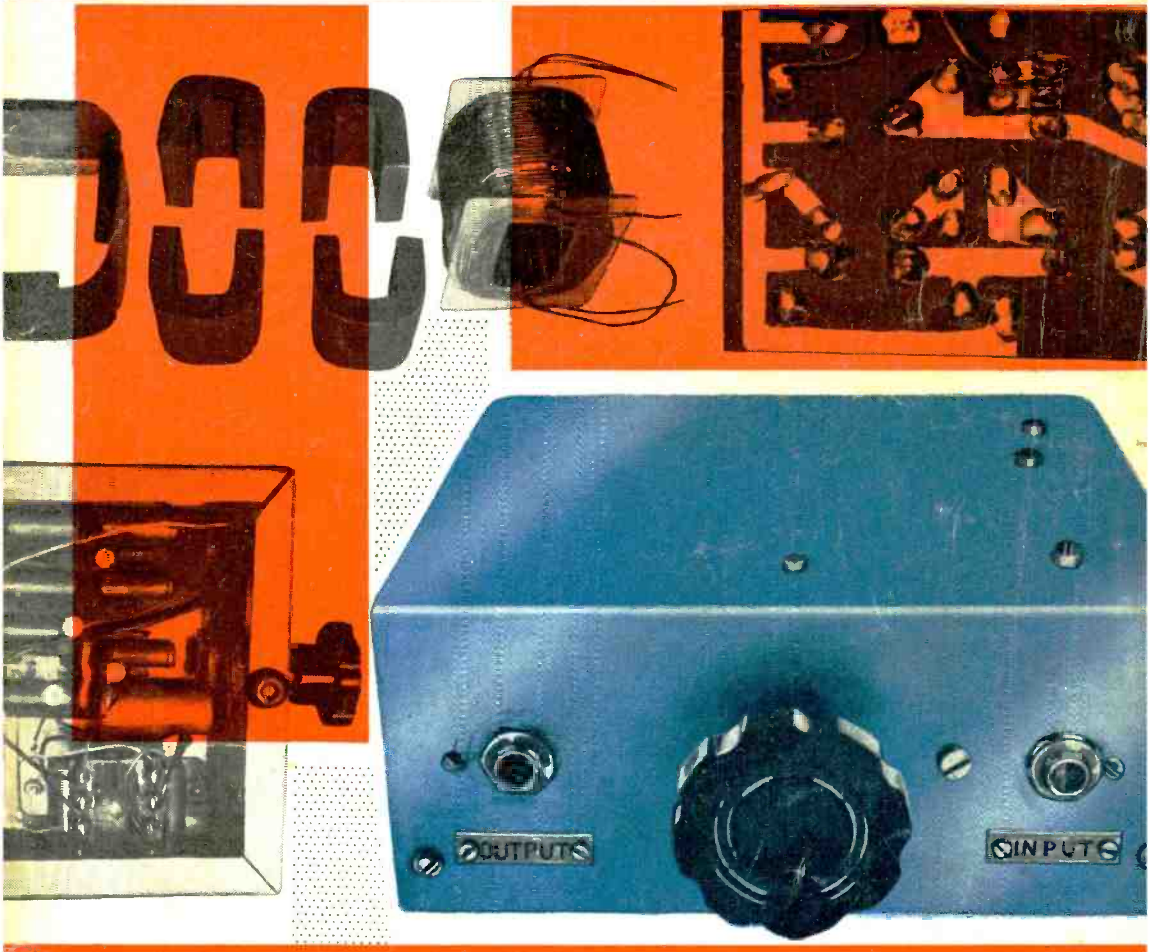
PRACTICAL WIRELESS

JULY 1964

2/-



TRANSISTOR 25 Watt P.A. AMPLIFIER

Tubes

Carr. & Ins. 12/6

HIGHEST QUALITY— COMPARE OUR PRICES

MOST MULLARD. MAZDA. COSSOR. EMITRON. EMI-SCOPE. BRIMAR. FERRANTI TYPES. PROCESSED IN OUR OWN FACTORY	GUARANTEED	6 Months	12 Months	NEW TYPES
	12in.	£2. 0.0	£3. 0.0	MW 31/47 £3.15.0
	14in.	£2.10.0	£4.10.0	MW 36/24 £4.15.0
	15–17in.	£3. 5.0	£4. 5.0	CRM 172
	21in.	£3.15.0	£5.15.0	MW 43/64 £6.0.0

SATISFACTION GUARANTEED

EKCO L.O.P.T. Unused replacements for Perspex cased 1954/7 models, complete with E.H.T. rect. unrepeatable. **39/-**

CO-AX. low loss. 6d. yd., 25 yds. 11/6, 50 yds., 22/-, 100 yds., 42/6. Co-ax Plugs, 1/3. Wall outlet boxes 3/6.

SPECIAL C.R.T. OFFER

Due to huge Bulk Special Purchase we are offering MW 31-74 Tubes at the unrepeatable price of 29/-. MW 36/24 ditto, 39/-. P.P. 12/6. The above are guaranteed for 6 months.

LOUDSPEAKERS. 3Ω Top Makes. 6½in. 8in. **7/6** 5in. 7 x 4in. **8/6**

CONNECTING WIRE

P.V.C. Bright colours. Five 25ft. coils only. **4/-**

3 VALVE AMPLIFIERS

Kit of new parts, consisting chassis, mains and output transformers, valves (P61, 6G6G, 6X5G) and all components. With full instructions for making high gain amplifier with separate base and treble controls, negative feed-back, etc. Truly unusual value at **29/-**

MAINS TRANSFORMERS

Excellent Quality Guaranteed. Upright mounting 250-0-250 V 60 mA. 6.3 V 3 A (80mA 12/6) Ditto semi-shrouded 9/6. **9/6**

13 CHANNEL T.V.s

Table Models. Famous Makes. Absolutely Complete. These sets are unequalled in value due to huge purchase direct from source. They are untested and not guaranteed to be in working order. Carr. etc., 15/-.

12in. **£2.19.0** 14in. **£4.19.0**

LEAK AMPLIFIER SNIPS

Due to a fortunate purchase we are able to make the following unrepeatable offers. All Amplifiers have line matching Output Transformers (Transformers to match these Amplifiers to 15 Ω Speakers can be supplied at 22/6 each).

TL/12 WATT (slightly used)	£10
TL/25 WATT (new)..........	£15
Pamphonic 60 watt Amplifiers, complete with pre-amp	£29

(Note—These Leak Amplifiers all have the added facility of volume and tone controls so that they can be used without a pre-amp. if very high gain is not required.)

★ BULK BARGAINS ★

12 POTS. Popular values. 5K to 2 Meg. Unused, mixed, pre-set, long sp., switch, etc. **4/6**

CONDENSERS. 25 Mixed. Electrolytic. Many popular sizes. List Value £5. Our price **10/-**

100 RESISTORS 6/6
Excellent. Sizes ½-3 watt.

100 CONDENSERS 9/6
Miniature Ceramic and Silver Mica Condensers, 3 pF to 5,000 pF. LIST VALUE OVER £5.

25 TAG STRIPS 4/-
2, 4, 6, 8 way etc. Unused.

100 HI STABS 9/6
1% to 5% 100 Ω to 5M Ω.

TRANSISTORS

GUARANTEED TOP QUALITY

Huge reduction. Red Spot standard L.F. type now only **1/6**

White Spot R.F. **2/-**

Mullard Matched Output Kits OC81D and 2-OC81. **12/6**

R.F. Kits (OC44, OC45 (2), 3 transistors. **12/6**

AF114	8/-	OC44	5/6
AF115	7/6	OC45	5/6
AF116	7/6	OC72	5/6
AF117	7/-	OC81	5/6
AF127	9/6	OC81D	5/6
OC26	12/6	OC82	6/-
OC33	14/-	OC170	8/6
		OC171	8/6

GERMANIUM DIODES

General Purpose miniature detector, A.V.C., etc. or 6/6 doz. **8d.**

Gold Bonded highest quality. Individually tested. 9/6 doz. **1/-**

SILICON RECTIFIERS

Guaranteed performance. Top Make. Tested 250V working. 100mA (3 for 9/6) **3/9** 250mA (3 for 19/6) **7/6**

VALVE HOLDERS. B7G, 6d. ea., with Screen 8d. ea., B9A 6d. ea., with Screen 8d. ea. Int. Octal 6d., Mazda Octal 4d., B8A 6d. (less 15% in dozens).

TURRET TUNERS

Most makes, your choice if available, with valve 16/-, less valves 10/-. S.A.E. enquiries.

COSSOR D.B. SCOPE TUBES. Type 09D Split Beam. Ideal for building your own quality oscilloscope whilst stocks last. **55/-**

LINE TRANS.

Huge quantity, most makes at only **29/-** S.A.E. enquiries.

RECTIFIERS. 250 v., 80 mA. 5/-; RM2. 6/9; RM3. 7/6; RM4. 19/6; RM5. 19/6; 14A86. 17/-; 14A97. 19/6; 14A100. 19/6; 16RC1-1-16-1. 7/9; 18RA1-1-1-16-1. 6/-; 18RD2-2-8-1, 14/-; 14RA1-2-8-2, 17/-; 14RA1-2-8-3, 20/-.

ELECTRIC MOTORS. AC/DC 3-8 volts. Totally enclosed standard mounting, powerful V pulley, spare brushes, 2in. x 2in. **7/6**

AM/FM RADIOS

Fantastic offer. 7 valves plus 2 diodes. Contemporary Cabinet. Top quality and finish. A.F.C. A.V.C. Absolutely complete. Guaranteed 3 months. **£11**

ENQUIRIES WELCOMED
Quantity Prices or Quotes for items not listed. Particularly rare values.
TELEPHONE C.O.D. ORDERS DISPATCHED THE SAME DAY.

GUARANTEED ★ VALVES ★

by return of post

THE MOST ATTRACTIVE COMPETITIVE VALVE LIST IN THE COUNTRY

All valves are new and unused unless otherwise advised

POST	3 MONTHS GUARANTEE	FREE TRANSIT INSURANCE.
1 Valve 6d., 2-11, 1/-. FREE for 12 or more valves.	In writing with every valve.	Satisfaction or Money back Guarantee on Goods if returned within 14 days.

0Z4	4/6	6K7G	2/-	20P3	12/6	DM71	5/9	EZ81	6/-	U22	6/9
1A7GT	8/3	6K7GT	4/9	20P4	17/-	EA50	1/3	FW4/500	7/-	U24	12/6
1C5GT	7/-	6K8G	5/-	20P5	15/-	EABC80	6/9	GT1C	12/6	U25	10/6
1D5	7/-	6K8GT	11/-	25A6G	8/-	EAC91	4/-	GZ32	7/6	U26	8/6
1D6	9/9	6K25	8/6	25L6GT	7/9	EAF42	8/3	GZ34	11/6	U31	7/-
1H5GT	8/-	6L1	9/6	25Y5G	8/-	EB34	1/3	HK90	9/6	U33	14/-
1L4	3/-	6L6G	7/6	25Z4G	7/-	EB41	5/-	HL41DD	8/6	U35	12/6
1LD5	4/3	6L18	7/9	25Z5	8/-	EB91	3/3	HN309	19/-	U37	26/-
1LN5	4/6	6L19	11/6	25Z6G	8/-	EBC33	4/9	HVR2	9/-	U50	4/9
1N5GT	8/9	6LD20	7/9	27SU	17/6	EBC41	7/9	KT32	6/9	U52	4/9
1R5	5/6	6N7	7/6	30C1	6/9	EBC81	7/9	KT33C	4/-	U76	5/6
1U5	5/3	6P1	9/6	30C15	11/6	EBF80	7/6	KT36	14/-	U78	4/6
1S4	7/6	6P25	8/6	30F5	7/6	EBF83	9/6	KT44	6/-	U107	12/6
1S5	4/6	6P28	9/9	30FL1	9/6	EBF89	7/9	KT55	17/6	U191	11/6
1T4	3/-	6Q6G	6/6	30L1	6/6	EBL21	10/9	KT61	11/-	U281	9/6
2D21	5/6	6Q7GT	8/9	30L15	9/9	EC52	4/9	KT63	4/6	U282	12/-
3A4	4/-	6R7G	9/-	30P4	9/6	EC91	4/6	KT66	13/6	U301	12/-
3A5	8/9	6SA7	5/9	30P12	7/6	EC92	8/6	KT76	8/6	U309	6/6
3D6	4/9	6SC7	4/9	30P19	13/6	ECC31	7/6	KT88	19/-	U329	9/6
3Q4	7/-	6SG7	4/9	30PL1	9/3	ECC32	4/-	KTW61	5/9	U339	11/6
3S4	5/-	6SH7	3/-	30PL13	9/6	ECC33	4/9	KTW62	6/6	U403	10/6
3V4	6/6	6SJ7	5/6	35C5	8/6	ECC34	9/-	KTW63	5/9	U404	6/-
5R4GY	9/6	6SK7	5/-	35L6GT	8/-	ECC35	5/9	KTZ6	11/-	U801	17/6
5T4	8/-	6SL7GT	5/9	35W4	6/-	ECC40	9/6	L63	3/-	UABC80	7/-
5U4G	5/6	6SN7GT	4/9	35Z4GT	5/6	ECC81	5/6	LN152	6/6	UAF42	7/9
5V4G	7/6	6SQ7	5/9	35Z5GT	7/-	ECC82	6/-	MU14	7/-	UB41	7/-
5Y3G	4/9	6SS7	3/6	41	6/6	ECC83	6/6	N37	10/6	UBC41	7/6
5Y3GT	5/6	6U4GT	9/6	42	6/6	ECC84	7/6	N78	13/-	UBC81	7/9
5Y4G	9/6	6V6G	4/6	50B5	7/9	ECC85	7/6	N108	13/-	UBF80	7/9
5Z4	9/-	6V6GT	6/9	50C5	8/6	ECC88	11/6	N152	8/3	UBF89	7/6
5Z4G	7/6	6X4	4/9	50L6GT	7/6	ECF80	8/9	P41	3/6	UBL21	12/-
5Z4GT	9/6	6X5G	5/-	53KU	9/6	ECF82	8/3	P61	2/9	UC92	7/9
6/30L2	9/-	6X5GT	6/-	61BT	17/6	ECH21	10/9	PABC80	8/-	UCC84	9/9
6A6	3/9	7B6	10/9	61SPT	11/-	ECH35	11/6	PC86	11/6	UCC85	7/3
6A7	9/-	7B7	7/9	62BT	13/6	ECH42	8/6	PC97	9/6	UCF80	10/6
6A8G	7/9	7C5	7/9	75	5/6	ECH81	7/-	PCC84	6/6	UCH21	9/6
6A8GT	12/6	7C6	7/6	78	5/-	ECH83	8/6	PCC85	7/9	UCH42	7/3
6AC7	3/-	7H7	7/3	80	5/6	ECL80	6/6	PCC88	11/9	UCH81	7/9
6AG5	2/9	7S7	15/-	83	9/6	ECL82	8/-	PCC89	9/6	UCL82	9/-
6AG7	6/9	7Y4	6/-	185BT	19/6	ECL83	10/6	PCC189	12/-	UCL83	12/-
6AK5	5/-	7Z4	6/-	185BTA	19/6	ECL84	12/-	PCF80	6/9	UF41	8/-
6AL5	3/3	8D	3/-	807	7/6	ECL86	10/3	PCF82	7/-	UF42	5/6
6AM6	3/-	10C1	11/6	813	49/-	EF22	7/-	PCF84	12/-	UF80	3/-
6AQ5	6/-	10C2	14/6	832	14/-	EF36	3/3	PCF86	11/-	UF85	7/6
6AT6	5/-	10F1	4/9	866A	12/6	EF37A	8/-	PCL82	7/3	UF89	3/-
6AU6	7/-	10F9	10/6	954	3/9	EF39	7/6	PCL83	9/-	UL41	8/-
6AV6	5/9	10F18	10/-	955	2/3	EF40	11/-	PCL84	7/3	UL44	14/-
6B7	8/6	10LD11	14/6	956	2/-	EF41	8/-	PCL85	10/6	UL46	9/9
6B8G	3/-	10P12	8/6	1625	5/6	EF42	6/9	PCL88	10/6	UL84	3/-
6BA6	5/6	10P14	9/6	5763	7/6	EF50-BR	1/6	PEN25	3/9	UM80	3/9
6BE6	5/6	10P18	7/-	9001	3/6			PEN45	8/6	UR1C	7/6
6BG6G	15/-	12A6	2/3	9002	4/9	EF50(A)	2/6	PEN46	4/6	UU6	11/6
6BH6	6/6	12AH8	11/-	9003	5/9	EF54	3/3	PL33	9/6	UU7	9/6
6BJ6	5/9	12AT6	6/6	ATP4	2/6	EF80	4/6	PL36	9/6	UU8	13/6
6BR7	8/6	12AT7	5/6	AZ31	7/6	EF85	6/-	PL38	15/-	UY1N	11/-
6BR8	9/6	12AU6	9/-	AZ41	7/-	EF86	7/6	PL81	8/3	UY21	9/6
6BW6	7/9	12AU7	6/-	B36	6/9	EF89	6/9	PL82	6/6	UY41	6/-
6BW7	5/-	12AV6	6/9	C1C	8/-	EF91	3/-	PL83	6/6	UY85	6/-
6C4	2/3	12AX7	6/6	CBL31	13/6	EF92	3/-	PL84	7/-	VP4B	9/-
6C5	5/6	12BA6	7/-	CCH35	13/6	EF183	9/9	PL820	8/3	VP23	2/9
6C6	3/6	12BE6	6/6	CL33	9/-	EF184	9/6	PM84	8/-	VP41	5/6
6C9	11/-	12BH7	8/9	CY31	7/6	EK32	7/6	PX4	12/6	VR105	5/6
6CD6G	19/6	12C8	5/6	D77	3/3	EL32	3/9	PX25	9/-	VR150	5/-
6CH6	6/6	12E1	17/6	DA30	11/6	EL33	11/-	PY31	8/-	W76	4/9
6D2	3/3	12H6	1/9	DAC32	8/-	EL34	11/6	PY32	10/-	W81	7/3
6D3	9/6	12J5GT	3/3	DAF91	4/6	EL35	6/-	PY33	10/6	X61M	11/-
6D6	3/-	12J7GT	8/-	DAF96	7/3	EL38	12/6	PY80	6/6	X63	8/6
6F1	4/9	12K7GT	4/9	DF33	8/9	EL41	8/-	PY81	6/3	X65	11/-
6F6	7/6	12K8	9/9	DF91	3/-	EL42	9/6	PY82	5/9	X66	7/9
6F6G	4/6	12K8GT	11/6	DF96	7/3	EL81	8/9	PY83	6/9	X76M	11/-
6F13	4/9	12Q7GT	4/9	DF97	7/6	EL84	6/6	PY88	8/9	X78	21/-
6F14	9/6	12SA7	7/-	DH63	5/6	EL85	9/9	PY800	7/9	X79	21/-
6F15	9/6	12SG7	4/6	DH76	4/6	EL91	3/9	PY801	7/9	X81M	9/-
6F19	6/-	12SH7	3/6	DK32	9/6	EL95	6/6	PZ30	9/6	Y63	6/-
6F32	4/9	12SJ7	5/6	DK91	5/6	EM34	8/9	R19	9/6	Z63	4/9
6F33	4/-	12SK7	4/6	DK92	7/-	EM80	7/6	RL18	11/-	Z66	8/6
6H6	1/6	12SN7GT	6/9	DK96	7/9	EM81	8/6	SP41	2/3		
6J5	4/3	12SQ7	8/6	DL33	7/6	EM84	8/9	SP61	2/-		
6J5G	3/-	13D3	6/6	DL35	7/6	EM85	9/6	SU25	16/-		
6J5GT	4/3	14S7	19/9	DL63	9/-	EN31	16/-	SU2150	4/6		
6J6	3/6	19AQ5	7/9	DL75	6/-	EY51	7/6	T41	6/9		
6J7	8/6	19BG6	14/-	DL82	9/-	EY86	7/3	TDD4	8/6		
6J7G	4/9	20D1	8/9	DL92	5/-	EY88	9/6	U14	7/6		
6J7GT	7/6	20F2	9/6	DL94	6/6	EZ40	7/-	U18	7/6		
6K6GT	6/-	20L1	16/-	DL96	7/3	EZ41	7/-				
6K7	5/9	20P1	9/6	DM70	5/9	EZ80	5/9				

