.f. amplifier with volume control, a four transistor push-pull type having proved adequate in sensitivity and gain. Space is available behind the panel for an additional paxolin board or veroboard on which an a.f. section can be mounted if desired.

Circuit Description

The aerial is fed via a 250pf trimmer capacitor to an aperiodic winding on the coil, loosely coupled to the tuned secondary winding, which in turn passes the tuned r.f. signal to the transistor base via a third inductive winding. The r.f. signal is amplified by the AF118 and then passed to the diode where the signal is demodulated and the resultant a.f. fed back to the base of the transistor via the $0{\cdot}1\mu F$ capacitor.

The signal is again amplified and being a.f. passes through the 2·5mH choke and buffer capacitor to the output.

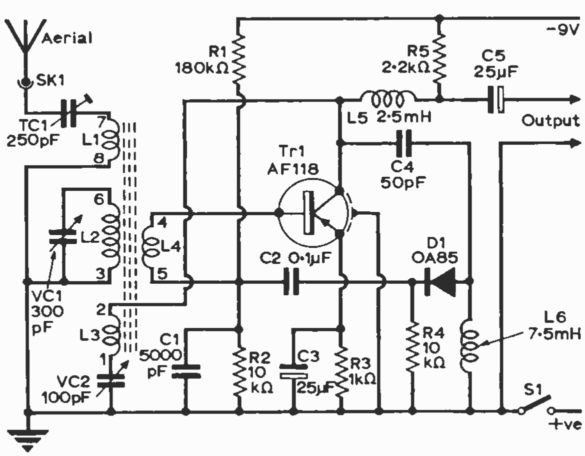


Fig. 1: Circuit of the reflex front end.

Regeneration is accomplished by a positive feedback loop (r.f.) from the collector to the tuned circuit and controlled by the 100pF variable capacitor.

The transistor is stabilised by the potential divider resistors in the base circuit and the resistor/capacitor network in the emitter line. A 10kΩ resistor gives bias to the diode.

It will be seen that the theoretical diagram coincides closely to the layout drawing showing the reverse side.

The tuning capacitor can for convenience be one section of a two gang, or the two sections in parallel provided this equals about 300pF. The one used by the writer was a surplus 196 +110pF having a slow motion spindle, thus avoiding an expensive slow motion dial. The panel is aluminium to minimise hand capacity effects.

The coil is made from a 2in. ferrite rod $\frac{5}{16}$in. diameter, around which is glued a sleeve of thin card. A further sleeve 1¼in. long is made to fit loosely over the previous one and is the coil former. The clear, quick setting glue sold in tubes is best for this job. The wire used may be 26 s.w.g. enamelled (or cotton covered) and the windings should also be

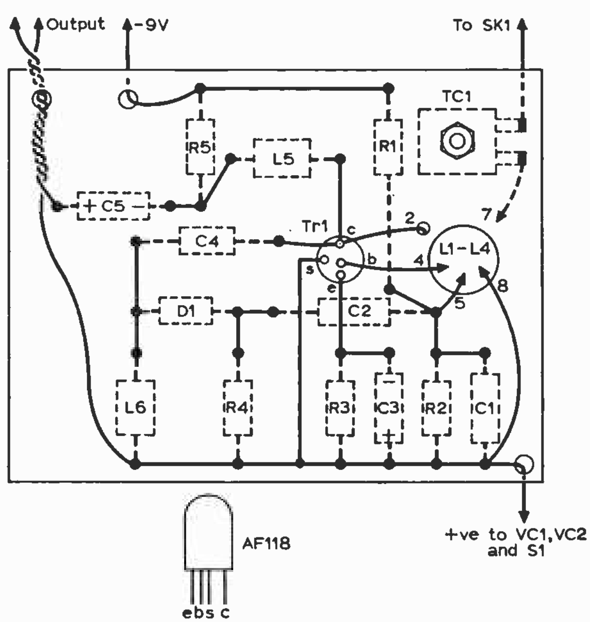


Fig. 2: Layout and wiring diagram. Components shown dotted, are on the reverse side.

★ components list

Resistors:

R1	180kΩ	R4	10kΩ
R2	10kΩ	R5	2·2kΩ
R3	1kΩ		

all 10% $\frac{1}{4}$W

Capacitors:

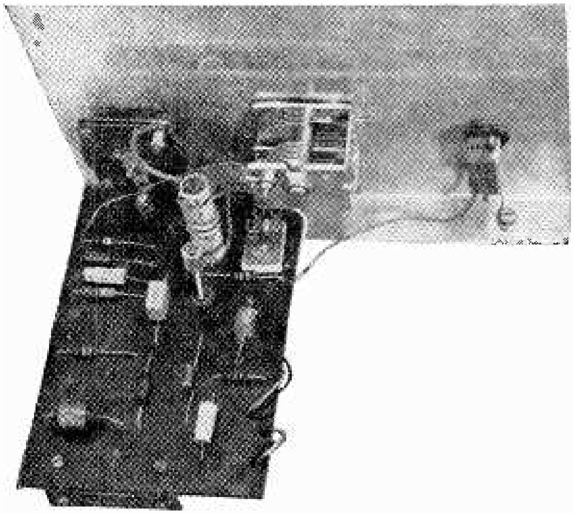
C1	0·005μF
C2	0·1μF
C3	25μF 12V electrolytic
C4	50pF
C5	25μF 25V electrolytic
VC1	300pF air spaced
VC2	100pF solid dielectric
TC1	250pF compression trimmer

Inductors:

L1, L2, L3, L4 see text and Fig. 3 for winding details
L5 2·5mH r.f. choke
L6 7·5mH r.f. choke

Miscellaneous:

8 x 6in., 18 s.w.g. aluminium; 5 x 4in. $\frac{1}{16}$in. paxolin; AF118 transistor; OA85 diode; S1 on/off toggle switch; battery clips; PP3 9V battery; transistor holder.



Above chassis view of the assembled receiver.

smeared with glue to keep them in position. The ends are taken through holes made in the former to the inside and brought out through the ends as per diagram.

It will be seen that leads 1 and 2 are kept away from the others as they are "lively" and carry the r.f. feedback.

The usual precautions should be observed when soldering small components to avoid overheating. The layout ensures that all leads are kept short and direct. In most instances the actual component wire ends can be used for wiring up. Where extra lengths of wire are required it will be found that 18 s.w.g. tinned copper wire will meet all requirements. Before

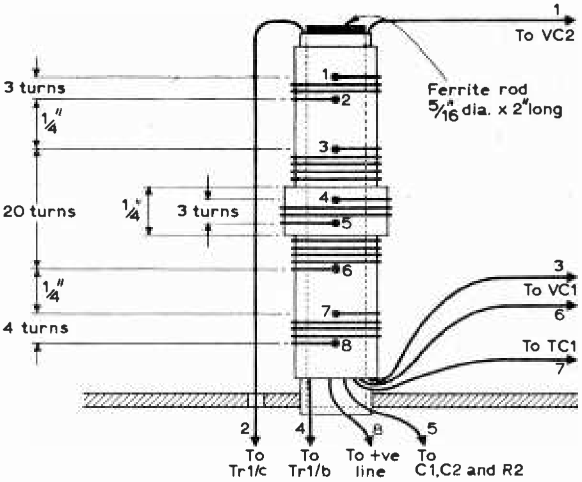


Fig. 3: Coil winding, see text for further details.

connecting the battery, make sure that all wiring is correct, as the transistor can become damaged.

Ensure that the collector is not in any way shorted to earth in connecting the regenerative capacitor. A solid dielectric type has been chosen as a protective measure, but if an air-spaced type is to hand it is as well to connect a 0·01μF capacitor in series as an added precaution.

Tuning Procedure

Tuning is best carried out by bringing the circuit to the threshold of oscillation, with the regenerative capacitor, and then rotating the tuning capacitor through the frequency range. It is important *not* to let oscillation actually take place (whistles or squeals from the loudspeaker) as in this condition the aerial is radiating and may cause interference to other listeners. The 250pF trimmer will help to match the aerial/earth system used and balance sensitivity with selectivity.

For the experimenter the range of frequencies covered may be altered to suit personal requirements by adding or subtracting to the number of turns on the main winding of the tuning coil. Up to ten turns off will bring in the 49 metre band whilst adding ten turns will bring in Radio Luxembourg. ■

the VARIOHM

MOST people engaged in the design and development of all but the simplest items of electronic equipment, would agree on the advantages accruing from having the use of a good resistance substitution box.

Laboratory class R.S.B.s are expensive and will not be considered. The R.S.B.s that will be covered will prove to be of considerable use for much development, and all servicing purposes. The factors requiring consideration when drawing up the specification of an R.S.B. are: 1. Degree of accuracy required. 2. Resistance range to be covered. 3. Wattage rating required. 4. Cost in relation to 1, 2 and 3. 5. Method of selecting required resistor.

FACTORS

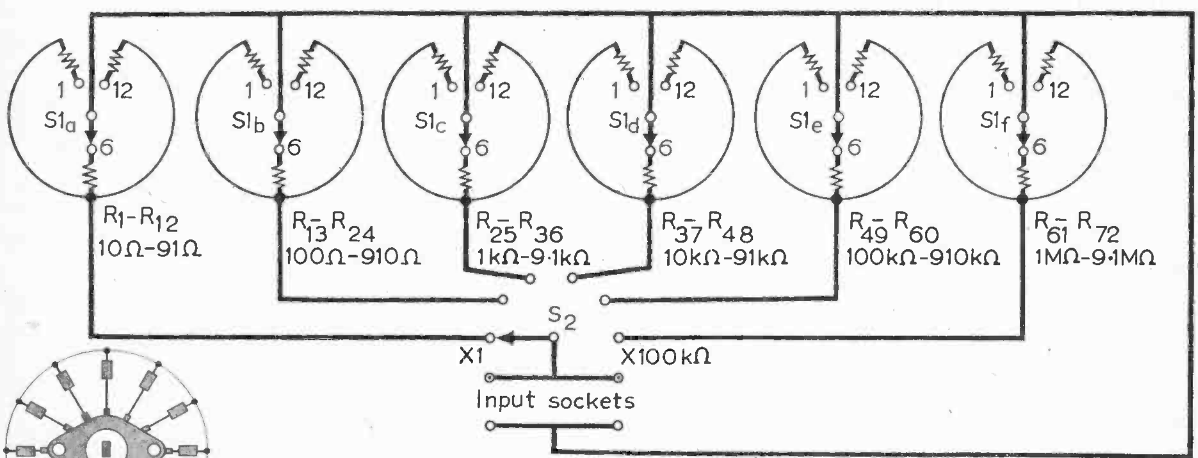
Taking these in turn, the degree of accuracy required (factor 1), is commensurate with the type of work undertaken. Half or one per cent resistors are an expensive luxury if only routine development or servicing work is undertaken. Conversely, 10% or "open tolerance" 20% resistors are clearly useless if required for very refined work. The best tolerance for all round work, including work of an experimental nature, is almost certainly 5%, particularly in view of the fact that good quality 5% hi-stab resistors are available, at the time of writing, at most reasonable prices from a number of advertisers.

As far as factor 2 is concerned, it is probably safe to say that an R.S.B. should cover as wide a range as practicable, otherwise the work involved is likely to be curtailed. Even if immediate needs are adequately served by an R.S.B having only a limited number of resistance values, provision should certainly be made for subsequent extensions as and when required.

The usefulness of the R.S.B. can be curtailed by factor 3 if work involving medium or high currents is undertaken. The current carrying capabilities of a resistor, expressed as a wattage in terms of E × I, I^2R or $\frac{E^2}{R}$ where E, I and R are voltage, current, and resistance respectively, must be adequate for the job in hand. Overheated resistors can suffer a resistance shift, so it is preferable to either derate the resistors in use or to select resistors of somewhat higher voltage than actually required. Unfortunately, high wattage resistors having a reasonably close tolerance (5%) are almost always wire wound, and therefore correspondingly more expensive.

All the previous three factors are involved in that of factor 4, cost. This is a problem for the individual to solve. The foregoing remarks, plus his own experience, wealth (or lack of it!) and requirements must be carefully considered and a working balance effected.