100's TYPES NOT LISTED S.A.E. ENQS.

Post: 2 lbs. 2/-, 4 lbs. 2/6, 7 lbs. 3/6, 15 lbs. 4/-, etc. (C.O.D. 2/- extra). ALL ITEMS LESS 5% AND POST FREE IN DOZENS.
(SHOPS RETAIL ONLY)

TECHNICAL TRADING CO.

350-352 Fratton Road, Portsmouth (Tel: 22034)
72 East Street, Southampton (Tel. 25851)
ALL MAIL ORDER, RETAIL SHOP AND HI-FI ROOM
11-12 NORTH ROAD, BRIGHTON. Tel. 67999

CLEAR PLASTIC PANEL METERS

First grade quality. Moving Coil panel meters, available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Available as follows. Type MR. 38P. 1 21/32in. square fronts.

50µA	32/6	1A. DC	22/6
100µA	29/6	5A. DC	22/6
200µA	27/6	3V. DC	22/6
500µA	25/-	10V. DC	22/6
50-0-50µA	29/6	50V. DC	22/6
100-0-100µA	27/6	100V. DC	22/6
1mA	22/6	150V. DC	22/6
5MA	22/6	300V. DC	22/6
10mA	22/6	500V. DC	22/6
50mA	22/6	750V. DC	22/6
100mA	22/6	15V. AC	22/6
150mA	22/6	50V. AC	22/6
200mA	22/6	150V. AC	22/6
300mA	22/6	300V. AC	22/6
500mA	22/6	500V. AC	22/6
750mA	22/6		

Type MR. 52P. 2½ sq. fronts.

50µA	57/6	1mA	32/6
100µA	47/6	10mA	32/6
500µA	37/6	100mA	32/6
50-0-50µA	57/6	1A. DC	32/6
100-0-100µA	47/6	300V. DC	32/6
		300V. AC	32/6

Type MR.65P 3½ x 3¼in. fronts.

50µA	59/6	1mA	35/-
100µA	49/6	10mA	35/-
500µA	39/6	100mA	35/-
50-0-50µA	59/6	1A. DC	35/-
100-0-100µA	49/6	300V. DC	35/-
VU Meter	59/6	300V. AC	35/-

POST EXTRA

BAKELITE PANEL METERS

First grade quality. 3½in. square fronts.

25µA	65/-	1A. DC	29/6
50µA	42/6	5A. DC	29/6
100µA	39/6	*1A. AC	29/6
500µA	35/-	*5A. AC	29/6
50-0-50µA	42/6	*30A. AC	29/6
100-0-100µA	39/6	300V. DC	29/6
1mA	29/6	*300V. AC	29/6
10mA	29/6	300V. AC	35/-
100mA	29/6	VU Mtr.	49/6

*Moving iron, all others moving coil.

ILLUMINATED 'S' METER

1 21/32in. sq. front. Cal. in S units. 6V lamp. 29/6. P.P. 1/-. Ditto 2 5/16in. sq. 39/6. P.P. 1/-.

MORE METER BARGAINS

100µA.	2½in.	Flush rd.	42/6
30-0-30mA	2½in.	,, ,,	9/6
300V. AC	2½in.	,, ,,	25/-
500V. AC	2½in.	,, ,,	25/-
1mA Meter Rectifiers			8/6

Post Extra.

6IN. PANEL METERS

Flush panel mounting, hermetically sealed. 300A. DC m/c 65/-. Post 5/-.

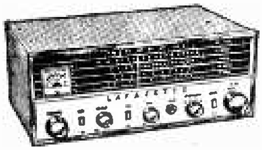
R.C.A. HEADSETS

Low imp. Fitted with std. jack plug. 15/6. P.P. 1/6.

TELEPHONES TYPE H

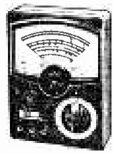
Sound powered, generator bell ringing 2 line connection. Fully tested. £4.19.6 pair. Carr. 5/-.

HE-40 DE LUXE 4-BAND COMMUNICATION RECEIVER



Frequency coverage 550Kc/s to 30 Mc/s continuous. Operation 220/240 volt A.C./D.C. The perfect receiver for short wave listening. Special features include: Slide rule tuning dial—electrical bandspread—0-100 logging scale—improved selectivity—built in "S" meter—A.V.C.—Noise limiter—B.F.O.—Phone jack built in 5in. speaker—tone-control—standby switch—supplied with three aerials, ferrite loop for broadcast band, adjustable 58in. whip for short wave and wire aerial. Smartly styled durable metal cabinet. Supplied brand new and guaranteed with manual. £24.15.0 carriage paid. S.A.E. for full details. Part exchanges welcome.

MODEL ITI-2 MULTITESTER 20 000 O.P.V.



20,000 o.p.v. D.C.; 10,000 o.p.v. A.C.

Specifications:

D.C. V:	0-5-25-250-500-2500 V.
A.C. V:	0-10-50-500-1000 V
Current:	0-50µA-25mA-250mA
Resistance:	0-60K-6MΩ
Capacity:	0.01-0.3mFd (at AC 10 V)
Decobel:	—20dB-+22dB
Output range:	0-10-50-500-1000 V
Battery:	1.5 V U12
Size:	3½ x 4½ x 1¼in.

Supplied complete with batteries, leads instructions. 82/6. Post 2/6.

MARCONI TF144G/4 STANDARD SIGNAL GENERATORS

First release of this late mark. 85Kc/s to 25Mc/s ±1%. Output variable from 1µV to 1 volt. Internal sine wave modulation 400c/s up to 75% depth. Operation 200/250 volt A.C. Offered in really excellent condition, like new fully tested and guaranteed. £25. Carr. 30/-.

TE-20 RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120Kc/s—260Mc/s on 6 bands. Directly calibrated. Variable RF attenuator. Operation 200/240 V. A.C. similar in appearance to TE-46 CR Bridge. Brand new with instructions. £12. Carr. 5/- S.A.E. for details

NATIONAL H.R.O. RECEIVERS

SENIOR MODEL. Complete with a full set of 9 coils covering 50Kc/s to 30Mc/s. Each receiver thoroughly checked and tested before despatch. Dual purpose rack model for table or 19in. rack mounting. Extremely good used condition. £18.18.0. Carr. £1. 200/250 volt A.C. power supplies for H.R.O. also sold separately, 59/6. Carr. 5/-. S.A.E. for full details.

ERSKINE TYPE 13 DOUBLE-BEAM OSCILLOSCOPE

Time base 2c/s—750 Kc/s. Calibrators at 10 Kc/s and 1Mc/s. Separate Y1 and Y2 amplifiers up to 5.5Mc/s. Operation 110/230 volt A.C. Supplied in perfect working order. £27.1 .0. Carr. 20/-.

TWIN MOTOR BARGAIN

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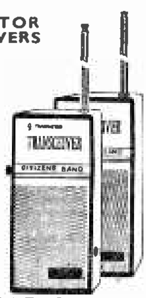

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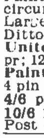

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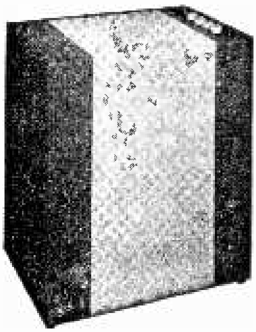

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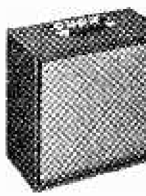

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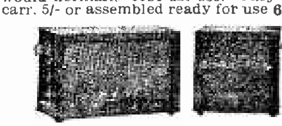

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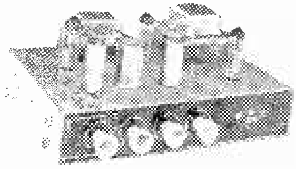
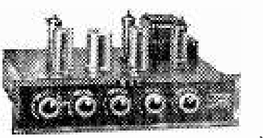


Two input sockets with associated controls allow mixing of "mike" and gram., as in A10 High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 dB 30-20,000 c/s. Six negative feedback loops. Hum level 60 dB down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs for **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, LEAD OR RHYTHM GUITARS,** etc.
OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/- extra.)
If required louvred metal cover with 2 carrying handles can be supplied for **18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9** and 9 monthly payments of **24/9.** Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Microphones, etc., with cash and credit terms.

LINEAR TAPE PRE-AMPLIFIER. Type LP/1, Switched Negative feedback equalisation. Positions for Record 1⅞in., 3¾in., 7½in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9 gns. S.A.E. for leaflet.

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



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. Ganged Bass and Treble Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10-watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-.
Kit can be supplied assembled and ready to use for **59/6** extra.

R.S.C. GRAM. AMPLIFIER KIT. 3 watts output. Negative feedback. Controls Vol., Tone and Switch. Mains operation 200-250 v. A.C. Fully isolated chassis. Circuit, etc., supplied. Only **39/9.** Carr. 3/9.

HI-FI CRYSTAL PICK-UP HEADS. (Cartridges.) Acos Standard replacement for Garrard, B.S.R. and Collaro. **16/9.** Acos Stereo-Monaural, **29/9.** Ronette Stereo-Monaural **39/6.** B.S.R. Stereo **39/9.**

BRADMATIC RECORDING HEADS. High Impedance Record/Playback **22/-.** Low Impedance Erase. **12/6.**

MARRIOTT RECORDING HEADS. High Impedance, Record/Playback **15/-.** Low Impedance, Erase, **10/-.**

PICK-UP ARMS. Complete and with latest Acos/hi-fi Turnover Cartridge **29/11.**

CRYSTAL MICROPHONES. Hand type NP110 **14/9,** R.T.C. **19/9,** Acos Mic 40 **25/9,** Acos Mic 45 **29/9,** Stick type Acos 39-1 **39/9.** BM3 with neck band and heavy table stand **59/9.** Lapel type **29/9.**

COLLARO JUNIOR 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only **£3.19.6.**

B.S.R. UA14 4-sp'd AUTO-CHANGERS with hi-fi turnover head, **£6.19.6.** Carr. 4/6.

GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER with high fidelity pick-up. Latest model. For 200-250 v. A.C. mains, **£7.17.6.** Carr. 4/6.

GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTOCHANGERS. Turnover GC8 head, for 200-250 v. A.C. mains. **£11.9.0.**

GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2-3 ohm speaker. For 200-250 v. A.C. mains. Size 11¼ x 2½ x 2½in. Controls: Vol. and Tone with Switch. Only **59/6.**

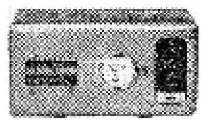
SENSATIONAL STEREO OFFER

A complete set of parts to construct of a good quality Stereo amplifier with an undistorted output total 6 watts. **4 Gns.** For A.C. mains input of 200-250 v. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. Stereo Pick-up Head **19/9** extra with above only.

HEAVY DUTY CHARGER KIT. 6/12 v. 6 amps., variable output. Consisting of Mains Transformer 0-200-230-250 v.: F.W. (Bridge) Selenium Rectifier; Ammeter, Variable Charge Rate Selector Panels. Plugs. Fuses, Fuseholder and circuit. **59/9.** Carr. 4/6.

R.S.C. BATTERY CHARGING EQUIPMENT Guaranteed 12 months.

All for A.C. Mains 200-250v., 50 c/s.



ASSEMBLED 4 amps 6/12 v. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved grey hammer finish. Fused and ready for use with mains and output leads and battery clips. Carr. 4/6. **59/9**
Terms: Deposit **12/-** and 5 monthly payments of **12/-.**

ASSEMBLED 6/12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Fused, ready for use with mains and output leads. **39/9** Carr. 3/9.
6/12v. 1 amp. 27/9 Less meter.

CHARGER KIT, 12 v. 14 AMP or 24 v. 7 AMP
Consisting of mains trans. 200-230-250 v. F.W. (Bridge) selenium Rectifier. Ammeter, Fuses, Variable Resistor, Heavy Steel Stove enamelled case and Circuit. Only **£9.19.6.** Carr. 15/-. Please state if 12 v. or 24 v. kit required.

BATTERY CHARGER KITS
Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders. Grommets, panels, Heavy Duty Clip, circuit. Carr. 3/6 extra.
6 v. or 12 v. 1 amp. **22/9**
As above, with Ammeter .. **28/9**
6 v. 2 amps. **19/9**
6 v. or 12 v. 2 amps. **25/9**
6 v. or 12 v. 2 amps, inclusive of Ammeter **35/9**
6 v. or 12 v. 4 amps, with Ammeter and variable charge rate selector...... **52/9**

CHARGER AMMETERS
0-1.5 a., 0-4 a., 0-7 a. **8/9** ea.

CHARGER KIT, 12v. 10 Amp. with variable charge rate adjustment and ammeter. **£4.19.6.** Carr. 10/-.