As far as factor 5 is concerned, ease of resistor



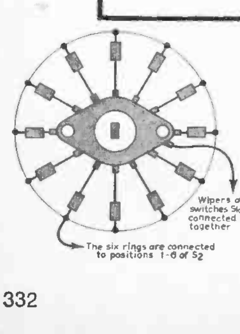
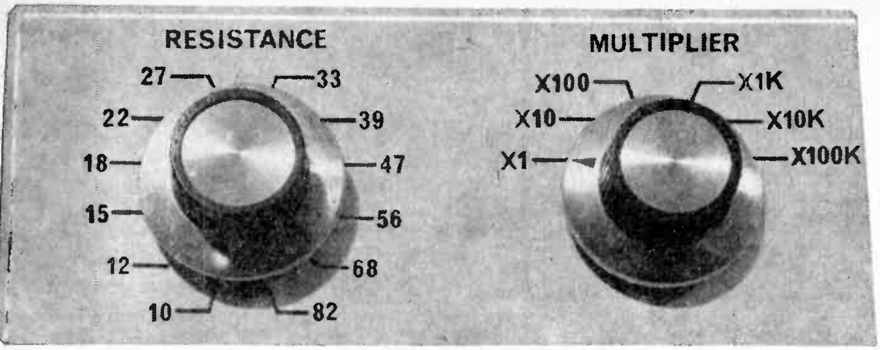


Fig. 1: This shows the general circuitry of the Variohm resistance substitution box. There are twelve resistors connected to each wafer of the switch, but only three are shown in the interests of clarity. The small inset (left) shows the idea, however, this is only a pictorial drawing and it should not be taken that the switch looks exactly like that sketch shown in the inset.



resistance substitution box

by H. T. KITCHEN

selection makes some form of switching mandatory. There are various possible switching combinations, For all-round versatility, the switching circuitry used in the prototype under discussion is as good as most (and better than some). This is shown in Fig. 1 from which it will be seen to consist of a six-pole twelve-way switch, and a single-pole six-way switch. Before investigating the switching further, it may prove instructive, principally for our beginner friends to digress a little and look at "preferred values". These are values originally applied to resistors, but now being also applied to capacitors, for manufacturing convenience. There are 13 values in the sequence 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 91. Multiples of × 10, × 100 etc, up to × 100kΩ are also available, providing resistors from 10Ω up to 10MΩ in the same sequence. Thus the first sequence starts at 10 and ends at 91, the second starts at 100 and ends at 910 and so on. Strictly speaking, as written above, the highest resistance available is 9·1MΩ (91) × 100kΩ. A 10MΩ resistor is available, and this is usually the highest value commonly used.

SWITCHING

To revert to the switching, the preferred values are selected by the six-pole twelve-way switch S1a-f, each of the decades being associated with each of the six poles, S2 the single-pole six-way switch being used to select the decade required. An example may perhaps clarify matters. Suppose a resistor of 560kΩ was required, S1 would be set to 56Ω and S2 to the × 10kΩ position. 56 × 10kΩ gives us the required 560kΩ resistor.

Since there are 13 preferred values, and the most commonly used switches have a maximum of 12 positions, it is unfortunately necessary to break the sequence by dropping a value. In the prototype, for reasons that are not relevant to this article, the value dropped was "91". Readers interested enough to build this R.S.B. will have to decide for themselves which value to drop.

Constructionally, the R.S.B. is very easy to build and, with careful shopping, need not prove expensive. It is contained in a home-made cabinet, to the dimensions of Fig. 2. S2 is a rotary "wave change" switch, with two poles, each of 6 ways. In order to reduce contact resistance the two halves of the switch are wired in parallel. This is by no means essential, and readers having single-pole switches having 6 or more "ways" can certainly use them.

S1 is a Radiospares Maka-a-Switch having six separate single-pole twelve-way wafers. There should be little difficulty experienced in wiring this up, provided the orientation of the wafers on the shaft is borne in mind, though this difficulty should not arise if the switch is mechanically assembled prior to soldering the resistors on to the wafers. It is mentioned because I myself found it more convenient to solder the resistors on to the wafers and then assemble these on to the switch shaft.

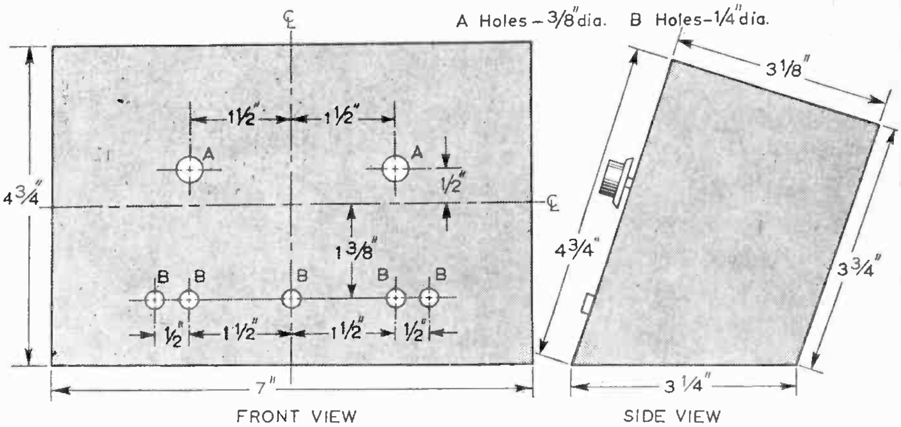


Fig.2: Dimensions of the cabinet and drilling details of the front panel.

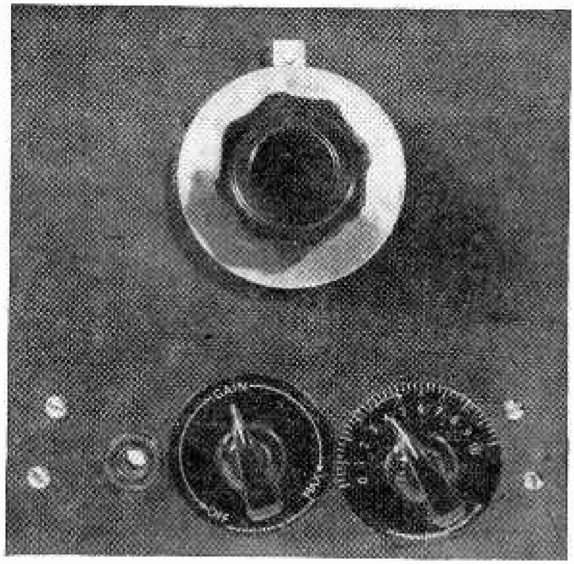
SOCKETS

It sometimes happens that it is desirable to know the magnitude of the voltage being developed across a resistor. In experimental work, there are usually plenty of connecting leads going to the circuit being developed. It was therefore decided to add an extra pair of sockets, in parallel with the R.S.B.s input sockets, to facilitate the connecting of a voltmeter in order to measure the voltage being developed across the resistor in circuit.

As the input sockets and internal "works" are electrically "floating", it was found necessary to provide an additional earth socket in order to earth the cabinet and minimise the pickup of hum voltages when the R.S.B. was used on high impedance circuits. ■

Personal 4 RECEIVER

by D.V. Debbage



THE main shortwave receiver being out of commission due to an extensive rebuilding programme, a unit was required which would enable listening contact to be kept on "eighty" and top band—both phone and c.w.—but which at the same time had to be relatively simple and quick to build.

The Circuit

The circuit finally arrived at is shown in Fig 1, the first two stages being quite conventional.

As c.w. facilities were required, initial thoughts centred on a separate b.f.o. but a little experimenting found this to be unnecessary. The heart of this little receiver being Tr3 and associated circuitry from which it will be noted that a regenerative detector is used instead of the usual separate diode.

In the interest of simplicity only one i.f. amplifier is used, the loss of the usual second i.f. amplifier being compensated for by using high gain transistors in the Tr1 and Tr2 positions, plus the judicious use of regeneration in the detector stage. Tr3 thus fulfils three requirements, these being an increase in gain, increased selectivity by narrowing the response curve of i.f.t.2, and rendering c.w. and most s.s.b. signals intelligible.

For a.m. reception VR1 is advanced to a point just short of oscillation, and for c.w. and s.s.b. reception the detector should be just gently oscillating. Incidentally, seventeen different regenerative configurations were tried entailing six different types of transistors before a satisfactory circuit was found. In the prototype this detector stage slid gently into oscillation with VR1 two-thirds advanced.

In Fig. 1 a dotted capacitor *(Cr)* is shown connected between the collectors of Tr2 and Tr3. This is the regenerative feedback path and it will probably be found on testing that there is sufficient stray capacitance present for correct operation. However, should regeneration not take place at any setting of VR1, a small fixed capacitor in the region of 2pF can be used, or a "twisted pair" may be tried.

As stated earlier, cover was required for "eighty" and top band and the Denco Range 3 coils were used—blue for the aerial

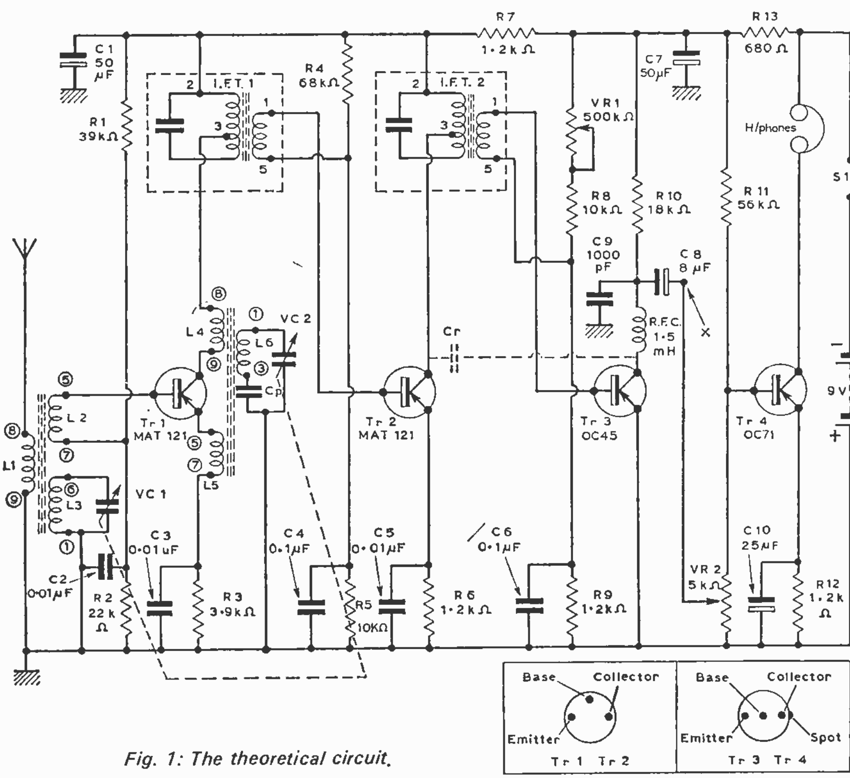


Fig. 1: The theoretical circuit.

★ components list

Resistors:

R1	39kΩ	R8	10kΩ
R2	22kΩ	R9	1·2kΩ
R3	3·9kΩ	R10	18kΩ
R4	68kΩ	R11	56kΩ
R5	10kΩ	R12	1·2kΩ
R6	1·2kΩ	R13	680Ω
R7	1·2kΩ		

all 10% ½W miniature

Semi-conductors:

Tr1, Tr2	MAT121
Tr3	OC45
Tr4	OC71

Inductors:

L1, L2, L3 Denco, code blue } 3T transistor coils
L4, L5, L6 Denco, code red } 3T transistor coils
I.F.T.1. Weyrad P50/2CC
I.F.T.2. Weyrad P50/3CC
R.F.C. 1·5mH r.f. choke

Capacitors:

C1	50μF 12V electrolytic
C2	0·01μF
C3	0·01μF
C4	0·1μF
C5	0·01μF
C6	0·1μF
C7	50μF 12V electrolytic
C8	8μF 12V electrolytic
C9	0·001μF (1000pF)
C10	25μF 6V electrolytic
Cp, Cr	see text
VC1/VC2	Twin gang 310pF with trimmers

Miscellaneous:

VR1 500kΩ potentiometer; VR2 5kΩ potentiometer with switch (S1); headphones 2000–4000Ω impedance; battery PP4 or PP9 (9V); 2 B9A holders.

coil and red for the oscillator, the capacitor denoted Cp in Fig. 1 being 1100pF.

There is no reason why other ranges should not be used and if this is done the value of Cp and the pin connection for connection of this capacitor can be ascertained from the leaflet supplied by the manufacturers with each coil.

The i.f. transformers listed were used solely because they were to hand at the time of construction but other transistor types may equally be used. If available, a double tuned transformer in the i.f.t.1 position would be preferable.