R.S.C. MAINS TRANSFORMERS (FULLY GUARANTEED)

Interleaved and Impregnated. Primaries 200-230-250 v. 50 c/s. Screened

TOP SHROUDED DROP THROUGH
250-0-250v. 70mA, 6.3v. 2a, 0-5-6.3v. 2a .. 17/9
350-0-350v. 80mA, 6.3v. 2a, 0-5-6.3v. 2a .. 18/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a .. 21/9
250-0-250v. 100mA, 6.3v. 3.5a, C.T. .. 19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 25/9
300-0-300v. 130mA, 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier 29/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 26/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 26/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9

FULLY SHROUDED UPRIGHT
250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a. Midget type 2½ x 3 x 3in. .. 17/11
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 27/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 27/11
300-0-300v. 130mA, 6.3v. 4a, C.T. 6.3v. 1a. for Mullard Amplifier 33/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 27/11
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a .. 35/9

FULLY SHROUDED (continued)—
425-0-425v. 200mA, 6.3v. 4a, C.T. 5v. 3a .. 55/9
425-0-425v. 200mA, 6.3v. 4a, C.T., 6.3v. 4a, C.T., 5v. 3a 59/9
450-0-450v. 250mA, 6.3v. 4a, C.T. 5v. 3a .. 69/9

OUTPUT TRANSFORMERS
Midget Battery Pentode 66:1 for 3S4, etc. 4/6
Small Pentode, 5,000Ω to 3Ω 4/6
Small Pentode 7/8,000Ω to 3Ω 4/6
Standard Pentode 5,000Ω to 3Ω 5/9
Standard Pentode 7,000Ω to 3Ω 5/9
10,000Ω to 3Ω 5/9
Push-Pull 8 watts, EL84, or 6V6 to 3Ω or matched to 15Ω 9/9
Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 to 15Ω 19/9
Following types for 3 and 15Ω speakers:
Push-Pull 10-12 watts 6V6 or EL84 .. 18/9
Push-Pull 15-18 watts, 6L6, KT66 .. 22/9
Push-Pull Mullard 510 Ultra Linear .. 29/9
Push-Pull 20 watts, sectionally wound. 6L6, KT66, EL34, etc. 49/9

MIDGET MAINS Primaries 200-250 v. 50 c/s. 250v. 60mA, 6.3v. 2a 11/9
250-0-250v. 60mA, 6.3v. 2a .. 12/11
Both above size 2⅜ x 2½ x 2½in.

FILAMENT TRANSFORMERS
All with 200-250v. 50 c/s primaries 6.3v. 1.5a., **5/9;** 6.3v. 2a, **7/6;** 12v. 1a, **7/11;** 6.3v. 3a, **8/11;** 6.3v. 6a, **17/6;** 12v. 1.5a. twice, **17/6.**

SMOOTHING CHOKES
150mA, 7-10 H, 250 ohms 11/9
100mA, 10H, 200 ohms 8/9
80mA, 10H, 350 ohms 5/9
60mA, 10H, 400 ohms 4/11

CHARGER TRANSFORMERS
All with 200-230-250v. 50 c/s Primaries: 0-9-15v. 1½a. **12/9;** 0-9-15v. 2a, **14/9;** 0-9-15v. 3a, **16/9;** 0-9-15v. 5a, **19/9;** 0-9-15v. 6a, **23/9;** 0-9-15v. 8a, **28/9.**

AUTO (Step up/Step down) TRANS.
0-110/120-200/250v. 50-80 watts **13/9;** 250 watts, **39/9;** 150 watts, **27/9.**

MICROPHONE TRANSFORMERS
120: 1 high grade, clamped, **8/9.**

SEE LEFT HAND PAGE FOR MORE ITEMS

THE WORLD'S BEST SELLING KIT-SETS — Heathkit DAYSTROM — HIGHEST QUALITY AT LOWER COST

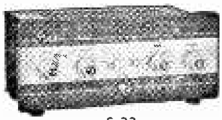
Millions of Heathkit models are in use throughout the world because:—

★ ***They are so easy to build.*** *Even for an absolute beginner.*

★ ***The manual of instructions is foolproof.*** *Because all manuals are written by the world's experts in kit-set design.*

★ ***You get professional appearance and performance*** *with every model.*

HI-FI AMPLIFIERS



S-33

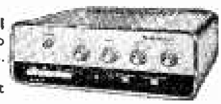
6W STEREO AMPLIFIER. Model S-33. 3 w/chl. Inputs for radio, tape and gram. Stereo/Mono ganged controls. Sensitivity 200MV.

£18.18.0 Assembled **£13.7.6** Kit

6W DE-LUXE STEREO AMPLIFIER. Model S-33H. An inexpensive stereo/mono amplifier with high sensitivity. Suitable for use with Decca Deram cartridge.

£21.7.6 Assembled **£15.17.6** Kit

TAPE RECORD/REPLAY AMPLIFIER KITS. Will operate with most tape decks. Send for details.
TA-1M (Mono), **£19.18.0** Kit **TA-1S** (Stereo), **£25.10.0** Kit



18W STEREO AMPLIFIER. Model S-99. Ganged controls. Stereo/Mono gram, radio and tape recorder inputs. P/B selection.

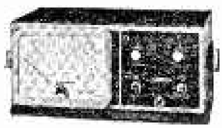
£37.19.0 Assembled **£27.19.6** Kit

5W HI-FI MONO AMPLIFIER. Model MA-5. A low priced amplifier based on the S-33. Printed circuit construction makes it easy to build. **£14.19.6** Assembled. **£10.19.6** Kit

HI-FI SINGLE CHANNEL AMPLIFIER. Model MA-12. Ideal for use with Models USC-1 and UMC-1. 0.1 % THD at 10 W. Wide freq. range.

£15.18.0 Assembled. **£11.18.0** Kit

OTHER MODELS



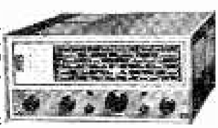
DE-LUXE LARGE SCALE VVM KIT, Model IM-13U. a.c. and d.c. volts 0.1-1500v in 7 ranges. Ohms to 1000MΩ in 7 ranges 6" Meter. Modern styling with unique gimbal mount.

£18.18.0 Kit. **£26.18.0** Assembled

PUBLIC ADDRESS AMPLIFIER. PA-1. For vocal and instrumental groups, guitars, etc. 50 Watts r.m.s., output, 4 inputs, 2 loudspeakers in one compact unit. Send for full details.

£74.0.0 Assembled **£54.15.0** Kit

Set of 4 Legs 17/6 extra.



COMMUNICATIONS TYPE RECEIVER RG-1. A high performance low cost receiver for the discriminating listener. Freq.: cov. 600 kc/s-1.5 Mc/s and 1.7 Mc/s to 32 Mc/s. Send for details.

£53.0.0 Assembled **£39.16.0** Kit

SELF SUPPORTING AERIAL TOWER KIT. Model HT1. Ideal for Amateur Radio or TV reception, etc Strong steel construction, height 32 ft. tapered square section 3ft. x 3ft. at base.

Kit **£29.15.0** Oxide Painted. **£35.15.0** Galvanised.

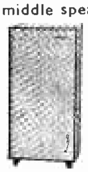
Accessories available. Send for details.

COTSWOLD SPEAKER SYSTEMS

STANDARD MODEL

Acoustically designed enclosure 'in the white' 26 x 23 x 15½in. 12in. bass speaker, elliptical middle speaker, 2 in. pressure unit. Covers 30-20,000 c/s.
Complete kit with all controls.

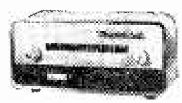
MFS SYSTEM



A minimum floor space model for the smaller room. 36in. high x 16½in. x 14in deep. Similar performance to standard model.

Price either model **£23.4.0** Kit

HI-FI TUNERS



FM-4U

Model FM-4U. Tuning range 88-108 Mc/s. Tuning unit (FMT-4U) with 10.7 Mc/s I.F. (£2.15.0 inc. P.T.). I.F Amp. (FMA-4U) complete with cabinet and valves

Total **£15.18.0** Kit

AM/FM TUNER. Covers FM 88-108 Mc/s. A.M 16-50, 200-550, 900-2,000 m. Tuning heart (£4.13.6 inc. P.T.), and I.F. Amp.

Total **£26.10.0** Kit

EQUIPMENT CABINETS

A large range, in kit form or assembled and finished, available to meet most needs. Illustrated details on request.

Prices from **£6.19.6** to **£29.8.0**

MONEY BACK GUARANTEE

Daystrom Ltd. unconditionally guarantee that each Heathkit product assembled in accordance with our easy to understand instruction manual must meet our published specifications for performance or the purchase price will be cheerfully refunded.

Please send me FREE BRITISH CATALOGUE (Yes/No)
Full details of model(s)..
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A member of the Daystrom Group, manufacturers of the WORLD'S LARGEST-SELLING ELECTRONIC KITS

SURBITON PARK RADIO LTD.

ALL ORDERS DESPATCHED SAME DAY ● WE PAY POSTAGE and INSURANCE
MONEY REFUND GUARANTEE

LEADING STOCKISTS OF MARTIN RECORDAKITS AND AUDIOKITS

MARTIN RECORDAKITS

	Price	Dep.	&	Mthly. pmts. of
HALF TRACK				
TAPE AMPLIFIER FOR STUDIO DECK with ready wired printed circuit, control and input panels, mains and output transformers, knobs, plans, screws, etc. EF86, ECC83, EZ80, EM85 and 2 EL84. 3 watts output. Magic eye, Radio and Mic. inputs, ext. speaker socket, tone and monitor controls. Can be used as an amplifier	£11.11.0	24/-	12	19/-
COLLARO STUDIO DECK. Very latest model. 3 speeds, 7in. spools	£10.19.6	22/-	8	27/3
CASE for above with 8 x 5in. speaker, two-tone grey	£5.5.0			
COMPLETE KIT with tape and microphone	£29.0.0	58/-	12	48/2
QUARTER TRACK				
COLLARO STUDIO DECK fitted with Marriott "X" heads	£17.17.0	37/6	12	29/5
TAPE AMPLIFIER FOR STUDIO DECK as described above but quarter track	£12.12.0	27/-	12	20/8
CASE with speaker, two-tone grey	£5.5.0			
COMPLETE KIT with tape and microphone	£35.0.0	70/-	12	58/2

BRENELL TAPE EQUIPMENT

	Price	Dep.	&	Mthly. pmts. of
DECK Mk. 5 Series 2, half track, 4 speed	£32.11.0	66/-	12	54/-
AMPLIFIER for above with power pack	£26.0.0	52/-	12	43/2

MARTIN AUDIOKITS

The new Martin All Transistor Ten Watt Amplifier Kits represent excellent value for money. Each unit is complete, requiring only to be connected to the next. We show the four most popular units here. Others are available. Leaflets on request.

	Price	Dep.	&	Mthly. pmts. of
UNIT 1—FIVE INPUT SELECTOR. Size 3¼ x 3in. Mag. PU, Crystal PU, Radio, Mic., Tape head, 9-15 Volts. Must be used with unit 4	£2.7.6	—	—	—
UNIT 4—PRE-AMPLIFIER AND CONTROL. 6¾ x 2¼in. Volume on/off, bass and treble controls, 9-15 Volts. Must be used with unit 1	£3.2.6	—	—	—
UNIT 5—MAIN AMPLIFIER 10 WATTS. 6 transistor transformerless push pull output. Mounted on heat sink. 3 ohms output. 24 Volts	£5.12.6	—	—	—
UNIT 6—POWER SUPPLY. 24 and 9 Volts. Heavy duty transformer, rectifier and smoothing	£2.12.6	—	—	—
CONTROL PANEL for unit 1 and 4	10.6	—	—	—
ALL FOUR ABOVE UNITS (FORMULA 1456) WITH PANEL. 3 Ohms output	£14.5.0	28/6	12	23/7
1456 with Wharfedale matching transformer 15 Ohms	£14.18.6	30/-	12	24/10

GRAMOPHONE UNITS, MOTORS, PICK-UPS

	Price	Dep.	&	Mthly. pmts. of
Decca Deram Arm and Plug-in Shell	£5.5.0	—	—	—
Decca Deram Transcription Cartridge	£4.14.6	—	—	—
Decca Deram Auto Cartridge	£3.13.6	—	—	—
Decca FFSS Arm with Stereo head	£18.18.0	40/6	12	23/1
Garrard SRP10 with Mono cartridge, single player	£5.9.11	—	—	—
B.S.R. UA14 with TC8 Mono cartridge, 4-speed changer	£16.19.6	20/-	6	23/3
Garrard Autoslim, Mono cartridge, 4 speed changer	£7.17.0	20/-	7	22/6
Garrard AT6 Autoslim de Luxe, GC8 Mono cartridge	£11.9.0	26/6	9	24/9
Garrard 4H/F with Mono cartridge	£17.0.0	34/-	12	28/2
Garrard Lab Type "A" Transcription auto-changer, with Mono cartridge	£19.14.9	39/6	12	32/9
Garrard 301 Strobe	£22.0.0	44/-	12	36/6
Philips AG1016. Stereo cartridge, will change 7in records (adaptor 10/- extra)	£12.12.0	27/-	12	20/8
Goldring GL58 with arm, less cartridge	£17.1.9	36/-	12	28/2
Goldring GL70 with arm, no cartridge	£27.[illegible]	55/-	12	45/8
Goldring "88" Transcription, no arm	£18.18.5	41/-	12	31/1

ARMSTRONG - NEW TUNER AMPLIFIERS

	Price	Dep.	&	Mthly. pmts. of
MONO				
AF208 A.M./F.M. Radio chassis, bass and treble controls, P.U. inputs, etc.	£21.4.0	46/-	12	34/10
227M A.M./F.M. Radio chassis, 10 watts	£33.18.0	70/6	12	56/1
223 A.M./F.M. Self-powered (Tuner only)	£28.15.0	57/6	12	47/9
224 F.M. only, Self-powered Tuner	£22.10.0	45/-	12	37/4
STEREO				
Stereo 55 A.M./F.M. Radio Chassis, with Stereo gram inputs	£29.18.0	62/6	12	49/5
227 A.M./F.M. Radio chassis, Stereo gram, 10 watts each channel	£48.15.0	97/6	12	81/1
226 A.M./F.M. Radio chassis, Stereo gram, 10 watts each channel, Filter, Magnetic pick-up, etc.	£56.0.0	112/-	12	93/2

OTHER TUNERS

	Price	Dep.	&	Mthly. pmts. of
Tripletone F.M. Tuner, less power	£13.19.6	28/-	12	23/2
Tripletone F.M. Tuner, self-powered	£15.14.6	31/6	12	26/1

STEREO AMPLIFIERS—VARIOUS

	Price	Dep.	&	Mthly. pmts. of
Armstrong 222 Integrated, 10W per channel	£27.10.0	55/-	12	45/8
Dulci GA505, Integrated	£18.18.0	40/6	12	31/1
Rogers Cadet Mk. 2 with pre-amplifier, 4 ECL86 valves	£26.15.0	53/6	12	44/5
Leak Stereo 20 Main amplifier	£30.9.0	64/6	12	50/3
Leak Varislope 2 stereo pre-amplifier	£25.0.0	50/-	12	41/6
Quad 22 Stereo Control Unit	£25.0.0	50/-	12	41/6

For Quad Main Amplifiers see Mono section.

MONO AMPLIFIERS

	Price	Dep.	&	Mthly. pmts. of
Linear L45, 3 watt, 3 valve	£5.19.6	—	—	—
Linear Diatonic, 12 watt, suitable Mic. or Guitar	£12.12.0	27/-	12	20/8
Linear Conchord, 30 watt, ideal Guitar amp., with cover	£18.0.0	36/-	12	29/10
Dulci GA5, integrated amp., 5 watt, ECL86 valve	£13.2.6	28/6	12	21/6
Dulci DPA15, 15 watt with 2-valve pre-amp.	£26.5.0	52/6	12	43/6
Tripletone Hi-Fi Major with pre-amp. Suitable for Guitar or Mic. etc.	£15.18.9	35/3	12	26/1
Leak TL/12, 10 watt Main amp. only	£18.18.0	40/6	12	31/1
Leak Varislope Mono pre-amplifier	£15.15.0	31/6	12	26/1
Quad, 15 watt Main amplifier only	£22.10.0	45/-	12	37/4
Quad, pre-amplifier, Mono	£19.10.0	39/-	12	32/4

JASON F.M. AND TV SOUND TUNER KITS

	Price	Dep.	&	Mthly. pmts. of
FMT1, complete with 4 EF91 valves	£7.4.6	21/-	7	20/6
FMT2, less power, complete with 4 EF80 valves	£9.4.6	20/-	9	20/6
FMT2, with power, complete with 4 EF80 and 1 EZ80	£11.4.6	22/6	9	24/9
FMT3, Fringe, complete with valves, less power	£10 19.0	22/-	8	27/3
FMT3, with power, complete with all valves	£12.19.0	26/-	12	21/6
JTV/2, switched F.M. and TV sound, self-powered, all valves	£15.12.6	33/6	12	25/8
Mercury II, as JTV/2 but less power, all valves	£11.0.0	22/-	8	27/3
Instruction book included in all kits. Available separately. 2/6 switched 3/6.				
JTV/2 ready built, state channels	£22.5.0	44/6	12	36/11
Monitor, ready built as Mercury II	£16.15.6	33/6	12	27/9

LOUDSPEAKERS

	Price	Dep.	&	Mthly. pmts. of
Goodmans Axiette	£5.5.7	—	—	—
Goodmans Axiom 10	£6.5.11	—	—	—
Goodmans 5K/20/XL	£7.7.0	—	—	—
Goodmans XO 5000 cross-over	£2.0.11	—	—	—
Goodmans Axiom 201, 12in. unit	£10.17.4	22/5	12	17/11
Goodmans Axiom 301, 12in. unit	£15.4.6	30/6	12	25/3
Wharfedale Super S/RS/DD	£6.14.2	—	—	—
W.B. HF1012 10in.	£4.7.6	—	—	—
FANE 12in. Unit, 20 watt	£5.5.0	—	—	—
Wharfedale W12/EG 12in. 15 watt Lead Guitar speaker	£10.10.0	21/-	12	17/5
Wharfedale W15/EG 15in. 15 watt Bass Guitar speaker	£17.10.0	35/-	12	29/-
Wharfedale Super 10/RS/DD 10in. high quality unit	£10.18.0	23/8	12	17/11
Wharfedale RS/12/DD 12in. 15 watt Hi-Fi	£11.10.0	27/6	9	24/9

EASILY REACHED BY FREQUENT FAST TRAINS FROM WATERLOO TO SURBITON

SURBITON PARK RADIO LTD.

Phone KIN 5549

48, SURBITON ROAD, KINGSTON-UPON-THAMES, SURREY

- Order for Cash, C.O.D. or Terms
- Hours 9 a.m.-6 p.m. (1 p.m. Wed.)
- Open ALL DAY Saturday
- Established 30 years

STERN-CLYNE

Electronics Centres throughout Great Britain

NEW LOW PRICES — NOW YOU CAN AFFORD A CAR RADIO

THE 'HIGHWAYMAN' OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE

Look at these features:
★ Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valves types EBF83 and ECH83. ★ No Buzz, high output and sensitivity. ★ Printed circuit (latest type). 7 x 4in. high flux p.m. speaker and baffle. ★ Medium and Long Waves. ★ Push button for fingertip control. ★ Extremely low battery consumption (less than ½-amp). ★ Easy to fit any make car (Positive earth only). ★ 12-volt operation. ★ Compact size, measures only 7 x 7 x 2in. deep. ★ Easy assembly, supplied with dial and drive already mounted.

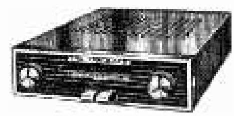
Special inclusive price of ONLY **£7.19.6** Plus 5 P. & P.

All parts available separately. Individually priced parts list and comprehensive instruction booklet 2/6 post free. (Deducted from cost if complete parcel purchased later.)

THE "TRAVLER" MkII

Introducing our new ready-built transistorised car radio for ONLY

9½ Gns. P. & P. 5/-.



including 7" x 4" speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions.

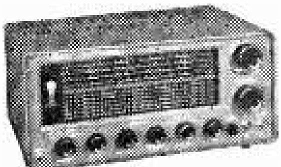
H.P. Terms: Dep. £2.19.6
and 7 monthly payments of £1.2.6. (Plus 5/- P. & P.)

Star Features ★ Handsomely Styled. ★ Mullard Valves and Transistors. ★ Push Buttons. ★ 1½ watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.) ★ Easily Fitted. ★ Radio Luxembourg (and many other foreign stations) 12 volt Positive Earth Only (applies to 99.8% of the cars on the road). ★ Dimensions 7 x 2 x 7" depth.

Optional extras. 3 section chromium plated weatherproof telescopic aerials type 1 17"/44". 19/6; type 2, 2"/43", 29/6, both plus P. & P. 2/6 if purchased separately.

THE WORLD AT YOUR FINGERTIPS!!

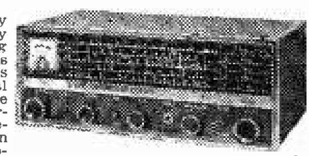
THE HE-30 4-BAND COMMUNICATION RECEIVER



One of the finest general coverage bandspread Receivers available at this price. Covering 550Kc/s—1600Kc/s. 4.8Mc/s—14.5Mc/s. 1.6Mc/s—4.8Mc/s. 10.5Mc/s—30Mc/s. Illuminated slide rule dial, calibrated every 5Kc/s on 80 and 40 metres. Edgewise S-meter, 0-100 logging scale, coverage from 0.55—30Mc/s. 8 valve plus Recifier superhet circuits. RF stage with an Aerial Trimmer. 2 IF Stages. B.F.O. control Q-multiplier. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier) Frequency (BFO). Band Selector. IF Gain. Trimmer. AVC-MVC Switch. Anl Switch. Main Tuning. Bandspread Tuning and Headphone Jack. Selectivity—60dB at 10Kc/s. 0.8Kc/s at 6dB (with Q-multiplier) IF-455Kc/s. External PM Speaker reqd., 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. Size 15 x 10 x 7½in. Grey crackle finish. 220/240 volt A.C. mains. 50-60 cycle operation. Full instructions and circuit diagram supplied. Send S.A.E. for leaflet.

PRICE **40 Gns.** Carriage Paid

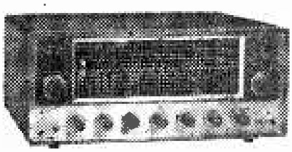
THE HE-40 4-BAND COMMUNICATION RECEIVER



Completely built and ready to go. High sensitivity Superhet receiver covering 550Kc/s—1,500 Kc/s. 1.6 Mc/s—4.4 Mc/s. 4.4 Mc/s—11 Mc/s 11 Mc/s—30 Mc/s. Electrical Bandspread tuning. Slide rule type tuning dial. Internal ferrite rod aerial for medium waveband reception and 1 59in. 10 section chromium plated telescopic whip aerial for the short wave bands Sockets for optional outdoor aerial, internal high flux monitor loudspeaker. Latest modern miniature B7G base valves. Headphone socket (may also be used for external loudspeaker), ANL, BFO, built-in "S" meter. 220/240 volt A.C. mains, 50-60 cycle operation. Handsomely styled cabinet with grey crackle finish and handsome front panel, with chrome and satin chrome fittings. Measures 13½in. x 8½in. x 5½in. (high) and weighs only 11½ lbs. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and short wave listeners of all ages. Send S.A.E. for leaflet.

PRICE **£24.15.0** Carriage Paid

THE NEW HE-80 COMMUNICATION RECEIVER

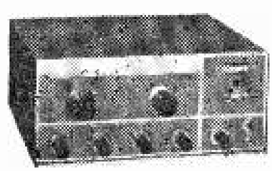


The HE-80 has outstanding sensitivity 0-100 logging scale for instant re-set, built-in "S" meter special recording Jack, remote Control Socket allowing simultaneous control with transmitter, 100K/c crystal oscillator circuit providing accurate harmonic signals of either 4 or 8, ohms impedance. Two headphone sockets, one high, one low.

TECHNICAL SPECIFICATIONS.
Frequency Coverage: Band 1 540—1605Kc; Band 2 1.6—4.8Kc; Band 3 4.8—14.5Mc; Band 4 10.5—30Mc; Band 5 144—146Mc/s. **Band Spread (Ham Band directly read):** 80 Metre Band; 40 Metre Band; 20 Metre Band; 15 Metre Band; 10 Metre Band. **Sensitivity:** 1 micro-volt for 10dB signal to noise ratio. **Selectivity:** Normal 10Kc at —75dB, 1.25 at—6dB. With Q-multi: variable to 700 c.p.s. at 6dB. **Operation:** AM. SSB. CW and FM. AM diode detector. SSB/CW product detector (BFO), FM gated beam detector. **Power Source:** 240 volts 50/60 Cycles A.C. **Power Consumption:** 60 watts. **Audio Output:** 1.5 watts. 8 or 500 ohms impedance. **Auxiliary Circuit:** Electrical Bandspread. Q-Multiplier. ANL. AVC-MVC, BFO. 100Kc crystal calibrator. **Valve Line-up:** 4—6AQ8. 6BL8. 3—6BA6. 2—6BE6. 6AL5. 6AQ5. OA2, 6CA4. **Dimensions:** 17in. wide, 6½in. high. 10in. deep.

PRICE **59 Gns.** Carriage Paid

"STARFLITE TRANSMITTER"



Designed to meet the needs of most amateurs the Starflite has single-knob bandswitching, front panel switch to select any of five crystal positions with provision for an external VFO. Controlled carrier modulator permits almost 100% of the CW input to be used on AM peaks. Grid-block keying provides chirp-free operation. A full wave silicon diode power supply effects extremely low output ripple for cleaner CW transmission, electron-coupled Pierce Oscillator, capacitance bridge neutralization of the final and a three-stage lowpass filter. An illuminated edgewise D'Arsonval panel meter. Pi-network output provides the correct impedance match between the plate circuit and any 50-72 ohm co-axial feeder. Easy to follow point-to-point instructions supplied with each set of components. When constructed the Unit is housed in a heavy gauge steel Cabinet finished in grey crackle.

SPECIFICATIONS: Power Input—90 watts peak; Operation: C.W., AM Phone—crystals or VFO Control; Band coverage: 80-10 metres; Coupling: Pi-network; Valve Line-up: 6146. (2) 6CL6. 12AX7, 6DE7. Low Pass Filter. Size 13½in. wide x 12in. deep (inc. knobs) x 6½in. high (inc. rubber feet). Weight 28 lbs. Power Requirements, 200/240 v. 50-60 CPS. 225 watts.

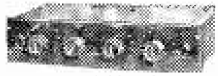
MAY BE BUILT FOR **35 Gns.** Carriage & Insurance 15/-

SEE FOLLOWING PAGES FOR ADDRESSES AND OTHER ITEMS ▶

STERN-CLYNE

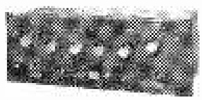
Electronics Centres throughout Great Britain

MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT



Employing two EF86 valves and designed to operate with the Mullard AMPLIFIERS but also perfectly suitable for other makes with input up to 250 m/V.
★ Equalisation for the latest R.I.A.A. characteristics. ★ Inputs for Crystal Pickups and variable reluctance magnetic types. ★ Input (a) Direct from High imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier. ★ Sensitive Microphone Channel. ★ Wide range BASS and TREBLE Controls.
KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£9.10.0** (Carr. & Ins. 5/-).
Instruction book and detailed price list (free with kits) available separately at 2/- Post Free.

MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT



Designed mainly for Mullard Range of Amplifiers, also suitable for any Amplifiers requiring input up to 250mV. incorporates 5 input Channels, including for Tape and Magnetic Pickups. Separate Bass and Treble controls. High pass filter 20 to 160 c/s. low pass filter 5-9 Kc/s. Totally enclosed in case Size 11¼ x 4¼ x 4¼.
KIT OF PARTS **£10.0.0** (Carr. & Ins. 5/-). ASSEMBLED & TESTED **£13.13.0**
Instruction book and detailed price list (free with kit) available separately at 3/6 Post Free.

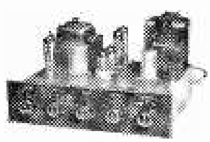
MULLARD "5-10" MAIN AMPLIFIER

For use with MULLARD 2 or 3 valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS and MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer.
COMPLETE KIT (Parmeko Output Trans.) **£10.0.0**
ASSEMBLED AND TESTED **£13.13.0**
(Carr. & Ins. 6/6).
ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.
Instruction book and detailed price list (free with kit) available separately at 2/- Post Free.

COMBINED PRICE REDUCTION

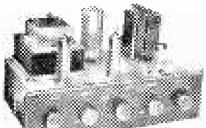
MULLARD 5-10 Main amplifier and 2 valve Pre-Amp. Kit £15.15.0. C. & I. 8/6. Built and tested, £21.10.0. C. & I. 10/-.
MULLARD 5-10 Main Amplifier and 3 valve Pre-Amp. Kit £19.10.0. C. & I. 8/6. Built and tested, £25.10.0. C. & I. 10/-. With Partridge Transformer £1.6.0 extra.

THE MULLARD 5-10RC AMPLIFIER



The popular complete "5-10" incorporating Passive Control Unit providing up to 10 watts high quality reproduction with input of 600mV. Specified components and new MULLARD VALVES. Includes PARTRIDGE MAINS TRANSFORMERS and choice of PARMEKO or PARTRIDGE Output Transformers. Surplus power available for Tuner
COMPLETE KIT **£12.0.0**
ASSEMBLED AND TESTED **£16.0.0** (Carr. & Ins. 7/6). With PARTRIDGE OUTPUT TRANS. £1.6.0. ex.
Instruction book and detailed price list (free with kit) available separately at 2/- Post Free.

THE MULLARD 3-3RC



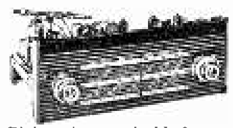
A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN.
KIT OF PARTS **£8.8.0**
ASSEMBLED AND TESTED **£11.10.0** (Carr. & Ins. 6/6).
Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available. Please state L.S. impedance.
Instruction book and detailed price list (free with kit) available separately at 2/- Post Free.

THE "MONO-GRAM"

A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls. PARTRIDGE output Transformer producing up to 3 watts undistorted output. (Carr. & Ins. 3/6).
Kit of Parts **£4.10.0** Assembled and Tested **£6.0.0**
Instruction book and detailed price list (free with kit) available separately at 2/6 Post Free.

SEE PRECEDING PAGE FOR OTHER STERN-CLYNE PRODUCTS

CHASSIS BARGAIN

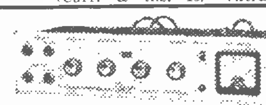


A 6 valve Superhet Radiogram Chassis of outstanding quality covering MW 200/550 Metres. LW 1,200-2,000 Metres. VHF 87-100Mc/s.
Incorporating internal Ferrite Rod Aerial and the famous Gorler Tuning Heart for VHF. Pick-up input suitable for most modern Record Players. Power output 4 watts, valve line up E180, EABC80, EF86, ECH71, EL84, ECC85. Volume On/Off and Tone Control, attractive black Tuning Dial size 15" x 6" with gold lettering and contrasting cream and gold knobs. A.C. 200/250 v. Size 15 x 7¾ x 6¼". P. & P. 5/-.
PRICE **16 Gns.** Or £3.9.0 deposit (plus P. & P.) and 9 monthly payments of 32/8.

MODEL CR3/S TAPE RECORDER

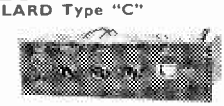
MODEL CR3/S incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin-Track 3-speed Deck operating at 1⅞in., 3¾in. and 7½in. speeds. Complete with microphones and 1,200ft. tape.
KIT OF PARTS **£33.8.0**
ASSEMBLED AND TESTED **£43.0.0**
(Carr. & Ins. 15/- extra).

STEREO TAPE PRE-AMPLIFIED



MODEL STP-1. For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ½ and ¼ track Stereo Decks. Incorporates Ferrox-cube Oscillator, 4-speed Equalisation Signal Lever Meter and separate Gain Control. Includes separate Power Unit. KIT OF PARTS **£22.0.0** (Carr. & Ins. 8/6) ASSEMBLED **£28.0.0**
Instruction book and detailed price list (free with kit) available separately at 5/- Post Free.

TAPE PRE-AMPLIFIER MULLARD Type "C"



Suitable for most ¼ track. Mono Tape Decks. Incorporates Ferrox-cube Push-Pull Oscillator. Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit.
KIT OF PARTS **£14.0.0** (Carr. & Ins. 7/6). ASSEMBLED **£19.10.0**
Instruction book and detailed price list (free with kit) available separately at 3/6 Post Free.

MULLARD TAPE AMPLIFIER MODEL HF/TR3/MK. II

Based on Mullard's Type "A" design and suitable for most ¼ track Mono Tape Decks. Incorporates Ferrox-cube Treble inductor, Gilson Output Transformer, and 3-speed Equalisation. Includes separate Power Unit, using PARTRIDGE Mains Transformer.
KIT OF PARTS **£13.13.0** (Carr. & Ins. 7/6). ASSEMBLED **£19.0.0**
Instruction book and detailed price list (free with kit) available separately at 3/- Post Free.

COMBINATION TAPE UNITS

All our Tape Units can be supplied specially matched to any Tape Deck such as Collaro, Brenell Mk.5 Series II, also the Wearite. Specimen prices as below.

	Kit	Assembled
STP-1 Pre-amp with Collaro Studio Tape Deck......	£36. 0.0	£42. 0.0
Assembled with track switch fitted, **£44.2.0.**		
STP-1 with Brenell Mk. 5 Series II with Track Switch fitted		
STP-1 with Brenell Mk.5 Series II, ¼ Track Deck......	£68. 4.0	£74.15.0
Type "C" Pre-amp with Collaro Studio Tape Deck....	£24.10.0	£30. 0.0
Assembled with deck wired and matched, **£32.2.0.**		
Type "C" Pre-amp with Brenell Mk.5 Series II Deck..	£46.11.0	£53. 1.0
Assembled with deck wired and matched, **£55.3.0.**		
HF TR3 with Collaro Studio Tape Deck....	£24. 3.0	£29.10.0
Assembled with deck wired and matched, **£31.12.0.**		
HF TR3 with Brenell Mk.5 Series II Deck	£46. 4.0	£51.11.0
Assembled with deck wired and matched, **£53.13.0.**		

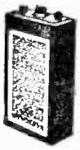
Carr. & Ins. 15/- on above units. Send S.A.E. for comprehensive price list.