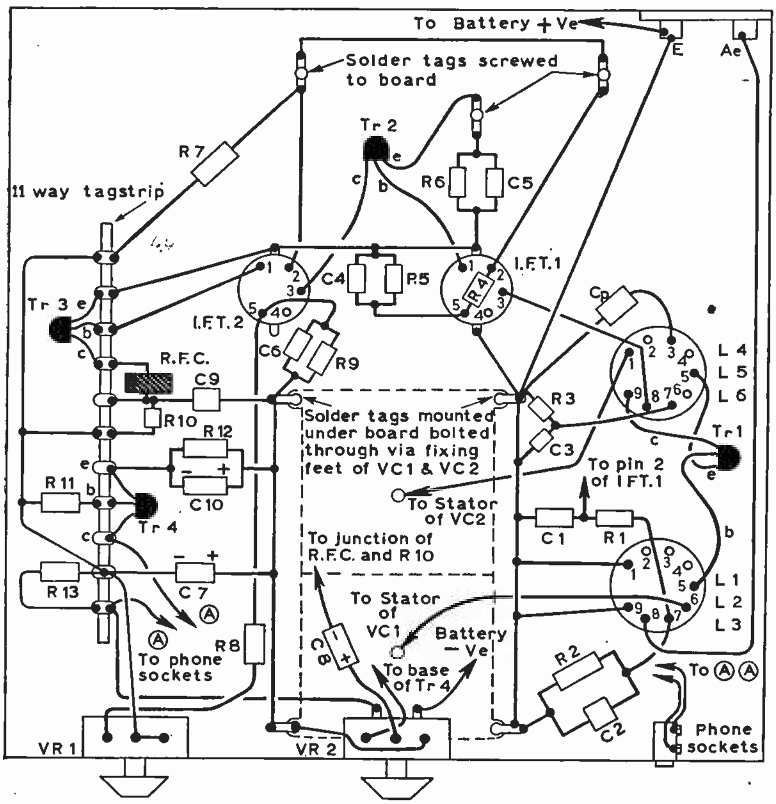


Fig. 2: Component layout and wiring on the underside.

The detector is shown feeding a single stage amplifier which is more than adequate for use with phones. If it is decided to feed a separate amplifier and loudspeaker, Tr4 and associated components may be omitted and the a.f. signal taken off at the point marked X.

Regarding the volume control VR2, this is a necessity as the audio output is controlled by this, and in no event should the regeneration control VR1 be used to control volume as sometimes suggested for circuits of this type. The function of VR1 is to keep the detector in its most sensitive state at all times.

Construction

The prototype was built on a paxolin sheet 6 x 6 x $\frac{1}{16}$in. with a similar piece bracketed on to form a front panel.

A general wiring diagram is shown in Fig. 2 but no measurements are given, as the size of individual twin gang capacitors varies somewhat but the relevant component positions and connections can readily be seen.

Although a single range is to be covered, it will be noted that the plug-in method has been used because with these coils it is

—continued on page 337

Five steps to hi-fi

PART FIVE . . . . . . YOUR EQUIPMENT AND YOU

IAIN SMITH

QUALITY of sound is, to some extent, a personal thing. It has been said that one man's fidelity is another man's distortion. No hard and fast rules can be made as to what turntable should go with what pick-up etc. It is all really a matter of personal choice. There are some parallels to draw, however broad you may wish to space them. For instance, you would not, through sheer common sense, fit a ten-and-sixpenny crystal cartridge into a £12 pick-up arm, the reason being that the vices of the cartridge would heavily outweigh the virtues of the arm. So it is up to you and your pocket. Only a rough guidance can be given and this is what this series of articles has tried to do.

Choice

Stereo or mono? The answer to this depends not only on your pocket but also on your circumstances. If you are living in a bed-sitting room measuring nine feet square, a stereo system could not be recommended. True there are several small stereo systems on the market but the loss of quality, which must accompany these small systems, does not make them a good investment for high fidelity fans. It should also be remembered that a mono system costing, say, £100 will usually be far superior in quality to a stereo system of comparable price.

Whether you choose stereo or mono it is recommended that you choose a stereo pick-up and if necessary suitably connect it for mono operation. If you decide on stereo, you may be wondering why you should not go out and simply buy a one piece stereogram and be done with it. There are several factors, so let us run briefly through some of them.

The main reason is that no matter how large the stereogram is and even with speakers at either end, the correct position of the speakers for stereo listening is rarely achieved. The distance between each speaker should be the same as the distance from the listener to either speaker. Another reason is that when speakers are in the same housing as the pick-up and turntable, acoustic feedback oscillation is a hazard. This is due to vibration from the speakers being fed back to the turntable and pick-up and being re-transmitted through the system. If you still decide on a stereogram, remember that, in some models, the quality of the parts that count can sometimes be questionable. Most of your money may be for the cabinet.

What equipment should you purchase? Let us assume that you are going to have a stereo system and you can budget for £100. Your dealer will recommend several different makes but here are some pointers to bear in mind. For reasonable quality in an integrated turntable and pick-up unit the Garrard SP.25 fares well. Fit this with a Decca Deram stereo cartridge and for less than £20 plus, say, £5 for a plinth, your weakest link is off to quite a good start. If, like the majority of P.W. readers, you want to build your amplification system, then perhaps two Mullard 510s plus the Mullard stereo pre-amplifier might be considered. Several firms advertise kits for these. If you prefer to buy, then £35 will get you a Rogers Cadet Mk. 3 stereo valve amplifier. For speakers a couple of Wharfedale Super 10s in suitable enclosures, which you may or may not build yourself, and your system is ready to go. Good quality should be obtainable from this type of system.

Just one tip if you buy the Garrard SP.25. This unit has a facility whereby at the end of each record the pick-up lifts, returns to its rest and the unit switches off. This feature is not really necessary in a high fidelity unit and removal of the mechanism reduces lateral friction of the pick-up arm to one-tenth of the original value! Removal of the mechanism is a simple job and it certainly reduces record wear.

Other Considerations

Having installed your system, you will now have to make sure that you do your part to keep it at peak performance. This means, essentially, care of your records and stylus. One of the most hazardous occupations in which a gramophone record can indulge is dust collecting. There are several devices on the market for removing dust from records but prevention is better than cure. The Watts "Dust Bug" is a device with a felt roller and a brush, which traverses the record while it is playing, rather like a pick-up, collecting dust from the surface of the disc.

If your pick-up has a hydraulic raising and lowering device, then use it. It can operate the pick-up far more gently than your hand and it will protect your stylus and records. Remember, if you drop your pick-up you can damage the cartridge or, at the best, you can chip the stylus. A worn or chipped stylus will damage your records and that is a reminder to renew your stylus regularly. Do not wait until you can hear something wrong for, by then, the damage is done.

Make sure that all interconnecting leads between the various units are screened. If you are troubled by hum this can be due to "earth loops" sometimes caused by screened leads having the screens earthed at both ends. To obtain best results from speakers, try different positions, as this can sometimes improve matters. Generally, speakers perform better when placed in the corner of the room.

With stereo systems it is important that left and right hand channels are connected correctly. It is also important to ensure that the speakers are phased correctly. That is, to ensure that both cones, when fed with the same signal, move in and out together. If they do not there will be detraction from the overall sound and a noticeable lack of "presence". One way to check is to listen to a mono recording with a good deal of bass, while reversing one pair of speaker leads. With the speakers out of phase a loss of bass will be most noticeable. When carrying out this test remember to switch the appropriate selector on your amplifier to "mono" thus paralleling both channels.

A good idea, when setting up a stereo system is to buy the Decca L.P. "How to give yourself a stereo check out". This disc has about one dozen tracks, each designed to test a different aspect of your system. Having set up your sound system, you may want to add a v.h.f./f.m. tuner in order to get high fidelity radio reception. If you have a mono system then you have two alternatives, either to build from a kit or buy. If yours is a stereo system, then at the moment, you will have to buy.

Broadcasts

Stereo transmissions are beamed on multiplex signal containing information for both left and right hand channels. How then does one aerial and one tuner give signals for each channel? To do this a stereo decoder must be used. This is connected between the tuner and stereo amplifier and splits the multiplex signal into l.h. and r.h. channel information suitable for feeding into the amplifier.

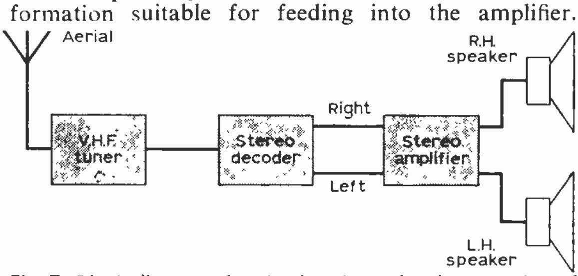


Fig. 7: Block diagram of a simple scheme for the reception of stereo broadcasts. The various units are at present available both ready built and in kit form from advertisers in P.W.

Whether you consider stereo radio worth while is another matter. The BBC transmissions are very sparse at the moment and there is little to indicate that this will change in the near future. It is, however, definitely on the way. Tuners have not been specifically dealt with in any part of this series because most people will probably wish to start with a record reproducing system. Having, I hope, given you enough information to do this, I am sure your interest, and appetite, will sharpen sufficiently to make you investigate tuners. If you feel like building one, how about starting with the transistorised switched FM tuner described in PRACTICAL WIRELESS a few months back?

This series was not meant to be a technical thesis on record reproduction, merely, as the title suggests, some general notes on the subject. I hope it has been helpful. ■

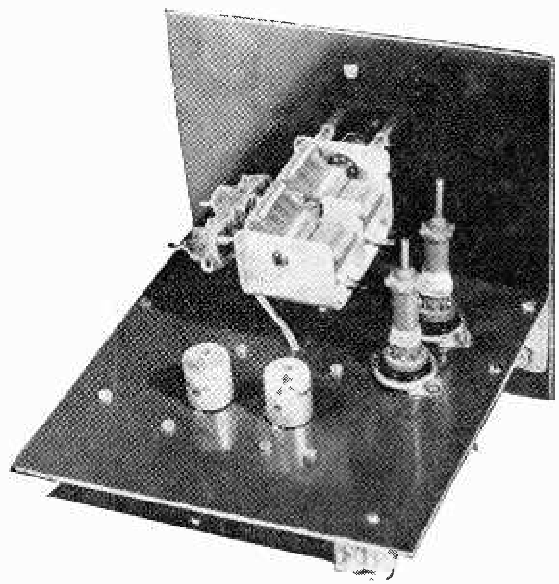
PERSONAL 4 RECEIVER

—*continued from page 335*

very easy to damage the formers when directly soldering to the pins, and furthermore other ranges can be used as desired.

When all wiring is completed, check all connections carefully, and if satisfied all is in order, connect the battery and switch-on.

The alignment procedure will not be repeated here as this has been described many times in these



Rear view of the Personal 4.

pages, also complete instructions are given in booklet D.T.B.4 available from the coil manufacturers for the modest sum of two shillings.

During alignment keep VR1 fully retarded until completion when i.f.t.2 can be peaked with VR1 advanced to the point of near-oscillation when it will be found that the sensitivity and selectivity of the unit will be extremely good for such a relatively simple receiver. ■

AND THE NEXT, PLEASE!

To borrow the well known advertising phrase—*That's Roy, that was!* We had to insert a footnote to the June leader owing to the substitution of Roy Mason for Edward Short (himself only recently substituted for Anthony Wedgewood-Benn) as the resident Postmaster General. We now have to bid farewell to Mr. Mason and welcome John Stonehouse to a seat that hardly had time to get warm. We are offering no prizes for guessing who will be next month's PMG!

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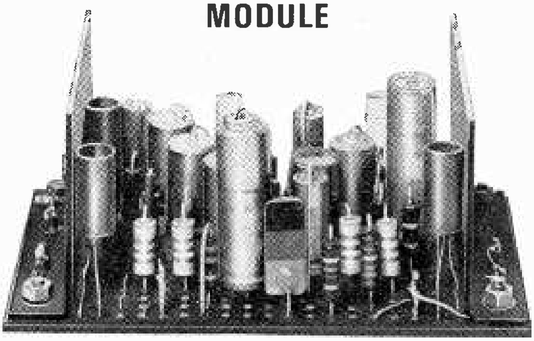

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WIRELESS INDEX

The index to Volume 43 of *Practical Wireless* is now available from the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

The price is 1s. 6d. inclusive of postage.

FIVE STEPS TO HI-FI

In Part three, page 203, second column, 40th line. This should read . . . "where n is the ratio of the number of turns of the Primary to those of the Secondary."

PORTABLE KEYLESS ORGAN

Moviecol Enterprises Limited have drawn our attention to the fact that the "Stylophone" electronic organ is the subject of British Patent application No. 16619/67.