SEND FOR CURRENT PRICE LIST OF ALL LEADING RECORDING TAPES AND ACCESSORIES

BELLING & LEE SPARK MASTER

1. Reduces plug burning.
2. Eases starting from cold.
3. Minimises pinking.

2/6 each. P. & P. 6d.



LEAD ACID ACCUMULATORS (Unspillable)

2 volts at 16 A.H. Brand New. Size 4 x 7 x 2in. **4/11** each. 3 for **12/6**. P. & P. 3/- per cell.

STABILISED POWER UNIT

A valuable unit, containing Mains Transformer with optional input 80 volts, 110 volts, and mains standard input voltage at 50 c/s. Output 6.3 volts at 750 m.a., 380 volts, centre tapped 6X5 full wave valve rectifier. Parmeko 15h smoothing choke, 8 mfd smoothing condensers. Plus neon stabiliser valve. The whole assembly being mounted on a compact chassis.

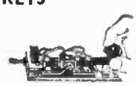
An ideal stabilised supply for the constructor for use in transmitters, model control, Hi-Fi equipment, and test equipment.

Price **49/6** P. & P. 3/6.

With polished sturdy wooden cabinet and mains lead. Price **59/6** P. & P. 5/-.

MORSE KEYS

Morse key assembly. Key with base, cover and terminals. Complete with lead.



6/11 P. & P. 2/-

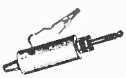
2 Morse Keys for **12/6**. Post free.

HIGH IMPEDANCE PERSONAL LISTENING EARPIECES

Suitable for all types of crystal sets and transistor sets. Complete with plug. Price **4/11** P. & P. 6d.

HI-FI GT50 RADIO JACK

MAKE A RADIO RECEIVER OUT OF YOUR AMPLIFIER. Full medium wave coverage. Ideal for all tape recorders, amplifiers, etc. No batteries required—just plug in. **29/-**.



BUMPER CONSTRUCTION PARCEL

Britain's Biggest Radio Bumper Bundle

One brand new 30 watt soldering iron complete with plug. Heavy duty 100 ma. 10 to 20 H Smoothing Choke. Two TCC Metal Encased Block Condensers size 4½ x 2½ x 1⅞in. value: 8mfd 350 v. working. Three paxolin Tag Strips —14 tags per strip. Six .05 mfd Electrolytic Condensers 350v. working. Six 50mfd 12v. working Bias Condensers. Six 750 pf Ceramic Trimmers. One operator's unit, containing host of valuable components, including Block Condenser, Jack Plug Socket etc. One heavy duty RF choke on stand, suitable for transmitting circuits. Three Brand New B7G Valves. Three Brand New International Octal Valves. Three black bakelite moulded control knobs. Six assorted pots. Three small selenium rectifiers. One pair low resistance phones.

35/- P. & P. 4/6.

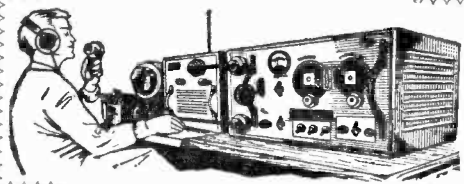
DYNAMOTOR

Run all your mains AC/DC equipment from your car battery. 6v. input gives 250v. output, or 12v. input gives 500v. output at 30 watts. Very low battery drain. Size only 5¼in. x 3¼in. A must for the caravanner. Only **25/-** P. & P. 3/6

NO. 19 SET INSTRUCTION HANDBOOK 3/11 each

1155 INSTRUCTION HANDBOOK 3/11 each P. & P. 3d.

SONA



NO. 19 SET TRANSMITTER RECEIVER

New stocks just arrived. Equipment comprises 3 separate units built into one chassis and separate power pack.

Specification: "A" Set Transmitter/Receiver. Frequency coverage 2-4.5 mc/s and 4.5-8 mc/s. (150-37 meters).

For R.T., C.W., or M.C.W. Range on R.T. 15 miles, C.W. 50 miles. Superhet R.X., I.F. 465 kc/s. B.F.O. etc.

R.X. valve line-up: 6K7, R.F.; 6K8 mixer, 2 6K7 I.F.; 6B8 det. A.F. phone output.

T.X.: 6K8, mixer, B.F.O., EF50 buffer, E834 ADC and output stage, which has to be decommissioned to conform with GPO requirements. Transmitter/Receiver 229/241 mc/s. Local use up to 1 mile. Valve line-up CV5, 6K7 and 6V6. Intercom set 2 valve A.F. amplifier for vehicle crew inter-communication. Valve line-up 6K7 and 6V6.

A 2½in. meter is built in reading L.T. and H.T. voltages, drive etc.

POWER UNIT. 12 volt DC input. Output 275 volts 110 m/a. and 50p volts 50 m/a. Equipment is of American or Canadian manufacture and is supplied in good condition.

PRICE complete with Power Pack Carriage 17/6. **£4.10.0**

19 set only Carriage 10/-. **£3.10.0**

Power Unit only Carriage 10/-. **£1**

Two 19 sets complete with Power Packs. Carriage 30/-. **£8.10.0**

Accessories

Handbook	3/6	P. & P. 6d.
Connectors 12 pin	12/6	P. & P. 2/6
6 pin	7/6	P. & P. 2/6
Control Boxes Single, new	6/6	P. & P. 2/6
Whip Aerials 8ft. 6in.	7/6	P. & P. 2/6
5ft.	4/6	P. & P. 2/6
Aerial Bases (Fits all types)	5/11	P. & P. 2/6
Headphones and Mike	12/6	P. & P. 2/6
Headphones less mike insert	5/-	P. & P. 2/6

TRANSISTOR SALE

Mullard OC44 (P. & P. 3d.)	3/11
Mullard OC45 (P. & P. 3d.)	3/11
Mullard OC71 (P. & P. 3d.)	2/11
Mullard OA90 (P. & P. 3d.)	1/11
Ediswan XD202 Germanium diodes (P. & P. 3d.)	1/11
Mullard OA79 (P. & P. 3d.)	1/11
Transistor holder 3-pin (P. & P. 3d.)	11d. each

MICRO ALLOY TRANSISTORS

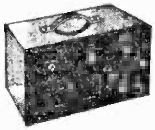
Mat 100	7/9
Mat 101	8/6
Mat 120	7/9
VHF Transistor ADT 140	15/-

Above MATs postage paid.

Ferrite Slab Aerials suitable for transistor sets 3/-. P. & P. 6d.

CRYSTAL CALIBRATOR No.7 MK.I

Using 6 valves, a 1 Mc/s crystal osc. is used to synchronise 2 multivibrator osc. operating at 10 Kc/s and 100 Kc/s respectively. Harmonics of 10-100 and 1,000 Kc/s are available up to 20 Mc/s. far beyond this on any sensitive set, modulator also incorporated for receiving. In small Bakelite case with carrying handle, power 2 v. L.T. 80-120 v. H.T. Circuit and instructions supplied. Brand new. **£2.15.0** P. & P. 5/-.

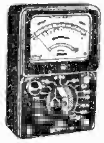


9v. BATTERY CHARGER AND A.C. ELIMINATOR MODEL LA. 6P.

A "must" for every transistor set owner Save those batteries by running your transistor set direct from AC mains this summer. Reactivate all your old PP3 batteries. Unit contains neon indicator and standard battery connections with nearly 2 yards of mains leads and plug. Also snap cord for connection to set.

NOW ONLY **19/6** P. & P. 2/6

SENSITIVE MULTIMETER



20,000 ohm per volt, 1% resistance used throughout. Single control system for all ranges. Compact and lightweight. Highly accurate. **£5.10.0** P. & P. 5/-.

BATTERY CHARGE ADJUSTERS

- Charge Rate Adjuster
- Government manufacture.
- Easily fitted to charging circuit.

3/6 each. 2 for **6/6**. P. & P. 1/- each.

ALTIMETER TRANSMITTER RECEIVER AN PN

Frequency approximately 400 to 700 mc/s.

TRANSMITTER

Containing two 9004 acorn valves and moving coil transducer wobbulator unit.

A.F. AMPLIFIER

Containing two 12SH7 and one 12SJ7 valves. The above chassis are housed in a black crackle case which contains three relays Resistors, Potentiometers, and the following valves: 3-12SH7, 1-12SJ7, 1-VR150/30 and 2-12H6's making a total of 14 valves in all. A Dynamotor Unit is also incorporated.

Ideal for radio control work, etc. Price **55/-** P. & P. 7/6.

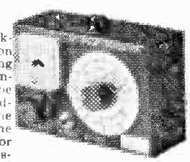
MAINS TRANSFORMERS

Input 0.200-250v. secondary tapped as follows: 3v, 4v, 5v, 6v, 8v, 9v, 10v, 12v, 15v, 18v, 20v, 24v, 30v, at 4 amps. BRAND NEW not government surplus. **35/-**. P. & P. 3/6.

FILAMENT TRANSFORMERS

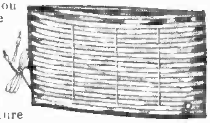
200-250 v. input, 50 c/s. Output 6.3 v. at 2 amps. **6/11**. P. & P. 1/3.

RF FIELD INDICATORS



Designed for checking the radiation from a transmitting antenna. The sensitivity can be controlled by adjustment of the panel control, the antenna length, or by increasing distance from the radiator. Frequency range 1-25 Mc/s. 200mA. DC. Complete with instruction book. Post free. **69/6**

PILLOW SPEAKER



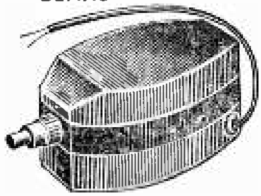
Listen while you laze with the revolutionary pillow speaker—the very latest novelty. An inflatable cushion with a built in miniature loudspeaker which will plug into transistor portables. Ample flex provided with plugs.

P. & P. 2/6. Price **25/-**

SONA

MORE BARGAINS OPPOSITE

THE "INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER



200/250 v. A.C. **35/-** Leaflet S.A.E.

PLASTIC RECORDING TAPE

			Spare Plastic Reels	
Double Play	7in. reel, 2,400ft.	42/-	3in.	1/6
	5in. reel, 1,200ft.	25/-	4in.	2/-
Long Play	7in. reel, 1,800ft.	22/6	5in.	2/-
	5¾in. reel, 1,200ft.	17/6	5¾in.	2/-
	5in. reel, 900ft.	15/6	7in.	2/6
Standard	7in. reel, 1,200ft.	17/6		
	5in. reel, 600ft.	11/6		

"EASISPLICE" Tape Splicer 5/-
Leader tape 4/6; Splicing tape 3/-.

CRYSTAL SET BOOKLET. 1/-.
CRYSTAL DIODE G.E.C. 2/-. GEX34, 3/-. OA81, 3/-.
HIGH RES. PHONES. 4,000 ohms. 15/-. 2,000 ohms 12/6.
MOVING COIL PHONES. 100 ohms. 10/-.
SWITCH CLEANER. Fluid squirt spout, 4/6 tin.

"6 + 1" TRANSISTOR RADIO MEDIUM AND LONG WAVE KIT

First class components to make a 6 transistor 2 waveband superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, *with car aerial coil*, printed circuit. 8½in. x 2¾in., but EXCLUDING Speaker and cabinet.
Speakers, 35 ohms, 7 x 4in., 21/- **£4.5.0**
5in., 17/6; 3½in., 15/6.

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 6/6.
JACKS. English open circuits, 2/6. Closed circuit, 4/3. Grundig type 3-pin, 1/3. Grundig lead jack 3/6.
JACK PLUGS. English, 3/-; Screened, 4/-; Grundig, 3-pin, 3/6; Phono Plugs, 1/-; Sockets, 6d.
ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in., 10d. 0.3in. **FORMERS.** 5937 or 8 cans TV1 or 2, ½in. sq. x 2¼in., or ⅝in. sq. x 1¾in., 2/- with cores.
SLOW MOTION DRIVES. 6:1, 4/3; 36:1, 10/6.
SOLON IRON. 25W, 200V or 230V, 24/-.
ANTEX SUB-MIN. IRON. 15w, 200 or 240v., 29/6.
BENCH STAND for above, 12/6. Spares in Stock.
Paxolin Panels, 10 x 8 x 1/16in., 2/-.
Miniature Contact Cooled Rectifiers, 250V, 60mA, 7/6; 250V, 85mA, 9/6. **Selenium Rect.,** 300V 85mA, 5/-, K3/25, 600V, 5mA, 5/-. RM4, RM5, 14A100, 14A116, 10/- each. FC31, 20/-. **TV etc. Silicon Sub-Min. Rectifiers.** 250V 450mA, 10/-.
Coils Wearite "P" Type, 4/- each.
Osmor Midget "Q" type, adj. dust core, from 4/- each. All ranges. List S.A.E.
Repanco DRR2. L. and Med. T.R.F. with reaction, 4/6. Med. wave D.R., 3/6.
Ferrite Aerials, M., 8/9; M. and L., 12/6.
Osmor Ferrite Rod Aerials, L. and M. for transistor circuits, 10/- each.
Ferrite Rods, 8 x ⅜in., 6 x ⅜in., 6 x 5/16in., 3/-.
H.F. Cokes, 2/6. **Osmor QC1,** 6/9.
T.R.F. Coils, A/HF, 7/- pair; HAX, 3/6.
Screwdriver, 3in., 6d. **Test Prods,** 2/9 ea.
Neoside Trimming Tool, 1/9.
Neon Mains Tester Screwdriver, 5/-.
Multicore Solder, 4d. yd. **Dispenser,** 2/6.

Aluminium Chassis, 18 s.w.g. Plain, undrilled. 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7 x 4in., 4/9; 9 x 7in., 5/9; 11 x 7in., 6/9; 13 x 9in., 8/6; 14 x 11in., 10/6; 15 x 14in., 12/6.
Aluminium Panels, 18 s.w.g., 12 x 12in., 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3; 8 x 6in., 2/-; 6 x 4in., 1/6.

MARTIN TAPE PRE-AMPLIFIERS & DECKS (PLAY-BACK THROUGH YOUR OWN AMPLIFIER)

B.S.R. 2 track Pre-amp.	£8.8.0	B.S.R. TD2 tape deck	£7.5.0
Collaro 2 track Pre-amp.	£8.8.0	Collaro Studio tape deck	£10.15.0

COMPLETE RECORDING & PLAY-BACK AMPLIFIERS

2 track B.S.R. amplifier	£8.8.0	Collaro amplifier	£11.11.0

MAINS DROPPERS. Midget adjustable sliders 0.3A, 1,000 ohms, 6/-; 0.2A, 1,200 ohms, 6/-; 0.15A, 1,500 ohms, 6/-; 0.1A, 2,000 ohms, 6/-.
MIKE TRANSFORMERS. 50-1, 3/9.
P.V.C. Covered Wire. single or stranded, 2d. yd.
Sleeving, 1 or 2 mm., 2d.; 4 mm., 3d.; 6 mm., 5d. yd.
SPEAKER-FRET. Gold, Maroon or Green Cloth 17 x 25in., 5/-; 25 x 35in., 10/-. **Tygan.** various colours 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples 1/-. Expanded Metal. Gold, 12 x 12in., 6/-. **Panel** mounting fuse holder, 2/-. Fuses 1¼in. 60mA-5A, 6d. Insulated side cutters, 3/6. Bib Stripper, 3/6.

RADIO AND TELEVISION SPARES

All leading makes, volume controls, etc., line output transformers, etc., B. V. A. valves (current and obsolete types). Send S.A.E. for quotation.

WEYRAD

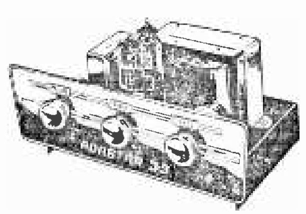
COILS AND TRANSFORMERS FOR 2-WAVE 6-TRANSISTOR PRINTED CIRCUIT AND FERRITE AERIAL

Long and Medium aerial—RA2W 6in. rod 208 pF tuning, with car earial coil,	12/6
Osc. Coil P50/1AC 176 pF tuning	5/4
1st and 2nd I.F. P50/2CC. 470kc/s 11/16in. dia. by ⅞in.	5/7 each
3rd I.F. P50/3CC	6/-
Spare Cores	6d.
Driver Transformer—LFDT4	9/6
Wavechange Slide Switch d'p'd't'	3/6
Printed Circuit—PCA1. Size 2¾ x 8½in. Ready drilled and printed	9/6
Volume Control, 5K-DP	4/6
35 ohm Speakers, 3½in., 15/6; 5in., 17/6; 7 x 4in., 21/-.	
Tuning Gang with trimmers	10/6
6 Mullard Transistors and diode	42/6
Constructor's Booklet	2/-
3 ohm O.P. Trans. O.P.T.1	10/6

NEW MULLARD TRANSISTORS OC71 6/-, OC72 7/6, OC81D 7/6, OC81 7/6, OC44 8/-, OC45 8/-, OC171 10/6, AF117 9/6.
Sub Miniature Condensers. 0.1 mFd. 30v., 1/3. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100 mFd 15 volt, 2/6 ea. Transistor Holders, 1/3

SINCLAIR "SLIMLINE" RADIO Med. wave kit, 2 transistors, 2 diodes, earphone, ferrite aerial, Cabinet 3 x 1¾ x ⅞in. 49/6, batt. 3/6.

ADASTRA 3-3 AMPLIFIER 3 WATTS HIGH FIDELITY AT LOW COST



READY BUILT, WIRED AND TESTED A.C. 200-250V. Valves ECL86 and EZ80. 3 ohms output. Controls: bass boost, treble and volume. Separate front panel with de luxe finish. Quality mains transformer. Enamelled chassis 6in. x 5in. x 3in. Price £4.19.6. Details S.A.E.
"Performs agreeably well" (The Gramophone)

BUILD YOUR OWN RECORD PLAYER
FROM £9.19.6 AND SAVE POUNDS!!

4 Speed Autochange or Single Player units supplied with Brand New 2-tone de luxe Portable Cabinets 17x15x8½in. Strong carrying handle, gilt finish clips and hinges. As used by Famous Make for 20gns. models. Ready cut-out motor board 14x13in. Front baffle with 7 x 4in. high flux loudspeaker and 3 watt 2 valve UY85, UCL82-2-stage amplifier ready built on metal chassis 12 x 3 x 2½in. Quality 3 ohm output transformer, low hum level circuit. Volume and Tone controls. 3-core safety mains lead. All items fit together perfectly. Special instructions enable assembly in 30 minutes, only 5 wires to join! 12-month written guarantee. Available separately or package deals as below.

AUTOCHANGER KITS COMPLETE (as above)

B.S.R. Monarch	£11.10.0	P.P. 5/6
Garrard Autoslim	£12.18.0	P.P. 5/6

SINGLE PLAYER KITS. Complete (as above)

E.M.I. Junior	£9.19.6	P.P. 5/6
Garrard SRP 10 Auto stop/start	£11.5.0	P.P. 5/6

OR SEPARATELY

Cabinet with board 14 x 13in. cut out to your choice	£3.9.6	P.P. 3/6
Amplifier with 7 x 4in. speaker	£3.17.6	P.P. 2/6
AUTOCHANGERS		
B.S.R. UA14	£5.19.6	P.P. 4/6
B.S.R. UA15 Slimline	£6.17.6	P.P. 4/6
Garrard Autoslim	£6.17.6	P.P. 4/6
SINGLE PLAYERS		
Garrard SRP10	£5.5.0	P.P. 4/6
E.M.I. auto stop/start	£5 5.0	P.P. 4/6
E.M.I. Junior	£3.7.6	P.P. 3/6
TRANSCRIPTION UNITS		
Garrard 4HF	£15.15.0	P.P. 5/-
Philips AG1016	£12.5.0	P.P. 5/-
Garrard AT6	£10.10.0	P.P. 5/-
BARGAIN		
B.S.R. Autochange UA12 Stereo/Mono	£7.10.0	P.P. 4/6

Replacement sapphire styli 5/-, diamond 15/-. Mono GP59 Xtals 15/-; Stereo Rennette 30/-.

BARGAIN SINGLE PLAYER KIT 200/250 v. A.C. (less cabinet)
£5.15.0 Post 5/-.
With 2-stage Amplifier; 3 watt; 2 valves, UCL82, UY85; High-flux 5in. speaker; 4-speed E.M.I. Turntable, 16, 33, 45, 78 r.p.m., Crystal Pick-up for LP/STD. Records, 7in., 10in., 12in.; Cut out Mounting boards 12½ x 9¾in.

ARDENTE TRANSISTOR TRANSFORMERS

D3085, 7.3 CT:1 Push-Pull to 3 ohms for OC72,	11/-
D3084, 1.74:1 C.T. Push-Pull Driver for OC72,	11/-
D3058, 11.5:1 Output to 3 ohms for OC72, etc.,	11/-
D167, 18.2:1 Output to 3 ohms for OC72, etc.,	12/-
D239, 4.5:1 Driver, ⅞in. x ⅝in. x ⅝in.	11/6
D240, 8.5:1 Driver, ⅞in. x ⅝in. x ⅝in.	11/6

ARDENTE TRANSISTOR VOLUME CONTROLS VC1545, 5K with switch dia. .9in. 5/3
DEAF AID EARPIECE. Xtal or magnetic 7/6
SUB-MIN. JACK AND PLUG 2.5 or 3.5 mm. 3/6 pair.

MINIATURE PANEL METERS

Size 1¾in. sq. Precision jewelled bearings, 2% accuracy, silvered dials, black numerals and fine pointers, zero adjustment screw on front of meter.

0-1 mA	27/6	0-50µA	39/6
0-5 mA	27/6	0-500µA	32/6
0-300V	27/6	"S" Meter	35/-

MOVING COIL MULTIMETER TK20a 0-1000 v. A.C./D.C., ohms 0-100k, etc., 49/6. 0-150 ma. 2in. scale

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Practical Wireless

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Contents

The Role of Broadcasting

THE recent events subsequent to the appearance of those electronic buccaneers Radio Caroline and Radio Atlanta have raised many interesting points. At the time of writing, the situation is still unresolved, although the fate of these floating "discophoriums" seems sealed by way of restrictive legislation. However, we do not intend to enter into the rights and wrongs of the affair. but to follow certain trains of thought.

Casting aside. therefore. any legal, moral or cultural considerations, it becomes manifestly clear that there exists a quite considerable public for the type of wares dispensed by Caroline and her sister craft. If there was ever any doubt, confirmation came by way of the extraordinary announcement from the BBC that their Saturday afternoon sports broadcasts on the Light Programme would be replaced by Caroline-type continuous pop music. Coming at the height of the controversy this was not only an admission of the drawing power of such broadcasts but even gave the impression of a panic measure.

Having established the existence of the demand for continuous pop music (though how any devotee can listen to more than one station at once is baffling, for we already have Radio Luxembourg and others) let us go a stage further.

On a recent TV interview, a spokesman for Radio Caroline talked of a great and general requirement for continuous background music with the minimum of interruption. His point (which is shared by others) was that TV is the medium for those wishing to sit and concentrate, whereas radio should be relegated more and more to providing only a non-stop supply of music which can be turned on and off like a tap.

So now we come to the fundamental issue: should this be the ultimate role of broadcasting?

The fact that pop music is cited is irrelevant; it could as well be any kind of music—indeed, so far as some are concerned, even perhaps traffic noises or sound effects! The need, apparently, is to soak continually in sound like blotting paper.

Transistor radios, due to their advantage of portability, have unfortunately contributed something to this morbid craving for background music, or noise. It is common enough to hear them being played loudly while the "audience" virtually ignores its efforts to entertain. We see the same thing in other places where somebody will feed a juke box with coins, only to become completely oblivious (perhaps wisely) to the less-than-hi-fi being pounded out, except in attempting to converse above the level of disorted watts. We also see it in the vogue for piped music at railway stations, in restaurants, clubs, pubs, lifts, etc. We shudder to think where it might be encountered next!

This pathological craving for noise for the sake of noise is a symptom of modern living and as such is the province of the psychiatrist, the neurologist and the sociologist. What we are concerned about is this tendency to regard sound broadcasting as a kind of super piped background music. Surely this is *not* the role of broadcasting?

Our next issue dated August will be published on July 7th

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

R.N. Radio Amateurs Donate Receiver

TWO serving members of the Royal Navy Amateur Radio Society recently made a call at the home, in Crewe, of 18-years-old John Hall who was paralysed as a result of an accident while serving in the Royal Navy. The visit was made in response to an appeal for help after another radio amateur had informed the R.N.A.R.S. of John Hall's interest in wireless, and so on April 18th, G3SJQ and G3JFF (Sub-Lieutenant David Davies and Chief Radio Supervisor Michael Matthews respectively) arrived at his home with a radio receiver which local hams had volunteered to modify for his use.

With this receiver and the help of other radio amateurs in the area, John Hall is now well on the way to achieving his ambition of obtaining an amateur transmitting licence.

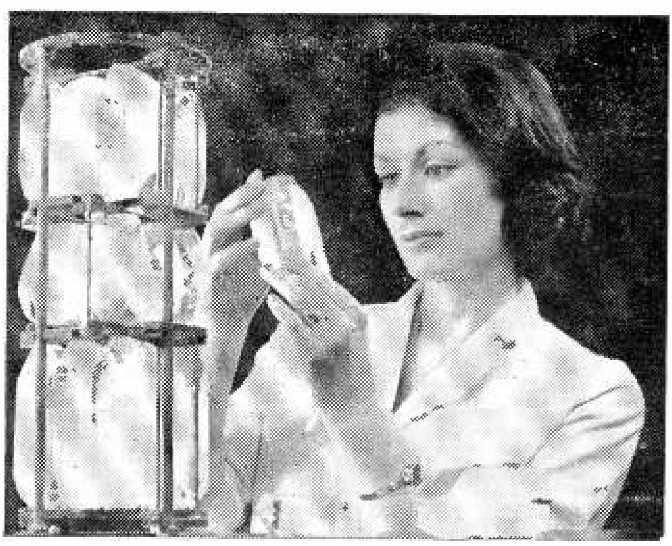
EUROPE'S FIRST QUARTZ GROWING PLANT

THE first commercial quartz-growing plant in Europe has been established by Standard Telephones and Cables Limited at their recently opened quartz crystal factory at Harlow, Essex.

Using specially designed pressure vessels and control equipment, STC technicians have perfected a process which permits the growth in less than a month, of large pieces of radio quality quartz, suitable for use in the frequency control units used extensively in broadcast transmitters, telephone and communications equipment. Against this the world's deposits of natural quartz took over 3,000,000 years to form.

Whereas natural quartz stones are very irregular in shape and carry unwanted minerals and other inclusions, these man-made quartz crystals are geometrically shaped and virtually free of defects This new process also presents economical advantages, as natural quartz of suitable grade (which is obtained entirely from Brazil) is expensive and the large pieces necessary for manufacture into frequency control devices are rare.

The growing process of the cultured quartz takes place inside 10ft. high, 12in. diameter steel cylinders at pressures of about 24,000lb./sq. in. and at about 400°C. Small, easily obtainable quartz chips are dissolved in caustic soda under these conditions and the quartz re-appears as a steady growth on special "seed" crystals placed in the upper part of the cylinder. Crystals grow to the required size—about 1lb.—in 21 to 24 days.



The quartz crystals shown in this illustration were grown in three weeks at STC's factory at Harlow.

NEW TELEPHONE CABLE FOR S.E. ASIA

THE first stage of the South-East Asia Commonwealth submarine telephone cable system (SEACOM) is to be laid in the China Sea during the next six months. Three cableships will lay some 2,000 nautical miles of cable linking Hong Kong, Jesselton (Sabah) and Singapore—operations which must be completed before the monsoon season starts in November. After extensive testing, the link will be opened for public service about the beginning of February next year.

SEACOM will introduce greatly improved communications both with and throughout the area, and a second stage in its development will complete the system to Australia. This will join Singapore and Hong Kong to COMPAC and CANTAT.

Like COMPAC and CANTAT, this latest submarine cable will have a capacity of 80 telephone channels, with stable circuits for all types of telecommunications.

ADEN GETS NEW WIRELESS RECEIVING STATION

NEARING completion at Salt Pans in Aden is a wireless receiving station being built by Cable and Wireless (Mid East) Ltd. as a sister station to the Company's existing transmitting station there. Between them, the two stations will provide a number of wireless services linking London with cities in various parts of the Middle East, Africa and India. These services will include public telegraph, leased circuits, telex and radio telephony. In addition, the pair will serve as a radio relay station on the London/Singapore, Hong Kong, Australia and Japan routes.

Radio Safety Device for Swimmers

ENGINEERS in the U.S.S.R. have announced a "hydro-acoustic" device which will automatically send out radio distress signals should any mishap occur to a swimmer carrying it.

The device consists of a miniature transmitter—which can be installed in a special pocket in a bathing cap—and a receiver on the shore. Should the swimmer stay under water longer than a minute, the transmitter will automatically send out distress signals, to be picked up on shore by the receiver, which will then give out light and sound alarms.

The transmitter itself consists of a sensor, a time relay, and a piezoceramic generator of ultrasonic waves and works with an accumulator.

New Branch of "Talking Book" Library

ON Friday, 1st May, Lord Fraser of Lonsdale, C.H., C.B.E., Vice-President of the Royal National Institute for the Blind and Chairman of St. Dunstan's, opened at Punch Street, Bolton, Lancashire, the Northern Branch of the Nuffield Talking Book Library for the Blind.

The new premises at Punch Street have been established to provide a localised library for the blind men and women of Scotland and the North of England because, as a result of recent technical advancements which have enabled the Library to accept a greatly increased membership, it has become impossible for the original premises in Middlesex to cope for the whole country.

These technical advancements refer to the Library's tape machines which in 1959 replaced the existing stock of disc recordings of literary works, which was necessarily limited in capacity. The present system, utilising a half-inch tape carrying no fewer than eighteen tracks, provides some twenty-one hours of reading time in one cassette.

The continued existence of the Talking Books Library—an entirely British innovation—is made possible to a large extent by the network of volunteers throughout the country who help to install and service Talking Book machines.

The rapid expansion of the Library membership now increases the need for these servicing volunteers and Mr. D. Finlay-Maxwell, Honorary Organiser of Servicing Volunteers, would be glad to hear from suitably qualified people within the Bolton Branch service area who would be prepared to help in this vital and rewarding work. Potential volunteers should write to him care of J. Gladstone and Co. Ltd., Wellington Mills, Huddersfield, Yorkshire.

Safety Plan to Protect Consumers

ON the eve of the Annual Conference (April 26th—29th) of the Radio and Television Retailer's Association and the Electrical Appliance Association, the President of the two Associations, Mr. A. R. Mitchell, explained a new "Safe Shopping" plan for the public, which was launched at this year's Conference.

The aim of the plan, as outlined by Mr. Mitchell, is to help protect the public from the increasing number of "apparently 'free' offers, switchselling, excessive interest charges, 'vanishing salesmen' and other devices" appearing in the domestic electrical retail market.

Under the plan, members of the public shopping at EAA shops will receive a registration card with their purchases of major electrical appliances and on return of this card to the Association they will be enrolled on a new Consumer Register. The card will then be returned to them with the serial number under which they have been enrolled. They can then write to the Association with any enquiries they may have; for advice or to complain — either about a product bought, or about service received, or about costs or either or both. Subsequently each enquiry will be investigated, the appropriate ones going before special committees which will then deal with them.

TRANSISTOR 25 Watt P.A. AMPLIFIER

BY A. J. SHORT

THERE are many occasions when an audio amplifier is required at places remote from an a.c. mains supply. To address crowds on sporting and gala occasions, for the modulation of mobile transmitters, and to control and inform the public at outdoor meetings, or for street advertising—these are but a few of the possible applications. A portable amplifier for use with electric guitars, now popular in dance bands, may be a further requirement.

It is, of course, practicable to operate a valve amplifier from a rotary or vibratory convertor. This system has the disadvantage, however, of being electrically inefficient, and large accumulators are necessary to provide the power for a relatively modest signal output. Methods of increasing the electrical efficiency of various systems, introduce—in their turn—further complications.

Advantages of Transistors

A transistor amplifier offers a very attractive answer to the problem. Firstly, a high degree of electrical efficiency can be obtained. Secondly, with no warm-up time involved, the unit need only be switched on for the actual occasions when it is required. Thirdly, the unit is much smaller and lighter than an equivalent valve amplifier. Fourthly, with no fragile valves included, the unit can be made more robust and less liable to damage than a valve amplifier. Fifthly, transistors can be expected to have an appreciably longer life than valves when worked under comparable conditions.

Design Requirements

It was decided that a useful level of power output for a simple, home constructed, transistor p.a. amplifier would be a nominal 25W peak audio. This permits the use of a pair of a wide selection of power transistors now offered by the manufacturers. Costs involved at this level are not excessive, and the remaining materials required can be readily obtained. If higher power levels are required more power transistors will be needed to drive the output stage and the cost of the amplifier increases sharply.

Concerning frequency range, it was decided that a nominal 200c/s to 7,000c/s, would be required. This has been achieved with reasonable linearity in the design. Some modest falling off of gain occurs at each end of this range, but the quality of reproduction under p.a. conditions is good.

The power supply requirements of an audio amplifier can be considerably reduced if the output stage is operated in Class B, as is now standard practice in transistor technique. A further advantage of using this mode of operation is that it cuts down the heat dissipation of the output transistors and reduces cooling problems.

In the prototype model of this amplifier it was considered unlikely that the amplifier would be actually producing its 25W for more than a few moments at a time, and the cooling was reduced further to accommodate this factor. Should it be thought that the amplifier might be operated at maximum output for appreciable periods, the cooling of the power transistors should be improved accordingly. This can be achieved by mounting the transistors on heavy copper, rather than aluminium, increasing the area of contact between the copper and the casing of the amplifier, and increasing the thickness and size of the amplifier instrument case. As the amplifier case is being used as heat "sink" or radiator, care must be taken to see that it is always used in a well ventilated situation.