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

Sorry

Having just noted the appearance of the June issue with my article "Experimental Transistor Millivoltmeter" pages 116–118, I append a list of errors for which I apologise.
p.116 column 1, line 20 ... "of between say 50μA and 2mA".
p.118 column 1, line 13 ... "of values for VR1".
p.118 captions to Figs. 2, 3 and 4 ... "For R2 read VR1".
p.118 column 2, line 7 from the bottom ... "currents below 100μA".
p.118 column 2, line 2 from the bottom ... "sensitivity between 50μA and 2mA".—**P. Williams** (*Paisley, Renfrewshire*).

The other leg

Regarding Mr. G. Williams' (E.17) letter in the July issue, I wonder if he is going to publish a decoder key for his interesting information. I wonder if a binary code was used. Some economy of "bits" seemed to have accrued, but then redundant information seemed to have crept into some "words"? (Perhaps there are some teething troubles in the equipment). By the way, I have NEVER been able to get my OC45's to oscillate above a few (very few) mega-hertz/cycles (envy!)—**K. Smith** (*E.*17).

★ ★ ★

I would like to comment on the subject of the OC45 transistor, owned by Mr. G. Williams, who claims in the July issue of your magazine, that it functions at 30Mc/s.

The manufacturers of this device claim an upper frequency limit of 6Mc/s, and I would like to point out to Mr. Williams that this transistor is of the alloy-junction construction. This is fabricated by alloying a metal containing large amounts of p-type impurity on to each side of a wafer of n-type semiconductor, this latter forming the base. By the very nature of this type of construction, the base region is physically rather thick, typically of the order of 0·0002 inches.

Now, it can be shown that the high-frequency cut-off, f_T, is inversely proportional to the square of the base thickness. Other factors do enter into the expression, but this is the predominant term. Thus, it can be seen that the thicker the base region, the lower will be the high-frequency cut-off, which can be shown to be no greater than 6Mc/s, for the OC45.

Transistors which do operate at very high frequencies are generally of diffused construction, where n-type and p-type impurities are diffused into an n-type collector region, for an n-p-n transistor. Base thicknesses of less than 0·00005 inches can be achieved using this technique, thereby increasing the value of f_T.

If Mr. Williams does have an OC45 which operates at 30Mc/s, then I suggest either that his device is incorrectly labelled, or that he send it back to the manufacturers for further investigation; after all, he might have discovered some new effect!—**C. J. Gibbins, B.Sc.** (*Liverpool*).

Solid status

Solid state apparatus employs transistors and diodes of silicon or germanium. The components are usually mounted on printed circuit boards and the connections are soldered. There are no valves employed and no components which are liable to deteriorate with age. The solid state circuit produces only small amounts of heat unlike many valve circuits which sometimes appear to compete with electric heaters for honours. It is however more likely to be damaged by heat than valve apparatus and should therefore never be mounted near any source of heat.

In general, therefore, a solid state apparatus will continue to work after being dropped on the floor, whilst any other type won't. This criterion however is not recommended as a practical method of differentiating circuits.—**P. Hardy** (*Surbiton*).

★ ★ ★

In reply to Mr. Tomlinson (July, 1968) I think I know the answer.

Solid State. We have seen a recent example of how to mystify the uninitiated where an easily understood symbol c/s, meaning cycles per second, became Hz pronounced (by me) HURTSES in memory of childhood pains in the physics lab, where a sadistic schoolmaster demonstrated alternating current with a shocking coil. "Several thousand volts, my boy, but it doesn't hurt because there's no current."

I think that same schoolmaster must have passed through the liquid state to the SOLID STATE and given the name in memory of himself. (Jones minor used to add "FROM THE NECK UP").—**G. C. Turner** (*East Grinstead*).

★ ★ ★

In response to W. J. Tomlinson's query on the term "Solid State" (July issue). This term is given to a piece of electronic equipment which has no moving parts, such as relays, etc. For example: One could call an audio amplifier a solid state device, in the way that it is purely electronic.—**G. Drinkwater** (*Manchester*).

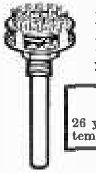
Those 'B' licensees

With reference to Mr. E. Mason's letter in the July issue I feel I must protest. I do not claim the ability to read the PMG's mind but perhaps I might suggest a reason for the lowering of B licensees permits to two metres.

Like the high frequency bands the two metre, seventy centimetre and twenty-three centimetre bands are harmonically related. Thus standard seventy centimetre practise is the use of a low powered two metre rig to drive a tripler-amplifier, with a similar arrangement for 23cm. Since the facility for two-metre operation therefore already exists why not allow Sound B licensees to use the band? The same conditions do not apply to the four metre or lower bands since no such harmonic relationships apply.

Mr. Mason appears to believe B licensees inferior to their Sound A counterparts. Why? We pass the same written examination, our technical competence is the same or, in some spheres, better. What, may I venture to ask, is the difference between a good B licensee and his A counterpart operating in the same mode on 70cm or above? I cannot speak for all Sound B amateurs but I, and I know of a number like myself, have never wanted to operate on anything other than Sound B territory. In addition my interest is the phase to amplitude s.s.b. technique, so why take the morse test?—**R. G. Mannas, G8BIK** (*London, N.*22).

MINIATURE WAFER SWITCHES



4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/6 each, 36/- dozen, your assortment.

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

BLANKET SWITCH

Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. 7/6 each.

COPPER CLAD ELEMENT

1250 watts—4ft. long but bent to U shape, ideal for overhead heater—just mount reflector above. 12/6 each, plus 4/6 post. £6 doz. post paid.

MAINS RELAYS

Type A 210/250V AC coil, 2 types, one for single whole chassis mounting, has 3 pairs heavy duty changeover contacts. 8/6 each.
Type B in clear plastic case on tin base, plugs into octal valve holder. 2 pairs changeover contacts. 12/6 each.

TRANSISTOR SET CASE

Very modern cream cabinet, size 5¼ × 3 × 1¼in. with chrome handle, tuning knob and scale. Price 4/6 plus 2/- postage. Printed circuit board for this case TRF circuit 2/6, superhet 3/6.

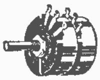
750mW TRANSISTOR AMPLIFIER

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

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.

GANGED POTS

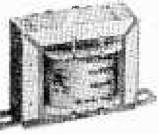


Standard type and size with good length of spindle—made by Morganite. List price is 10/- each but if you act quickly you can have them at 1/6 each. Following valves in stock all "lin" —100K +100K —500K +500K all new and unused. Post 2/9 on 1st doz. then 1/- per doz. 6 doz. or more post free.

THE TUBE IS FREE

This month with our 15/20 watt fluorescent kit we give a free 15in. tube. Ideal for fish tank, plant growing, or any normal lighting situation. Costs less than 1d. per day if left on all the time. Kit comprises Atlas choke, TV suppressed starter, three lampholders and two terry tube clips. Only 19/6 plus 4/6 Post and Packing, and the tube is yours for nothing, but you must collect this.

MAINS TRANSFORMER SNIP

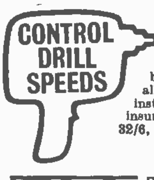


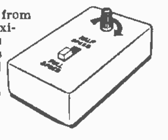
Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/40V) and isolated secondaries. Two types: (1) 12V 500mA at 9/6. (2) 15V 500mA at 10/5.

CAR BATTERY CHARGER

12V 1 amp.—will keep your battery up to scratch. Mains transformer with secondary isolated metal rectifier all housed in neat metal box with mains flex and charging lead terminated with heavy duty battery clips—bargain at 27/6 plus 3/6 P. & P.

DRILL CONTROLLER





Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 2/6 post and insurance. Or available made up 32/6, plus 2/6 post.

BARGAIN OF THE YEAR

MICRO-SONIC

7 transistor Key chain Radio in very pretty case, size 2⅜ × 2⅛ × 1⅛in. —complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5mv/m. Intermediate frequency: 465 Kc/s, or 455 Kc/s. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: permanent magnet type. In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. 19/6 plus 2/6 post and ins., less batteries

HI FI BARGAIN

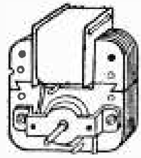
FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.
Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts. R.M.S.—Cone Moulded fibre—Freq. response 30–10,000 c.p.s.—specify 3 or 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜ over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5⅛in. A £6 speaker offered for only £3.9.6 plus 7/6 p & p. Don't miss this offer

THIS MONTH'S SNIP

CONTACT THERMOSTAT

As its name implies this will give control without being inserted, i.e. just strap it to the water tank (or hold it with magnets). Has dozens of applications, e.g. let the wife's smoothing iron or your soldering iron rest on it, will stop it from overheating whilst keeping it always at the ready. Fitted with calibrated dial for setting between 90°–190°F. or with dial removed range setting is between 80°–800°F. Price 10/-.

MOTOR BARGAIN



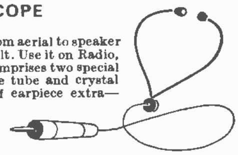
Silent running mains motor by very famous maker. Ideal for gramophone, tape recorder, fan, etc., etc. 200/250 volts AC., shaded pull start. Size approx. 2⅛ × 2⅛ × 1⅝ins. 1,400 r.p.m. Spindle diameter ⁵/₃₂in. Spindle length ⅜in. Brand new, guaranteed. Price 9/6, Plus 3/- post.

FLUORESCENT LIGHTING SNIP

THE TWENTYLITE

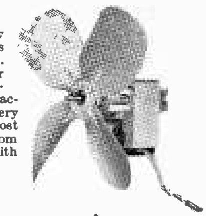
A Fluorescent lighting unit made by the famous Atlas company, with super silent polyester filled choke and radio suppressed starter. The tube springs in and out and the whole unit is beautifully made and finished white enamel. Amazingly economical. If left on all the time costs only one penny per day (uses ¼ unit). Measures 2ft. long. Is ideal in Kitchen, Bedroom, Hallway, Porch, Loft, etc. Don't miss this amazing offer. 39/6 with tube. Assembled ready to install. Postage and Insurance 6/6 extra.

RADIO STETHOSCOPE



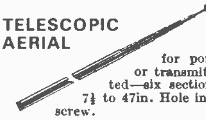
Easiest way to fault find—traces signal from aerial to speaker —when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. 29/6—twin stetoset instead of earpiece extra—post and ins., 2/9.

AC FAN



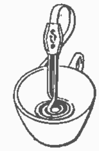
Small but very powerful mains motor with 6½in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.

TELESCOPIC AERIAL



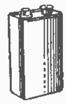
for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw.

QUICK CUPPA



Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. 19/6, post and insurance 1/6. 12v. car model also available.

RECHARGEABLE P.P.3



Nickel cadmium cells fitted into PP3 case—can be recharged indefinitely 120mA hrs. Capacity—9V. nom. charge at 10mA. Price 37/6. Components to make charger 6/6 extra.

MESSAGE TAPES

250ft. best quality PVC, made in USA. 3in. spool packed in self mailer box, 4/6 each or 3 for 12/-.

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These infra-red binoculars when fed from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for TV cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order but sold without a guarantee. Price £3.17.6, plus 10/- carr. and ins. Handbook 2/6.

KETTLE ELEMENT

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Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA. (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, condensers and instructions. Real snip at only 16/6, plus 3/6 postage.

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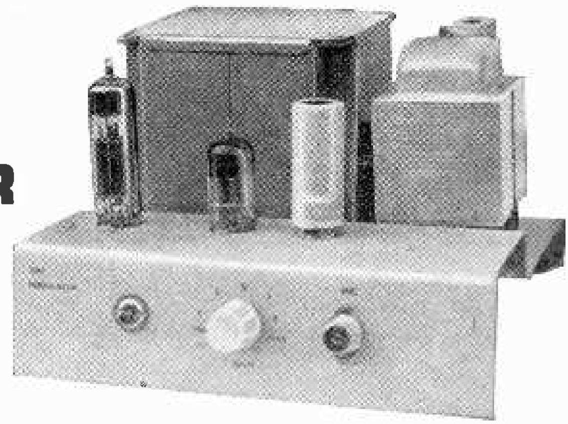
QRP MODULATOR

A.S. CARPENTER G3TYJ



THIS easily duplicated low power modulator was initially constructed for use with the "Ten-Fifty" Transmitter, details of which were given in an earlier issue* of this magazine. When c.w. is the preferred operating mode the "Ten-Fifty" Tx is complete in itself signalwise but a modulator may be considered a useful accessory with which to indulge in phone QSO's occasionally. The modulator to be described may be used with rigs other than the "Ten-Fifty" for it is an entirely self-contained unit. An "all new" construction cost is approximately £12 for some 10 hours' work.

An interesting feature of the QRP modulator is the use of the miniature audio valve, type Brimar ELL80, physically no larger than the more familiar EL84. The ELL80 comprises of two output pentodes in a single envelope which, when worked in Class AB1 push-pull can deliver up to 9W of audio power when suitably fed.

Quite clearly 9W is inadequate power with which to effectively plate/screen modulate a 50W r.f. signal but it *is* sufficient to so modulate r.f. inputs up to 20W. When it is required to modulate a r.f. input of 50W or so the transmitter may be cathode modulated, when some 5-6W of audio is sufficient. In some cases it may be possible to inject the modulation at the transmitter key socket and this has been done with the "Ten-Fifty" Tx. The modulator has also been used to cathode modulate a DX-40 transmitter although in this case a separate injection socket had to be fitted.

Top Band transmitters may be plate/screen modulated by the unit of course, therefore it is but a case of deciding exactly what is required and then suitably connecting the multi-radio modulation transformer accordingly.

The modulation transformer used in the prototype unit is a Woden type UM1 but the smaller physically and less expensive item—the Woden UM0 is also suitable. The UM0 may be run up to 10W but the UM1 can accommodate 60W. Such transformers can often be obtained inexpensively from amateur stations gone s.s.b.—or QRT!

Plate/screen modulation is superior to cathode modulation and is also less finicky to set up; cathode modulation on the other hand is much less demanding power-wise.

*PRACTICAL WIRELESS, *January 1967.*

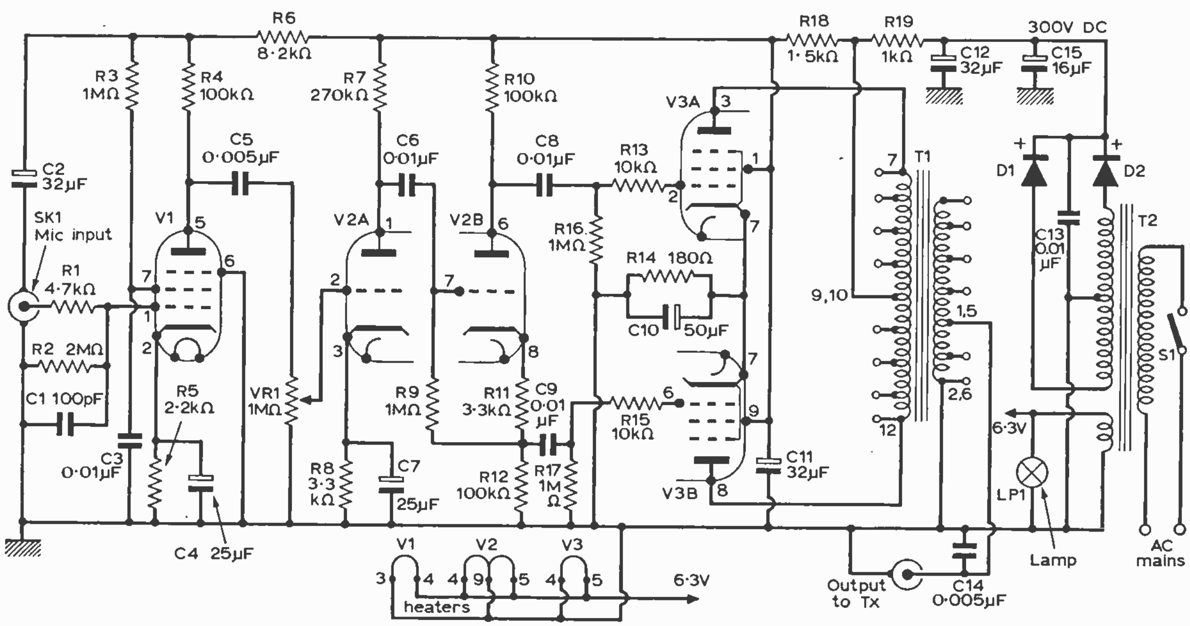


Fig. 1: Theoretical circuit of the low power modulator.

The complete circuit of the low power modulator may be seen in Fig. 1. The signal from a crystal microphone may be introduced at socket SK1 when V1 operates as a simple pentode connected speech amplifier feeding V2A, the gain control, VR1, being used between stages.

The anti-phase voltages necessary to drive the output pentodes are derived from V2B, the required voltages being developed across load resistors R10 and R12 since it is appreciated that the ends of these items remote from the valve are "earthy" to a.c. in both cases due to C11. Valve V2B functions therefore as a conventional phase-slitter and resistors R9 and R11 are merely leak and bias items respectively. Little benefit is derived from by-passing R11 with a capacitor.

The output pair function in Class AB1 and a potential of 9V positive with respect to chassis appears at the common cathode pin 7. The measured no-signal current of the cathode circuit was in the prototype 37mA and is within the maker's rating.

It should be noted that the parasitic "stopper" resistors R13 and R15 must on no account be omitted and one side of each should be connected direct to the appropriate grid tag.

The ELL80 anode-anode load required is 11,000 ohms, the secondary load (cathode) impedance being some 300Ω for the 6146 in the associated transmitter and connections to the modulation transformer are indicated in the circuit diagram. Since the prototype unit is used for cathode injection one side of the secondary winding is shown chassis connected but if plate/screen modulation is desired such a connection must be removed. Connections to T1 are then varied to suit the required load conditions and details of Woden modulation transformer connections for various loads may be found by referring to the manufacturer's instructions. In cathode connection some slight tendency to "downward" modulation has been noted at times but is not considered excessive.

Due to the meagre current drain of the low power modulator a comparatively small mains transformer may be used and a 60mA rating for the secondary is adequate. Used for full wave rectification a pair of BY100 silicon diodes are excellent and occupy little space. If a valve rectifier is preferred—and adequate mounting space is available—the EZ80 is ideal. Fitment of a small 2·5V flashlight bulb in the centre-tap lead of the secondary winding to chassis may be a well worthwhile inclusion as a protection device particularly when diodes are used.

The chassis dimensions used are given in Fig. 2 where a single section of 12 x 18in. 16 s.w.g. aluminium is bent to provide two mounting shelves of dissimilar height this being done deliberately to prevent the modulation transformer from dwarfing the valves. A single 8in. square section of 16 s.w.g. aluminium eventually bolts to the chassis underside flanges and confers both rigidity and component protection. The chassis front flange is allowed to slope backwards slightly and this not only improves the appearance but also simplifies operation of the gain control.

★ components list

Resistors:

R1	4·7kΩ	R11	3·3kΩ
R2	2MΩ	R12	100kΩ 5%
R3	1MΩ	R13	10kΩ
R4	100kΩ	R14	180Ω
R5	2·2kΩ	R15	10kΩ
R6	8·2kΩ	R16	1MΩ
R7	270kΩ	R17	1MΩ
R8	3·3kΩ	R18	1·5kΩ 1W
R9	1MΩ	R19	1kΩ 1W
R10	100kΩ 5%	VR1	1MΩ log.

All resistors 10% ½W

Capacitors:

C1	100pF silver mica		
C2	32μF 275V		
C3	0·01μF ceramic		
C4	25μF 12V		
C5	0·005μF ceramic		
C6	0·01μF ceramic		
C7	25μF 12V		
C8	0·01μF ceramic		
C9	0·01μF ceramic		
C10	50μF 50V	C13	0·01μF paper 1kV
C11	32μF 350V	C14	0·005μF ceramic
C12	32μF 350V	C15	16μF 450V

Transformers:

T1 Woden UM1 or UM0

T2 A.C. Mains input. Secs. 250–0–250V, 60mA 6·3V, 2A

Valves:

V1–6AM6, V2–12AX7, V3–ELL80

Diodes:

D1, D2–BY100

Miscellaneous:

Chassis (see text), valveholders B7G (1); B9A (2); knobs (1); lamp and lens (1); coaxial socket; cable; wire; etc.

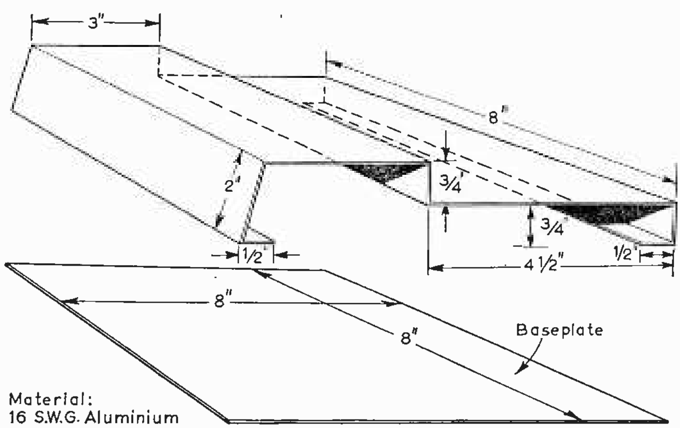


Fig. 2: Chassis and baseplate dimensions.

—continued on page 396

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TELESCOPIC FLOOR STAND. HEAVY BASE. Standard thread, ext. to 4ft. 7in. **49/6.** Carriage and Packing 4/6. Desk stand for stick mikes, **7/6.**

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

DOESN'T time fly, it only seems last week the summer schedules started, now they have only a few weeks to go, as on September 1st most International Shortwave radio stations will change to their autumn or spring schedules depending which side of the Equator they are, so most information in this column is liable to change on that date. In next month's issue I hope to list some of these schedules for various stations. Now here are this month's propagation predictions.

West Africa: 0800-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15 and 11Mc/s; 1800-2000 25, 21, 17, 15, 11, 9 and 7Mc/s; 2000-2200 21, 17, 15, 11, 9, 7, 6 and 5Mc/s;-2200-0200 17, 15, 11, 9, 7, 6 and 5Mc/s; 0200-0400 15, 11, 9, 7, 6, 5 and 4Mc/s; 0400-0600 15, 11, 9, 7, 6 and 5Mc/s; 0600-0800 21, 17, 15, 11 and 9Mc/s.

South Africa: 0800-1400 25 and 21Mc/s; 1400-1600 25, 21 and 17Mc/s; 1600-1800 25, 21, 17 and 15Mc/s; 1800-2000 25, 21, 17, 15, 11 and 9Mc/s; 2000-2200 21, 17, 15, 11, 9, 7 and 6Mc/s; 2200-2400 17, 15, 11, 9, 7 and 6Mc/s; 2400-0200 15, 11, 9, 7 and 6Mc/s; 0200-0400 11, 9 and 7Mc/s; 0400-0600 11 and 9Mc/s; 0600-0800 21, 17 and 15Mc/s.

East Africa: 0800-1200 25, 21 and 17Mc/s; 1200-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15 and 11Mc/s; 1800-2000 21, 17, 15, 11 and 9Mc/s; 2000-2200 17, 15, 11, 9 and 7Mc/s; 2200-0200 15, 11, 9, 7 and 6Mc/s; 0200-0400 15, 11, 9 and 7Mc/s; 0400-0600 17, 15 and 11Mc/s; 0600-0800 21, 17 and 15Mc/s.

South Asia: 0600-1200 21, 17 and 15Mc/s; 1200-1600 21, 17, 15 and 11Mc/s; 1600-1800 21, 17, 15, 11 and 9Mc/s; 1800-2000 17, 15, 11, 9, 7, 6 and 5Mc/s; 2000-2200 15, 11, 9, 7, 6 and 5Mc/s; 2200-0200 11, 9, 7, 6 and 5Mc/s; 0200-0400 11, 9 and 7Mc/s; 0400-0600 17, 15 and 11Mc/s.

South East Asia: 0600-1000 21Mc/s only; 1000-1200 21 and 17Mc/s; 1200-1400 21, 17 and 15Mc/s; 1400-1600 21, 17, 15 and 11Mc/s; 1600-1800 21, 17, 15, 11 and 9Mc/s; 1800-2000 17, 15, 11, 9 and 7Mc/s; 2000-2200 15, 11, 9, 7 and 6Mc/s; 2200-2400 11, 9 and 7Mc/s; 2400-0200 11Mc/s only; 0200-0400 15Mc/s only; 0400-0600 17 and 15Mc/s.

North East Asia: 0600-1600 17 and 15Mc/s; 1600-1800 15 and 11Mc/s; 1800-0400 11Mc/s only; 0400-0600 15Mc/s.

Australia via Asia: 0600-1000 21Mc/s; 1000-1200 17Mc/s only; 1200-1600 15Mc/s; 1600-1800 11Mc/s only; 1800-2000 11 and 9Mc/s; 2000-2200 11, 9 and 7Mc/s; 2200-2400 11 and 9Mc/s; 2400-0600 circuit closed.