The Circuit

The circuit consists of four stages: a.f. amplifier, phase splitter, push-pull driver, and output stage. For simplicity and economy the phase splitter, and push-pull driver stages are directly coupled. The output stage drives the loudspeakers via the autotransformer.

The a.f. amplifier Tr1 is a high gain stage employing an NKT223 audio transistor in Class "A", working at about 1mA. The circuit is completely orthodox and is fully temperature stable. The stage should be fed in a manner appropriate to the type of signal source employed.

In the circuit diagram shown, the appropriate components to suit the output from a crystal pickup or crystal microphone are given. It will be found advisable to keep the resistance of the volume control VR1 low to help to keep input noises at a low level, particularly when the amplifier is used in a situation having low ambient background noise.

The Second Stage

The second stage transistor Tr2 accepts the large output signal from the a.f. amplifier and, by means of a split load in collector and emitter circuits, produces two phase-opposed signals to be applied to the driver stage.

Of the available 8-9V h.t. rail, two volts appear across each of the two load resistors R10 and R11, and 4V across the transistor. This permits a maximum theoretical peak-to-peak signal of 4V to be applied to the two halves of the following stage. The large bias, of just over 2V, applied to the base of this transistor is in accordance with the high emitter voltage.

As part of the load is in the emitter circuit of this stage, a large signal voltage excursion occurs on the base of Tr2. The collector current and collector resistor of the first stage are so selected as to make available this large voltage swing (±2V).

The Third Stage

The third or driver stage consists of two transistors Tr3. Tr4 working in Class A push-pull to provide drive for the output stage. These two transistors are directly coupled to emitter and collector of the preceding phase-splitter, and the steady voltages on these points provide the bias for the driver stage.

Decoupled emitter resistors adjust the standing current in these transistors to about 25mA each, and the collectors are partially starved of h.t. voltage to keep the collector dissipation below the rated maximum for these components. The collectors of these transistors are connected to separate primaries of the driver transformer T1, wound so that the d.c. flux of the collector currents tends to cancel out. The a.c. fields, however, being in push-pull, are additive and are applied to the transformer secondary. The d.c. flux from the bias currents in the secondary is balanced out in the same way as in the primary.

The transistors in this stage should preferably be a matched pair.

The Output Stage

The output stage consists of a pair of matched power transistors, Tr5, Tr6, in Class B push-pull, and these are coupled to the loudspeakers via an auto-transformer T2. An auto-transformer is used here because of the simplicity of construction of this component. The power transistors are cooled

COMPONENTS LIST

Resistors:

R1	1MΩ	R11	1·5kΩ
R2	33kΩ	R12	470Ω, ½W
R3	4·7kΩ	R13	10Ω
R4	4·7kΩ	R14	100Ω
R5	1kΩ	R15	220Ω
R6	39kΩ	R16	1·5kΩ
R7	100kΩ	R17	20Ω, ½W
R8	18kΩ	R18	100Ω
R9	1MΩ	R19	820Ω
R10	1·5kΩ	R20	820Ω

All ±10%, ¼W except where otherwise stated.
VR1 50kΩ carbon potentiometer.

Capacitors:

C1 22pF silver mica
C2 100μF electrolytic 12V
C3 100μF electrolytic 12V
C4 100μF electrolytic 12V
C5 100μF electrolytic 12V
C6 100μF electrolytic 12V
C7 47pF silver mica 2%
C8 1,000μF electrolytic 12V
C9 100μF electrolytic 12V
C10 100μF electrolytic 12V
C11 100μF electrolytic 12V

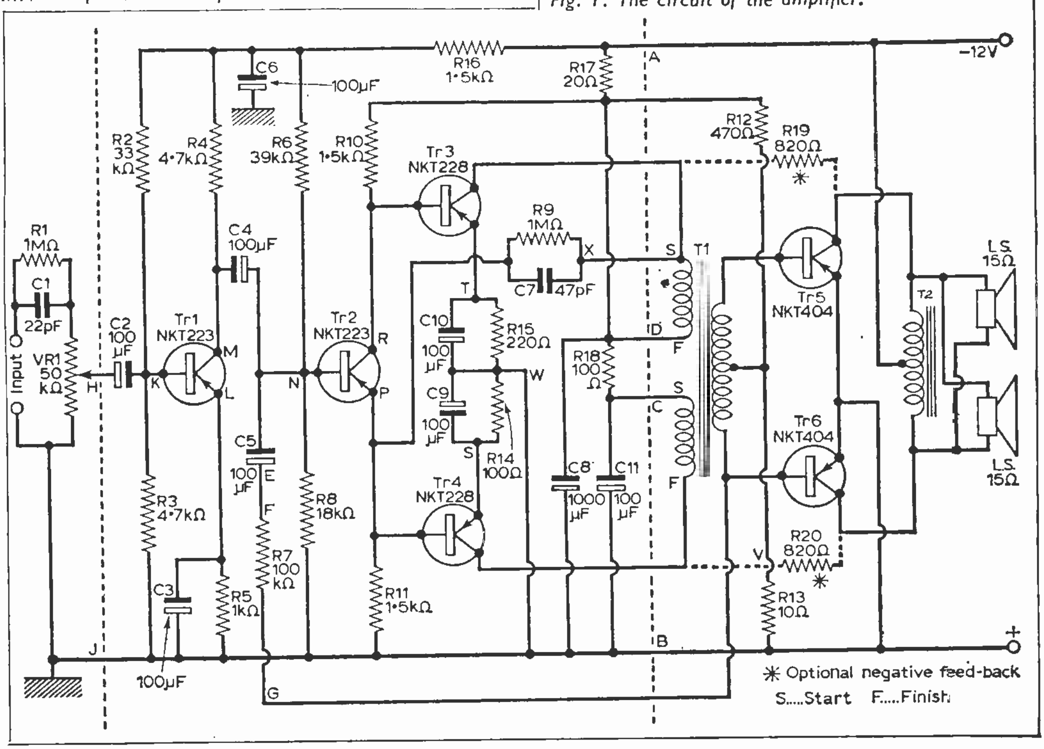
Transformers:

T1 Driver transformer (see text)
T2 Output transformer (see text)

Transistors:

Tr1 NKT223, Tr2 NKT223, Tr3 NKT228, Tr4 NKT228, Tr5 NKT404, Tr6 NKT404

Fig. 1: The circuit of the amplifier.



by a thick $\frac{1}{8}$in. aluminium plate on which they are mounted, which is, in turn, bolted directly to the metal case holding the amplifier. The case then serves to cool the transistors. Mica washers and silicone grease between the cooling plate and the body of the transistor serve to provide electrical insulation while maintaining thermal conductivity. The mica washers and insulating bushes for the transistor mounting bolts are provided by the transistor manufacturers.

In the prototype it was found convenient to mount the output transformer a short distance from the amplifier. When this is done, care must be taken to ensure that the connecting leads are thick and of low resistance, as currents of about 3A flow during peak signals.

When the output transformer is mounted in the same case as the amplifier the cores of the driver and output transformers should be kept at right angles to one another.

Construction

The first three stages are best constructed on a "home-made" printed circuit board, the full size layout of which is given in Fig. 2.

The copper coated laminate may be obtained from one of a number of advertisers in this magazine, and is cut to size with a fine hacksaw blade. The copper should then be brought to a bright shining finish by scouring with "Vim" or other detergent scourer, and well dried.

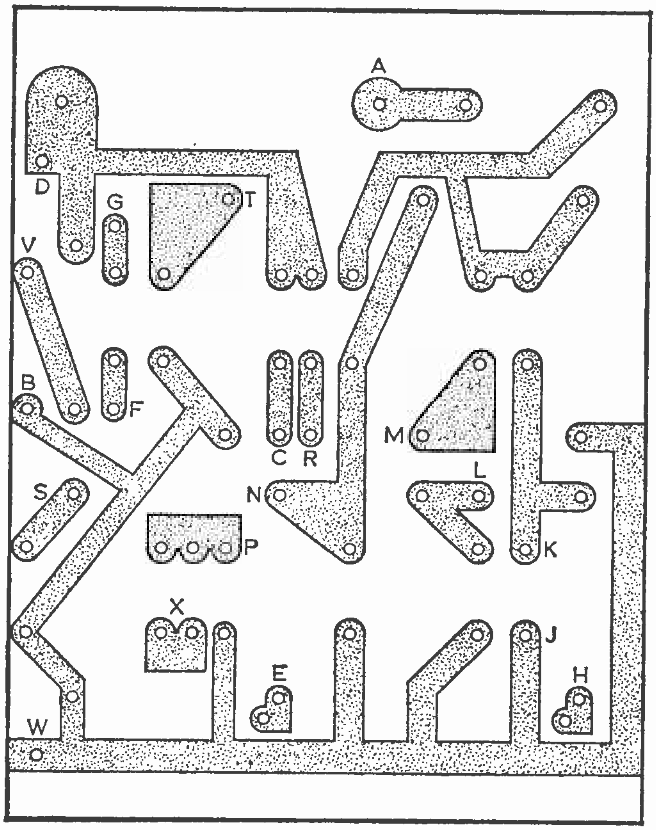


Fig. 2 (above): This illustration of the printed circuit is drawn full-scale and may be used as a template.

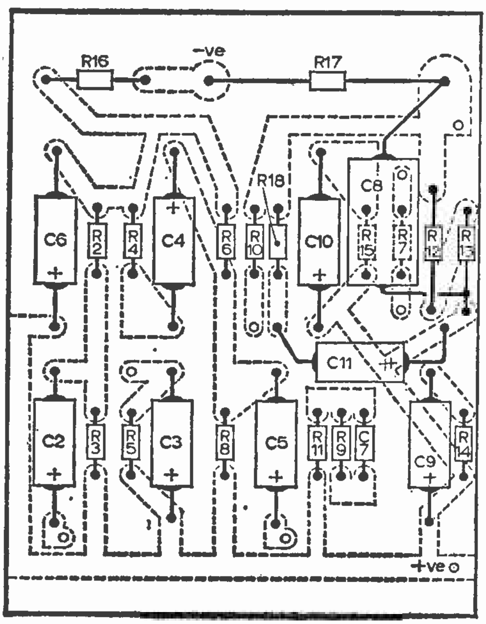


Fig. 3 (left): The layout of components.

A stencil of the printed circuit diagram should be made by cutting out and sticking Fig. 2, or a tracing thereof, to an ordinary postcard and cutting out the black portions with a sharp bladed penknife. The extracted pieces should be kept on one side to later locate the drilling holes.

The circuit diagram is then transferred to the copper laminate by drawing with a pencil through the cut-out portions of the stencil onto the copper. Once this has been done and checked, the printed circuit diagram on the copper can be filled in with a dark varnish stain, or dark french polish applied with an artist's brush. The identifying letters may also be marked in varnish if desired.

The varnish will now protect the covered copper from the etching solution to be used. The unprotected portions are to be dissolved away, so care must be taken to avoid greasy finger marks or varnish splashes on these parts.

The Etching Process

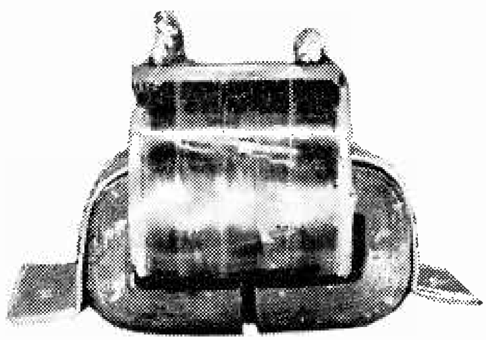
The etching solution consists of 4oz. ferric chloride, 1oz hydrochloric acid, 6oz. water, this solution can be made up by the local chemist.

A sufficient quantity of this solution should be poured in to a non-metallic container and the laminate floated, face down, on its surface. The rate of etching varies largely with temparature and may take 15 to 30 minutes or more. As soon as all trace of the unwanted copper has disappeared, the board should be well washed in running water to remove all traces of the etching solution.

When dry the board is drilled at the points indicated on the printed circuit diagram Fig. 2 and the varnish carefully scraped away with a sharp knife from the points to be soldered.

The components should then be inserted in position, as shown in Fig. 3 and soldered to the copper laminate. All loose ends should then be clipped off, connecting leads inserted and soldered, and the completed printed circuit board mounted in the instrument case by nuts and bolts through the unused ends of the printed circuit board.

Ensure that the underside of the board is well clear of adjacent metal work. The board is now best removed from the case until all assembly and testing has been completed.



The driver transformer ready to be clamped into position.

The Driver Transformer

The driver transformer T1 is quite simple and may be constructed in a few hours. It consists of two primaries of 480 turns each of 28 s.w.g. enamelled copper wire, and a centre-tapped secondary of 160 + 160 turns of 26 s.w.g. enamelled copper wire, wound on a type HWR 10/16/5 English Electric "C" core pair, or equivalent, see Fig. 4.

The required dimensions of the core are: cross-sectional area through centre limb, approximately 0·3 square inch, length of flux path approximately 5in., window area approx $\frac{1}{4}$ square inch as indicated in Fig. 5. A suitable core may be conveniently recovered from an old a.f. or output transformer. The laminations should be thin for minimum losses.

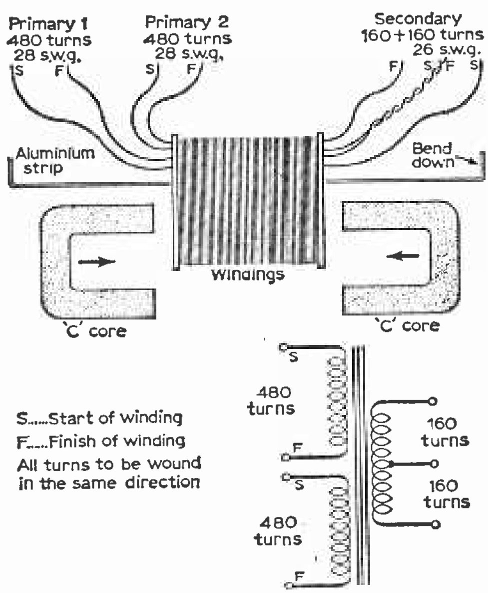


Fig. 4: Winding details for the driver transformer, T1.

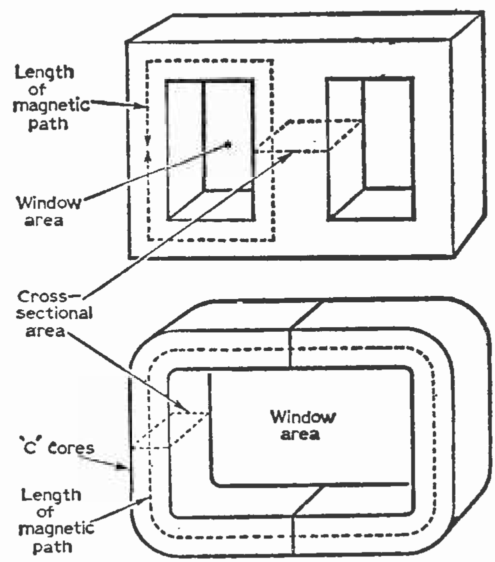


Fig. 5: Critical measurements for the transformer cores.

A cardboard bobbin should be first constructed to fit the core. This should be well dried and shellacked. The two primaries. of 480 turns each, are first wound in even layers, a layer of thin paper between each layer. Two layers of Sellotape should separate the two primaries from one another, and another two layers separate the primary from the secondary.

The secondary of 160 + 160 turns is then wound, bringing out a connection to the centre tap, and the final assembly firmly overtaped with Sellotape. All windings are in the same direction and the ends of the primaries brought out through the sides of the bobbin on the opposite side to those of the secondary.

The core should now be inserted. If "C" cores are used the two halves must be clamped firmly together. If laminations are used they must be inserted alternately from opposite sides to avoid having an air gap in the core, the final laminations being wedged, if necessary, to avoid buzz and chatter when the transformer is used.

A small tag-board should now be strapped to the transformer to take the connections to the windings, and each winding identified on the tag board.

The Output Transformer

For quality of reproduction, efficiency, and ease of construction, it was decided to design the output auto transformer T2 to generous proportions. The resulting performance, on test, was therefore found to be extremely satisfactory and the amount of wire winding involved was surprisingly small.

The prototype was required, primarily, to drive two 15Ω loudspeakers in parallel, but by means of a little juggling in design a most effective compromise to permit the use of alternatively one or two 15Ω, two or eight 3Ω loudspeakers, has been produced. The transformer consists of a single winding of 272 turns, tapped at 68 turns and 136 turns from one end as shown in Fig. 6. The two halves of the winding are wound with different sizes of wire to take into account the currents flowing.

The core consists of two pairs of English Electric HWR 50/32/5 "C" cores, or equivalent. The approximate dimensions of a suitable core are: Cross sectional area through centre limb, 1·8 square inches, length of flux path, 8in. window area 2½ square inches, all approximate (refer to Fig. 5).