West Coast, South America (*North of Chile*): 1200-1800 21Mc/s; 1800-2000 21 and 17Mc/s; 2000-2200 21, 17 and 15Mc/s; 2200-2400 17, 15 and 11Mc/s; 2400-0400 15, 11 and 9Mc/s; 0400-0600 15 and 11Mc/s; 0600-0800 15 and 11Mc/s; 0800-1200 15Mc/s only.

NORTH AMERICA

Canada: *R. Canada* is now using 17,820, 15,325 and 11,720 for its French transmission from 1315-1345 *not* 21,595, 17,820 and 11,720 as in last month's column, 21,595, 17,820 and 15,325 used from 1345-1830.

U.S.A.: *R. New York, Worldwide* (Station WNYW) had dropped 15,405 in favour of 15,440 for its beam to Europe from 1930-2200. Also, has a new transmission to Latin America in English. From 2200-2345 on 21,525 and 17,845, 2345-2400 on 17,845, 2400-0100 on 17,845 and 15,215.

AFRICA

Ethiopia: *R. Stn. ETLF,* Radio Voice of the Gospel, Addis Ababa, is giving strong signals in its Farzi programme from 1600-1625 on 15,400, the programme is repeated from 1630-1655 on 11,935. The station's intermission signal is the "Elizabethan Serenade" followed by four notes on a drum.

EUROPE

Federal Republic, Germany: *R. Deutsche Welle* has altered the frequency for its German programmes to East Asia, Australia and New Zealand from 0645-0940, was using 21,580, 15,205 and 11,795, now dropped 21,580 for new 9,650 beamed across Gt. Britain, Atlantic and Pacific Oceans.

Holland: The Happy Station Programme on Sunday mornings from 1030-1150 has dropped 11,730 for 5,980, still using 9,715 and 6,020. In November this year the Happy Station will celebrate 40 years on the air. A special Happy Station QSL card is being issued for the occasion for reports on Happy Station transmissions only.

Monte Carlo: *Trans World Radio* now uses 7,285 for its transmissions in English starting SU-FR at 0625, on Saturdays at 0610. The Sunday afternoon transmission is now aired from 1500-1615 on 7,255.

ASIA

Malaysia: The BBC Far Eastern Relay station at Tebrau has now dropped 15,435 for 15,350 with 7·5kW for 1345-1815 beamed to South Asia.

Pakistan: *R. Pakistan,* Karachi, is now giving fair signals on new 15,330 from 1845-1930 in Turkish and English to the Middle East and from 1945-2030 in English to British Isles and Europe.

AUSTRALASIA

New Zealand: *R. New Zealand* is now on the following schedule until September 1st. English to the Pacific Isles 1700-1945 on 9,520 and 6,080; 2000-0545 on 15,110; English to Australia 2000-2230 on 11,705; 2245-0545 on 17,770. To the Pacific Isles in English, Samoan and Niuean 0600-0800 daily on 9,540 and 6,080 0800-0845. Weekdays only in English and Rarotongan on 9,540 and 6,080, 0800-0845 Sundays only in English on 9,540.

FIRST comment this month is that you'll be hearing those callsigns on c.w. signing a bit faster if they are G's. The maximum speed for sending station identification in morse is now 20 w.p.m. and not 12 as it used to be.

A very thin month for the l.f. enthusiasts. Hardly a soul mentioned any frequency lower than 14Mc/s, and the sparse DX down there seems to be even sparser when I've listened too. Twenty metres has proved its usual interesting self but definitely the Band of the Month award must go to 15 metres. There have been some very good openings and these have varied, some midday, and some later after 2100. Even the early birds who raise their weary bodies at unearthly hours have logged some goodies.

Ten metres has been rather spasmodic, although it's usually possible to hear W stations on sideband at 5 and 9 plus, any time that this segment is stirring. When it has been open, though, ten has provided some very FB DX.

One or two v.h.f./u.h.f. fiends have queried the fact that no 144Mc/s logs and above appear. Well, what about it all you G8's. Is two metres really worth it, or is it just a quiet version of topband?

Just a reminder that evening classes usually begin in September. Have you checked if there is an R.A.E. course at your local institute? Many organisations run courses for R.A.E., both the written and c.w., but you should give the relevant body a ring. There might be a number of people who would like an R.A.E. course, but if the local authority don't know of this need, then they will not run a course. Go on, get on the land line now and have an a.f. QSO.

Little birds have whispered the following in my ear (left one actually). There's an HL9 either US or UF on at noon most days. Listen for s.s.b. just above 14,200kc/s. Just below this and about the same time, listen for VK9RJ. My best for the month —on 40, VS6DO, and on 15, 9M2CP.

P. Pollak reckons that JX might well be the prefix for Jan Meyen Island. He heard JX6RL on twenty, anyone think different or shall I put it to the vote?

LOGS

About 90 per cent of the logs this month were for fifteen metres. Hardly anyone listened below twenty metres, and only one or two scanned ten.

G. Haslip (Sussex), 19 set, 100ft. long wire, found 80 mostly full of Europeans (EU's), although one or two interesting calls came through, like GC3KEV and VS5RCS.

Someone who really claims an accolade for persistent listening in the face of heavy QRM. Logs received for 80, 40 and 15 metres.

F. McVerry (Lanarkshire), R1155, 75ft. end fed is the man who did it. Scalps taken from—DJ9RY/P, LA1H, SMØLK/P/Ø, W1MFY, WA1IRN, WA2BEE, WA4YHA, ZC4RB, 4X4UF, 9M2NF. Which is pretty good for 80 metres s.s.b. On 40 s.s.b. Francis managed to hook—CN8AW, CN8BV, CN8FF, EA6BG, EA8EX, EA8FF, GC3GS, HB9RZ, JW7YF, LA2PH/MM (near Capetown), PAØDX/M, PY1CBS, PY2NE, PY4BLR, PY6HL, PY7AKW, TJ1AL, TU2AK, TU2BQ, VE1APB, VO1AK, VU2OLK, WA3GTW, W4AVO, WB4IDW, W5FXZ, WA7IFM/MM, WA8ACQ, WØLLV, YV1BI, ZC4RB, ZS1JA, 4U1ITU, and all that was on forty. I daren't tell you what he heard on fifteen!

D. Grant (Kent) has just acquired a B40 receiver. He says it's working FB and the xtal is still very accurate. He also reckons that all bands are active with 10 mainly short skip with the odd South American station popping up. Fifteen is very good around 2000-2200hrs, while EU's clutter up twenty making good DX logging difficult. With a half-wave dipole at 25ft. Douglas heard these on fifteen metres s.s.b.—CE3DR, CR6EX, CX7BW, EA8BQ, EA8FF, EL4JY, ET3UN, HI8XCC, JA1PYP (running 20 watts). KG4AM, KG6ALY, KP4APQ, KV4CF, KZ5DK, LU3AX, MP4BGU, OA4OS, OD5FM, PJ3UM, PY1JZ, PY7LAV, SVØWM, VR4CR, YV1TP, ZC4MO, ZC4RB, ZD8Z, ZD9BE (Tristan da Cunha), ZS6DP, 4X4SO, 5H3JR, 8R1G, 9G1GD, 9K2BB, 9Q5DG, 9U5CR, 9U5SK.

PICKINGS

C. Morgan (Northumberland), 10 transistor s/het, 120ft. long wire, 15 metres a.m.—CE7DW, CR6GA, CR7CY, CR8AH, FG7XW, JA5AKY, PZ1CP, TN8DB, UA9KAB, VU2DKZ, 7XØVP.

P. Pollak (London), 840A, PR30, 60 ft. end fed, 15 metres s.s.b.—CEØAE, CN8BB, CR6GA, HS3DV, K5HYB, K6URK, KV4AD, KZ5NG, LU1DAB, MP4BDE, OA4UZ, PY6NG, TU2BQ, VK2NN, VQ9DH, W6USG, ZD8JW, ZD9BE, 4X4GV, 5H3JL, 9Q5ML.

M. Pasek (Notts), QP166/HRO, 150ft. long wire, 15 metres s.s.b.—HS3BA, ITØARI, JA4OK, KG4AM, KP4BCL, KZ5HL, K2UZU/P/KG6, MP4BGR, OH2BR/MM (near New York), VK9WD, VU2DKZ, VU2OLK, XW8BX, ZD8Z, 9M2NF, 9V1OC.

R. Dinning (Ayrshire), HA350/PR30, 252ft. end fed, 20 metres s.s.b.—AP2MR, CT2AW, DU2FU, EA6BQ, HV3SJ, HKØBKW, LU9DJW, OX3CJ, SMØCH, TF2WFI, TN8CS, UN1AB, VE8RCS, VP8CG, 5H3KJ, 5Z4KL, 9K2BJ, 9Y4VT. Robert queries NU2OF and assures that the call sign was read correctly.

G. Richards (Isle of Wight), GC-1U, 60ft. Vee end fed, 10 metres s.s.b.—CR6GS, CR7IC, EL2AK, EL2X, LU6DRB, LU7MAL, OD5FA, VQ9V, YA5RG, YV1EL, ZC4RB, 4X4VB, 5H3KL, 9J2DT, 9J2WR, 9L1KZ, 9Q5HU, 9Q5RV, 9V1NY.

CONTESTS

Busy month for contests. September 7th—8th, DARC phone contest: 7th—8th, V.H.F. N.F.D.; 7th—8th, VU/4S7 c.w. contest; 14th—15th, VU/4S7 phone contest; 15th, 3·5Mc/s field day; 21st—22nd, SSA c.w. contest; 22nd, National D/F hunt; 28th—29th, SSA phone contest.

If you live in GM land, don't forget the Scottish Mobile Rally at the Cartland Bridge Hotel in Lanarkshire. Early October (2nd—5th) is the date for the R.S.G.B. Exhibition at the New Horticultural Hall, Westminster.

SUMMER BARGAIN!

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound mains transformer, EZ80 rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7" wide × 3" deep × 6" high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with valves and good quality output transformer. LIMITED NUMBER ONLY.

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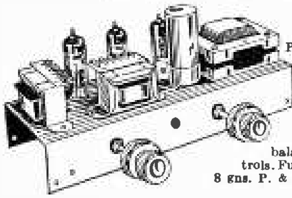
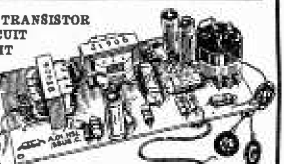
Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete ONLY **£5.9.6** P. & P. 8/-



Super De luxe version with ECL86 valves, sep. bass, treble and balance controls. Full feedback 8 gns. P. & P. 8/-

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT

Type TA1



- Peak output in excess of 1½ watts.
- All standard British components.
- Built on printed circuit panel size 6 × 3in.
- Generous size Driver and Output Transformers
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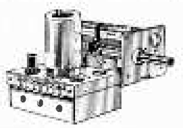
- Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p).
- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram 2/6 (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/-. P. & P. 3/-. Also ready built and tested, 52/6. P. & P. 3/-.

FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer & 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/-.

GORLER F.M. TUNER HEAD. 88–100 Mc/s. 10·7 Mc/s I.F.. 15/- plus 2/6 P. & P. (ECC85 valves, 8/6 extra.)

SPECIAL OFFER! PLESSEY TYPE 29 TWIN TUNING GANG. 400 pf + 146 pf. Fitted with trimmers and 5:1 integral slow motion. Suitable for nominal 470 Kc/s. I.F. Size approx. 2 × 1 × 1¼in. ONLY 8/6. P. & P. 2/6

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VIBRATORS. Large selection of 2, 4, 6, 12, 24 and 32 Volt. Non-sync. 8/6; Sync. 10/-. P. & P. 1/6 per vibrator. S.A.E. with all enquiries.

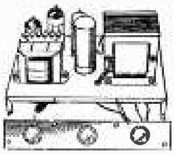
TRANSISTOR STEREO 8 + 8. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 Transistors giving 8 watts push-pull output per channel (16 W mono). Integrated pre-amp with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal-work, Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of.

Brief Specification: Freq. response ±3 db 20–20,000 c/s. Bass boost approx. to +12 db. Treble cut approx. to — 16db. Negative feedback 18 db over main amp. Power requirements 25 V at 0·6 amp.

Amplifier Kit	£9.10.0	P. & P. 4/6
Built and Tested	£12.10.0	P. & P. 4/6
Power Pack Kit	£2.10.0	P. & P. 4/-
Built and Tested	£3. 0.0	P. & P. 4/-
Cabinet (as illus.)	£2.10.0	P. & P. 5/6

(Special offer—£14.10.0. Post Free if all above kits ordered at same time or can be supplied built and tested for £18.0.0 Post Free). Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.)

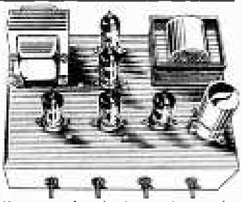
3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" 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. Complete with knobs, valves, etc., wired and tested for only £4.5.0. P. & P. 6/-.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. 79/6. P. & P. 6/-.

10/14 WATT HI-FI AMPLIFIER KIT



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Load lines were first used with valves, but they are equally applicable to transistors, for manufacturers' published graphs of both devices are static, that is they are compiled without anode or collector loads, so that anode or collector current variations do not produce anode or collector voltage variations. In practice, a valve or transistor cannot amplify unless it is coupled to a load, and to produce dynamic characteristics when so used would require separate curves for each value of load resistor. This is clearly impossible, but by the use of load lines equalling the value of the load and drawn across a family of output characteristics, the transistor or valve currents and voltages can be determined for any input signal.

Let's take a look first at Fig. 1 which shows a family of Va/Ia characteristics; the output characteristics of a typical power pentode. Each curve or parameter indicates the valve's anode current as anode voltage is raised from zero for different values of grid bias increased in 2V steps from 0 to —14V.

The recommended anode load for this type of valve is around 4,000Ω, the exact value depending on the output wattage required and the degree of distortion that can be accepted. However, if we take it to be just 4kΩ, then with a power supply of 240V, anode voltage will also be 240V at current cut-off. A dot can then be made on the horizontal Va axis to indicate this point.

At the other extreme, if it was possible to develop all the supply voltage across the load resistor instead of across the valve, current would be $I = \frac{240}{4{,}000}$ Amps or 60mA. A dot marked on the vertical Ia scale at this point will then provide the other extremity for the load line which can then be drawn across the graph.

In similar fashion, load lines for other values of load and/or supply voltage can be drawn. It will be seen that the higher the value of load resistor the more horizontal the load line becomes and that equal value load lines irrespective of supply voltage run parallel to each other. Having drawn the load line, the points where it intersects the individual curves will then indicate the actual anode voltage and current for that particular value of load and grid bias. Even more important, it will show up the disparities in the increases of anode current produced by regular decreases in grid voltage. Ideally, equal increases and decreases of bias from the no-signal or quiescent operating point should produce equal increases and decreases in anode current. Unfortunately this is never so, for the spacing between the curves for regular decreases in bias tends to increase towards zero. This means that from any practical no-signal biasing point, anode current will increase more for a fixed reduction in bias than it will decrease for an equal increase in bias. However, by careful choice of the standing bias and anode load, this disparity can be reduced to small proportions.

Output Versus Distortion

The quickest way is simply to place the edge of a ruler across such a family of output curves and note where its placing, pivoted from the h.t. supply value, cuts the parameters with the most uniform results. The no-signal biasing point would then be in the centre of such a line and of course must be greater than the peak value of the input signal to prevent driving the grid positive on peak positive half-cycles. Having then

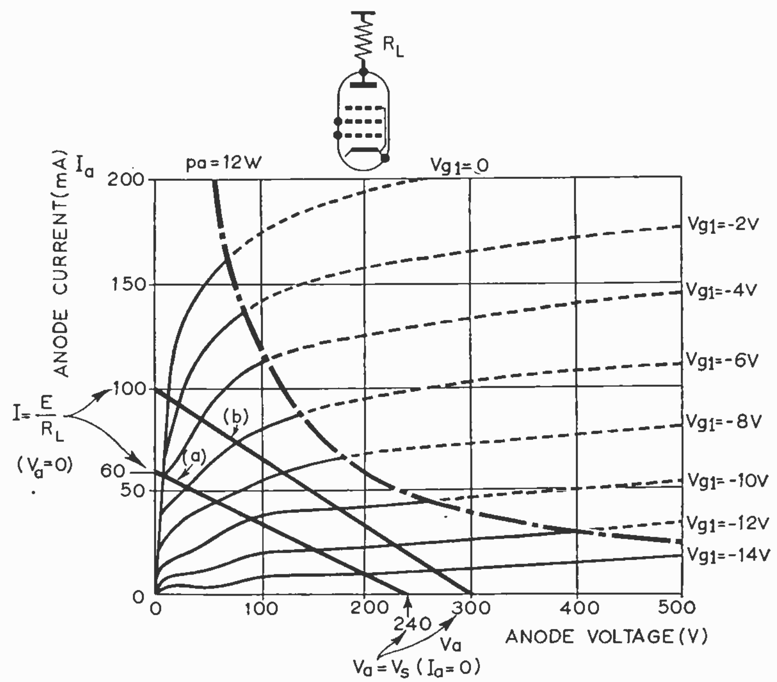

Fig. 1: Load lines drawn across anode characteristic curves of a power pentode. (a) is for a 4000Ω load with a 240V h.t. supply, (b) is for a 3,000Ω load with a 300V h.t. supply.

drawn a line which satisfies these requirements, its value can be determined by simple application of Ohm's law. The value of h.t. supply divided by the current indicated by the load line equals the value of optimum load. By moving the ruler over the graph it will become evident that higher outputs can be obtained at the price of greater distortion. In fact many manufacturers quote various anode loads for various power outputs with the associated maximum second harmonic distortion content. Some manufacturers issue graphs for output valves plotting the variation of anode load on one axis against the percentage of harmonic distortion on the other axis for different values of grid bias. However, by an extended application of the load line as demonstrated in Fig. 2, the variations in output current and voltage graphically demonstrate the distortion imposed on a pure sine wave input due to this irregularity in Va/Ia curve spacing. One half-cycle becomes compressed and the other extended when related to the input sine wave.

This distortion is termed "second harmonic distortion" because it exactly duplicates the waveform of any frequency upon which is superimposed a smaller amplitude signal at twice the frequency (second harmonic) and as shown in Fig. 3. Such distortion where one half-cycle is greater than the original while the other half-cycle is relatively smaller largely cancels out in push-pull outputs circuits, but third and other odd harmonics cannot be eliminated in this way and can only be reduced by negative feedback.

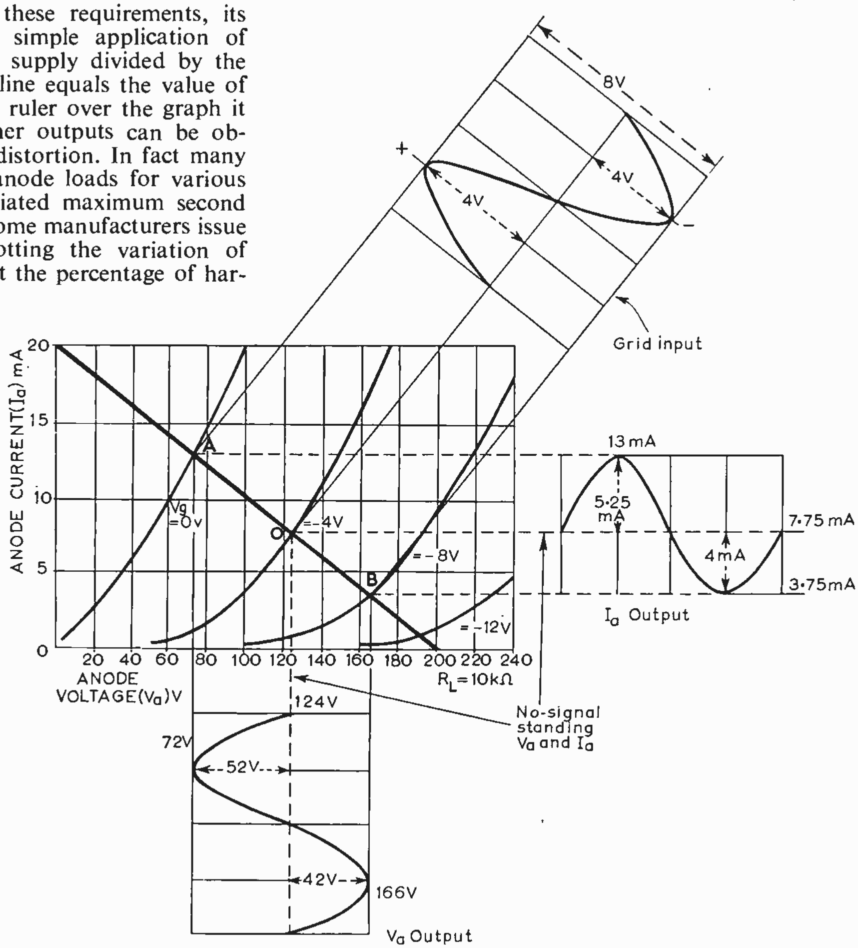

Fig. 2: Output waveform distortion resulting from unequal Ia increase and decrease with equal Vg + or − changes. Such distortion duplicates the effect of a superimposed signal at double the frequency (second harmonic) as shown in figure 3.

The distorted waveform shown in Fig. 3 is obtained by the algebraic addition of the two pure sine waves which means simply that similar terms are added while opposing terms are subtracted. In this illustration, excursions of the second harmonic above the zero line are added to similar excursions above zero of the fundamental, but subtracted from the fundamental below the zero line. Thus the harmonic peaks with the peak of the fundamental during the latter's first half-cycle to increase the total amplitude of the resultant, while it peaks in anti-phase with the peak of the fundamental in the second half-cycle to decrease the total amplitude by a similar amount. Furthermore, this phasing in and out mis-shapes the resultant as well as altering its amplitude, so it no longer represents a sine wave.

This distortion being caused by the non-uniformity of anode current variations instigated by the input signal is clearly indicated by the ratio of AO to OB on the load line (Fig. 2). These A and B limits are set by the peak amplitude of the input signal. If the grid input was less than 4V peak they would be closer set and have less disparity, but taking them as they stand, they indicate the maximum current changes through and voltage changes across a 10kΩ load resistor.

The generally accepted figure for maximum tolerable second harmonic distortion is 5% or 0·05 of the output. Therefore if we accept these figures as a maximum, the ratio AO/OB should not exceed 1·22. Ideally of course the ratio should be unity. This figure is obtained as follows: Where x equals the decimal percentage of second harmonic distortion, $\frac{AO}{OB} = \frac{1 + 2x}{1 - 2x}$ assuming x to be 0·05, i.e. 5%, then

$$\frac{AO}{OB} = \frac{1 + (2 \times 0{\cdot}05)}{1 - (2 \times 0{\cdot}05)} = \frac{1 + 0{\cdot}1}{1 - 0{\cdot}1} = \frac{1{\cdot}1}{0{\cdot}9} = 1{\cdot}22.$$

Again referring to Fig. 2 it is obvious that the AO/OB ratio could be improved towards unity by increasing the supply voltage and/or reducing the value of load resistor. In the interests of clarity only 4 Vg parameters are shown, but it is evident that by careful choice of load resistor and grid bias—the latter rather less than the figure shown, an almost unity AO/OB ratio could be obtained.

If regarded purely as a voltage amplifier, the stage gain A, represented by the ratio of anode voltage swing to grid input swing will equal:

$$\frac{Va\ (max) - Va\ (min)}{Vg\ (peak\text{-}to\text{-}peak)} = \frac{166 - 72}{8} = \frac{94}{8} = 11{\cdot}75$$

(see Fig. 2). With such purposely exaggerated second

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Calculating Power Output

Directly calculating valve or transistor power output is often considered rather difficult—but the same Ohm's law rules apply as when calculating the output of a generator or the power dissipated in a resistor. The only difficulties that arise are due to the necessity of separating the a.c. content of the output—the real power—from the steady d.c. component on which it is impressed. It can be calculated by I^2R, V^2/R or VI where I and V are in r.m.s. values and represent the true a.c. content of the output. To convert the peak-to-peak currents and voltages indicated on the graph to r.m.s. values, each value must be divided by 2 to determine the peak value, and then by $\sqrt{2}$ to convert to the r.m.s. figure. For finding output wattage from the VI formula therefore,

$$W = \frac{Va(max) - Va(min) \times Ia(max) - Ia(min)}{2 \times \sqrt{2} \quad \times \quad 2 \times \sqrt{2}}$$

As $2 \times \sqrt{2} \times \sqrt{2} \times 2 = 2 \times \sqrt{2}^2 \times 2$ or 8, this formula can be simplified to

$$W = \frac{Va(max) - Va(min) \times Ia\,(max) - Ia(min)}{8}$$

With transistors in the usual common emitter mode Vc and Ic replaces Va and Ia.

Having found maximum and minimum current values, it then becomes an interesting exercise to directly measure the second harmonic distortion in the output by the following formula, which is equally applicable to valves or transistors, Io in both instances equalling the no-signal standing current. Second harmonic distortion

$$\frac{\dfrac{I(max) + I(min) - Io}{2}}{I(max) - I(min)}$$

Even the simplest set of curves provide a wealth of information. For instance from the graphs of Figs. 1 and 5, it is quickly possible to find the a.c. resistance of the valves by dividing a small anode voltage variation, on the linear section of the characteristic, by the resulting variation in anode current. If the current change is expressed in milliamps, the a.c. resistance will be in kilohms. $Ra = \frac{dVa}{dIa}$. The prefix "d" indicates "change in". Similarly μ can be obtained by noting what Va change is necessary to alter Ia to the same extent as a change in Vg with Va constant. Having then obtained both Ra and μ, mutual conductance g_m can be found by $g_m = \frac{\mu}{Ra}$ and keeping Ra in kilohms, g_m is in mA/V.

Figure 4, which shows output characteristics of a common emitter amplifier enable the current gain β of the transistor employed to be

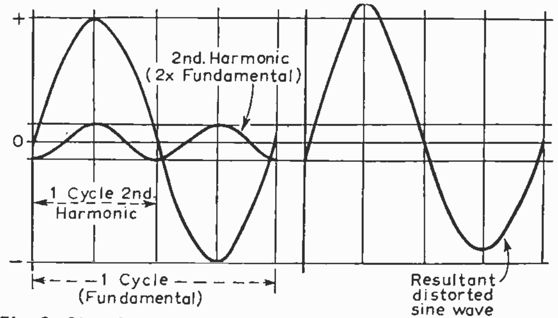

Fig. 3: Showing distortion impressed on sine-wave by second harmonic signal. Such distortion can be produced by a valve or transistor when equal increase and decrease in Vg or Ib, do not produce equal increases in Ia and Ic respectively.

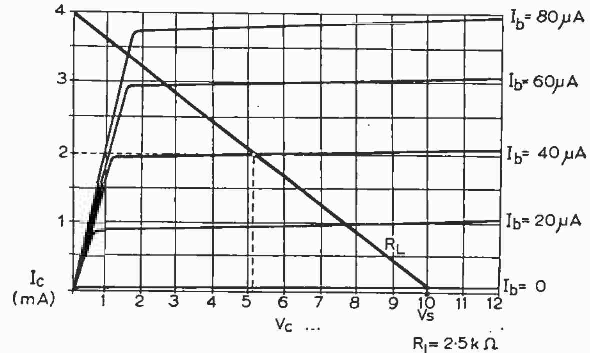

Fig. 4: 2·5kΩ load line across a family of typical transistor common-emitter output characteristics. A standing Ib of 40μA provides a good working point due to Ib changes producing virtually equal Ic changes. Standing Ic would then be 2mA with Vc just over 5V. The graph also shows how β can be determined by the change in Ic due to change in Ib with Vc constant. In this example with Vc at 5V, a 20μA Ib change from 20 to 40μA increases Ic by closely 1mA·

$$\beta \text{ Or } Hfe = \frac{\Delta Ic}{\Delta Ib} = \frac{1{,}000\mu A\ (1mA)}{20\mu A} = 50$$

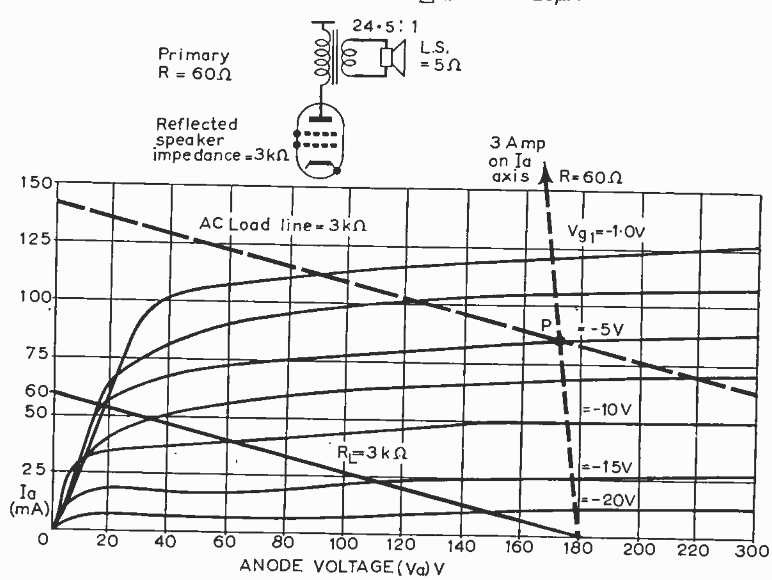

Fig. 5: When a load is transformer coupled, a load line equal to Rp provides the working point on any selected Vg curve. Load lines of equal value having the same angle to the base, a further load line equal to the effective impedance is then drawn through point "P" parallel with one of similar value. This "A.C." or "dynamic" load line shows the Ia Va excursions on signal input.

readily determined. β or Hfe $= \frac{dIc}{dIb}$ or the change in collector current brought about by a change in base current with collector voltage constant. Such factors and indeed all others are most readily taken from graphs and once one becomes accustomed to "reading" them, can be executed very quickly. However—to keep strictly to load lines.

Up till now, it has been assumed that the resistive load was directly connected in the anode lead of a valve or the collector circuit of a transistor, but most output stages, unlike voltage amplifying stages, employ a transformer coupled load for optimum power matching. This slightly complicates the issue of making a load line since the d.c. value of the transformer primary may be only about 50Ω while the actual load presented to the valve or transistor by normal transformer action may be several thousands of ohms. Clearly the load line must equal the Rp value for static d.c. currents, but must equal the impedance effectively presented to the signal by the transformer coupled load.

First step, therefore, is to draw a load line in the usual manner to equal the transformer's primary resistance. However, this value being so low, it will be impossible to actually terminate this line on the vertical Ia or Ic axis, as it would be several amperes, and without unduly extending the graph, must be drawn as shown in Fig. 5. The next move is to mark the most suitable or selected Vg curve where this load line intersects. The "a.c." load line must also then be drawn through this point but at an angle equal to that required by the value of the a.c. load.

If for instance the a.c. load is 3kΩ, as load lines of equal value have the same angle to the horizontal axis, draw this 3kΩ "a.c." load line parallel to a 3kΩ "d.c." load line, drawn as a guide on the same graph. This "a.c." load line will now indicate how the input signal varies output voltages and currents as did the conventional load line when the resistive load was directly connected to the valve or transistor.

Two facts about transformer coupled loads will now be apparent. First, the increase in Va or Vc obtained by eliminating the considerable voltage drop across the directly connected load reduces the degree of distortion introduced, while secondly, Va or Vc can now instantaneously exceed the Vs figure.

This brief outline then indicates that load lines are extremely useful and deceptively simple devices for really getting to know the functioning of valves and transistors under working conditions, and their uses can generally be summarised as follows:

1. Visual and rapid indication of the optimum load and best biasing point to provide maximum output with minimum distortion.
2. Permits direct measurement of second harmonic distortion.
3. Graphically indicates the voltage gain or power output of any stage.

So for a really informative exercise, mark out the load lines for various values of load across a set of transistor or valve output characteristics, and determine the best values for the greatest output compatible with acceptable distortion. The latter of course is achieved by selecting a bias point Ib for transistors, Vg for valves, which enables equal increases and decreases in signal input to produce equal but larger increases and decreases in collector or anode current, as the case may be. Then measure the stage voltage gain or power output obtained. With output pentodes especially, it is interesting to compare your own assessment of optimum load with the maker's recommended figure. ■

QRP MODULATOR —continued from page 344

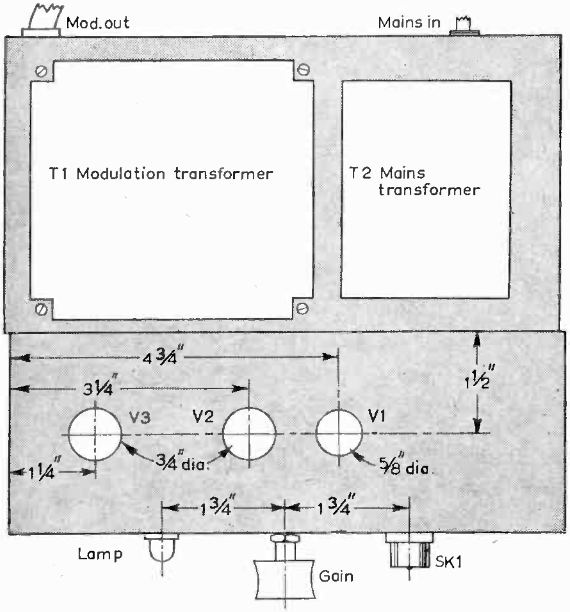

Fig. 3: Above chassis layout and dimensions.

Preliminary tests consist of checking for h.t.—chassis short-circuits and measuring voltages and currents throughout the unit during which time the gain control should be set at minimum and a pair of high impedance headphones connected to the output. A voltmeter connected across the full modulation transformer primary winding should ideally read zero on its 0-10VDC range if both valve sections of the ELL80 are drawing equal currents. When a crystal microphone is connected to SK1 it will be but necessary to rotate VR1 very slightly before room noises are reproduced; speech should sound crisp and there should be no traces of instability or oscillation. Thereafter it is merely a case of bringing the modulator into general use on the lines mentioned earlier and some "on the air" tests carried out taking care not to allow over-modulation to occur.

The low power modulator is certainly a useful item but if when construction is complete everyone has gone s.s.b. and there is no one left to talk to, do not despair! By omitting V1, and associated items, connecting SK1 to the top of VR1 via a 0·01μF capacitor and a 1MΩ resistor, fitting in place of T1 a decent push/pull speaker transformer plus a little degenerative feedback from its secondary to V2A, an excellent little 8W audio amplifier will result. Fed by a crystal pick-up gramophone records will be reproducible with a high degree of fidelity and more particularly so if a little tone compensation is added! ■

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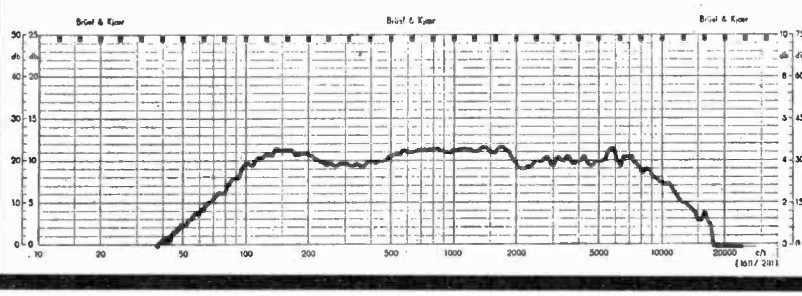

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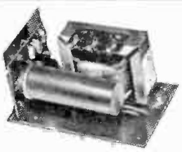

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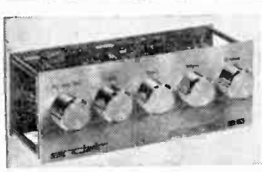

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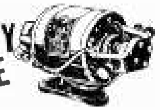

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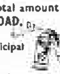

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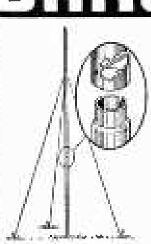

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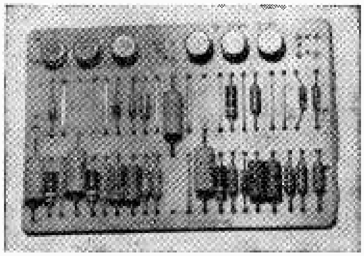

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PRACTICAL WIRELESS, SEPTEMBER 1968

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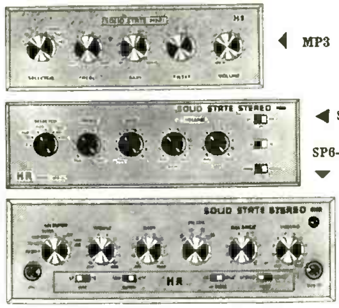

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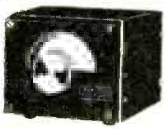

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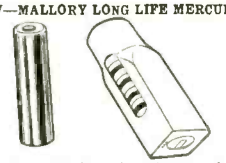

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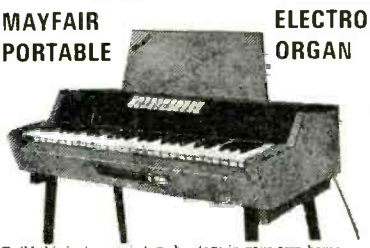

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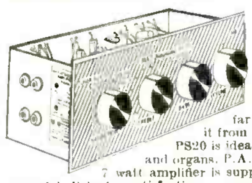

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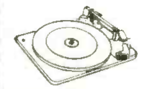

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