A suitable core of these dimensions, or the actual "C" cores themselves, can often be recovered from an ex-Government transformer, bought for a few shillings.

A suitable bobbin should be made to fit the core and well dried and shellacked. The end of the 18s.w.g. wire is passed through a hole made in the side of the former and 136 turns wound on in even layers, a thin layer of tissue paper between each layer. The end is brought out through another hole in the side of the former where it is connected to the end of the 15s.w.g. wire.

Sixty-eight turns of 15s.w.g. wire are now wound, and at the end of this portion a loop of wire, to provide the second tapping point, is passed through a suitable hole in the side of the former.

The final 68 turns are now wound and the whole assembly firmly taped to prevent buzz and chatter when the transformer is used. All windings should be wound in the same direction.

The core may now be placed in position and firmly clamped together to prevent gaps in the magnetic circuit. The wires from the winding can now have their ends cleaned and soldered firmly to a suitable tag strip.

Alternative Cores

Both transformers have been designed with ample margins of tolerance to accept modest deviations from the size of core specified, without change of number of turns. It should be appreciated, however, that in general, decrease in the size of the core requires an increase in the number of turns of all windings, and that finer gauges of wires will then be needed due to the smaller window areas. This, in turn, leads to increases in winding resistance, an undesirable characteristic.

The cores specified may be obtained from English Electric Co., Transformer Sales Dept, East Lancashire Road, Liverpool 10, Lancs.

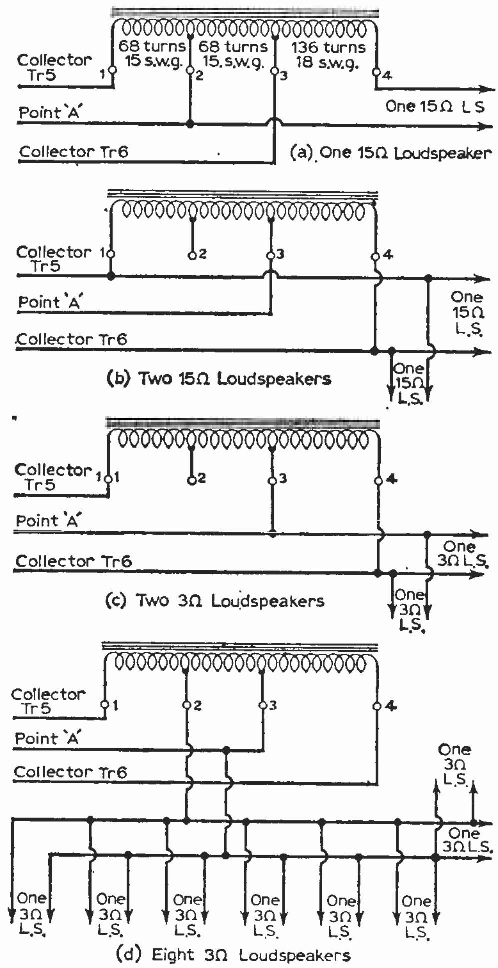


Fig. 6: Alternative output transformer arrangements.

Assembly of the Components

Flexible flying leads are attached to points C, D, G, V, W and X. A red battery lead is attached to point B and a black battery lead to point A, a flexible flying lead is also attached to each of these two points.

Connect the centre conductor of a length of microphone cable to point H and the screening to point J. This cable goes to the volume control.

—continued on page 239

model control receivers

TWO RECEIVER DESIGNS FOR 27Mc/s BAND OPERATION
BY F. G. RAYER

THE two model control receivers described here are for use with any home constructed or ready-made c.w. model control transmitter, working in the 27Mc/s band. The actual transmitter may have one or two valves, the higher power obtained from two valves being needed when maximum range is required.

The first receiver to be described is of very simple type, and is easily adjusted. It is suitable for short range working only—indoors, in a garden, or when sailing a boat on a small pond.

Much greater range is obtainable with the super-regenerative one-valve receiver, so it is suitable for planes and boats. It will also give good range with a low-power (hand held) transmitter.

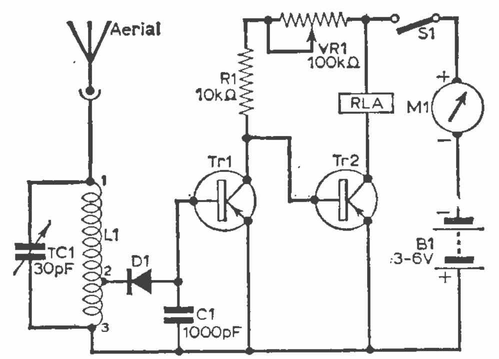


Fig. 1: A simple two-transistor receiver for short range work.

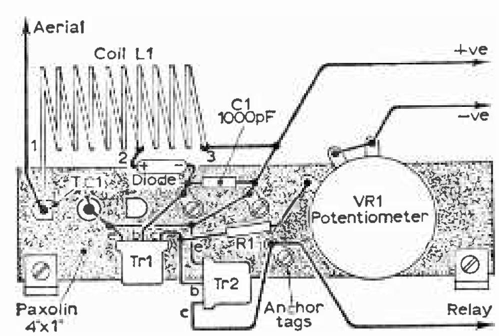


Fig. 2: The method of construction for the transistor receiver recommended by the author.

Transistor Receiver

The circuit of this simple two transistor receiver is shown in Fig. 1.

When the carrier signal is received, the diode causes the base of transistor Tr1 to become negative. Tr1 conducts, increasing the voltage drop in the collector circuit resistors (R1, VR1) so the base voltage of Tr2 is more positive, releasing the relay RLA so that the relay contacts close.

The receiver parts can be assembled on a small piece of paxolin, or on a tag board (see Fig. 2). The layout is not important, though connections in the tuned circuit should be reasonably short.

The tuning coil can be self-supporting, and can have 12 turns of 18 s.w.g. bare or enamelled wire. It is about ½in. inside diameter, and about ⅞in. long. The tapping 2 is four turns from end 3, and the coil is supported by soldering it to tags.

For best results, a good quality diode for 27Mc/s or higher frequency is required. Most types, except cheap sub-standard surplus, are satisfactory. Tr1 is a high-gain audio or r.f. transistor, such as OC71, etc. Tr2 is a small output type transistor, such as OC72. The transistors operate as direct current amplifiers, their cut-off frequency is thus of no importance, but they should have high gain.

The relay is the usual model control type, with 1,000 to 5,000Ω windings. A 5mA, 10mA or similar meter, or multi-range meter, is placed in one battery lead for tuning purposes.

Tuning Up

A vertical aerial, some 16in. to 24in. long, is connected to 1 on the coil. The transmitter aerial may be removed. With the transmitter and receiver near together, the 30pF trimmer TC1 is rotated until a dip in current is observed each time the transmitter is keyed. Tuning is quite flat. The transmitter aerial can then be added, and the receiver is moved a few yards away, and the 100kΩ potentiometer and trimmer are set for best results.

Range should be sufficient for the purposes mentioned when used in conjunction with a two-valve transmitter. For maximum possible range, the tapping 2 may be modified a turn at a time, to suit the diode and Tr1. The aerial may also be lengthened, and the turns on the coil can be

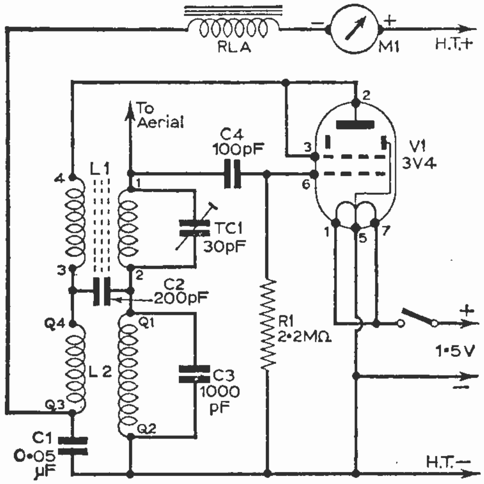


Fig. 3: A super-regenerative circuit for better reception.

adjusted so that resonance is obtained with the 30pF trimmer nearly completely unscrewed.

Super-regenerative Receiver

The circuit of a more sensitive receiver employing a single valve is shown in Fig. 3.

The small coil L1 is tuned to 27Mc/s by adjusting its core and the 30pF trimmer TC1. Regeneration is obtained from the feedback winding which is coupled to L1.

L2 is the quench coil, with its own feedback winding, and it takes the valve in and out of oscillation.

This super-regeneration receiver gives great sensitivity, and a good current change (to operate the relay) even with a weak input signal.

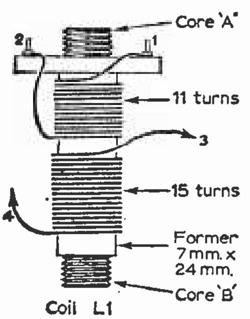
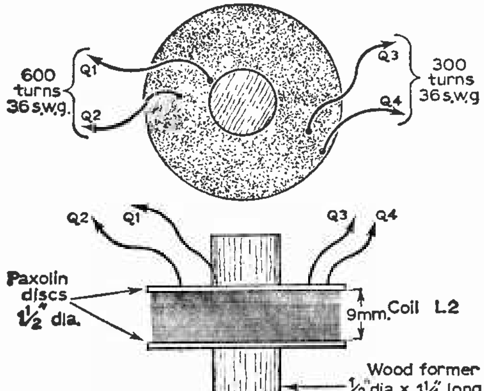


Fig. 4 (left): Winding details of the 27Mc/s coil.

Fig. 5 (below): The construction of the quench coil.

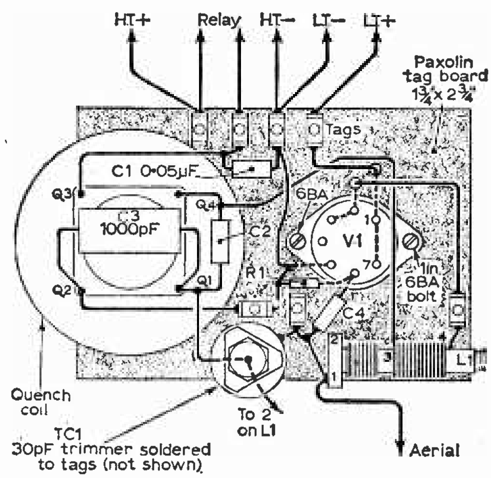
Fig. 6 (right): The layout and wiring of the one-valve receiver.



The 27Mc/s coil is wound with 26 s.w.g. enamelled wire, with turns side by side, as in Fig. 4. A space of about $\frac{1}{16}$in. is left between 11 turn and 15 turn windings. Two cores are necessary in the coil, one inserted from each end. Each core is initially screwed in for about two-thirds of its length. Both windings are in the same direction, and touches of adhesive will help hold the ends.

A piece of wood ½in. in diameter and about 1¼in. long is used for the quench coil. Two paxolin discs, about 1½in. in diameter, and with ½in. holes, are cemented on the wooden former, leaving 9mm winding space, as in Fig. 5. Both windings are of 36 s.w.g. enamelled or silk covered wire, and are in the same direction.

The 600 turn winding begins at Q1, and ends at Q2. A strip of paper is then placed over this winding, and the 300 turn winding is put on, beginning at Q3 and terminating at Q4.



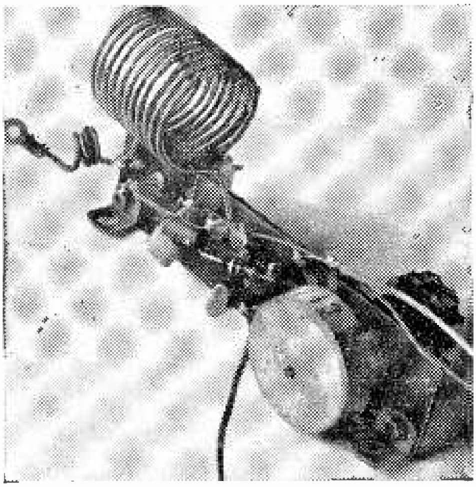
The receiver is built on a tag board or paxolin panel, refer to the layout shown in Fig. 6. Leads to the 27Mc/s coil, 30pF trimmer, valveholder, and 100pF and 200pF capacitors must be very short and direct. The quench coil can be held with a woodscrew.

Valveholder tag numbers in Fig. 3 are for a 3V4. Other valves may be experimented with. The best current change is obtained with a valve having a high mutual conductance.

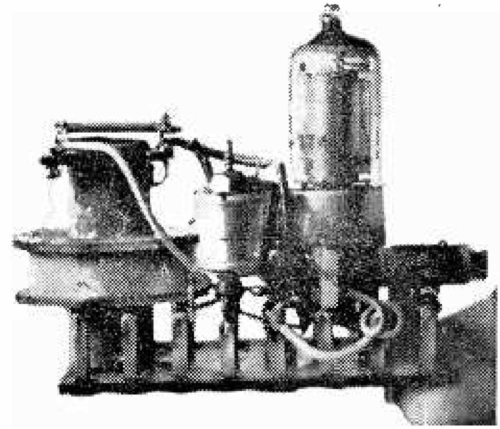
The relay is the ordinary high resistance model control type, and a 10mA or similar meter is added in the h.t. lead. Any 1½V dry battery is satisfactory for the filament. A 67½V miniature battery is necessary for h.t.

An aerial some 12in. to 18in. or so in length, is connected, and the receiver is placed near the transmitter, the transmitter aerial being removed. The 30pF trimmer is turned with an insulated tool, until the meter shows a current drop each time the transmitter key is closed. If this drop is extremely small, screw in core A a little, and unscrew the trimmer, to restore tuning. If no current drop can be found, screw in core B a little, and again adjust the trimmer.

If the current drops when the transmitter key is closed, but does not rise immediately the key is released, core B may be too far in. The inductance/capacity ratio of circuit L1, TC1, depends on the positions of core A and the 30pF trimmer, while the degree of regeneration also depends on the extent to which core B is screwed in. Adjustments to obtain a good current drop are very easy



The prototype of the two-transistor receiver.



The more sensitive one-valve receiver completed.

near the transmitter, but become progressively more critical, as the range is increased.

The aerial length also has considerable effect on regeneration, so is best left unchanged, once satisfactory adjustments have been made. Any change to the aerial, or core positions, will make re-tuning necessary. When adjustments have allowed a good current change to be obtained at some yards range, with no aerial on the transmitter, the transmitter aerial can be added, and transmitter tuning checked.

If no possible adjustments give any current drop, connections to one winding of the 27Mc/s coil may have been reversed. If L1 is readily tunable to the transmitter signal, and only a very small current drop can be obtained, then connections to one winding of the quench coil are probably reversed. ■

The "Junior" Crystal + 2

FURTHER INFORMATION CONCERNING TRANSFORMERS

THE author of the Junior Set + 2 (P.W., May 1964), has asked us to point out that Messrs. Radiospares have changed the size and design of their T/T3 transformer. The new version is more efficient and will of course work perfectly in the receiver, but unfortunately will not fit in the space allocated for it on the board. If a larger sandwich box is used to house the receiver, there will then be no problem.

Should the new T/T3 transformer be used then refer to Fig. 12 and call either of the widely spaced tags red, and the other blue. Of the closely spaced tags take any outside one and call this yellow, and the next tag to it brown. The other two tags are not used. Red and blue may be changed round for best results.

The following alternative transformers are all absolutely suitable, will fit in the space provided, but need changed colour coding:

D189 ARDENTE, T22 (make unknown) (Messrs. Henries Radio Ltd.).

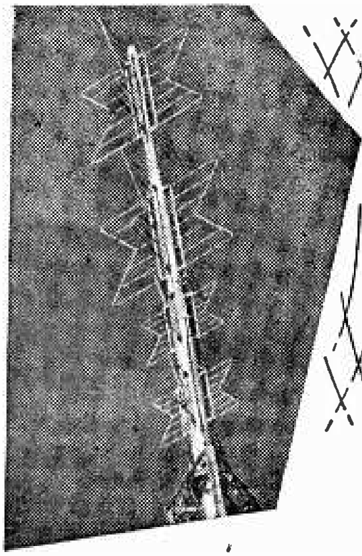
LT/44, Eagle Products (Messrs. Sexton, 162 Grays Inn Road, W.C.1.).

Coding Changes (Fig. 12)	LT/44	Ardente 189	T22
For Blue read	Green	Blue	Outside Red
For Brown read	White	Green	Outside Green
For Red read	Red	Yellow	Outside Red
For Yellow read	Red (lead near White)	Red	Outside Green
Fixing	as text exactly	adhesive	adhesive

The author would recommend LT/44 since this is almost identical in appearance to the T/T3 originally specified.

We apologise for a small draughtsman's error in Fig. 12 where "D" on the coil should go to the junction R1/R2/C4 and not as shown to the battery positive line.

Beginners who wish to have help over any difficulties may of course use our query service, enclosing the usual query coupon.



On Your Wavelength

By THERMION

OFTEN I have wondered why no manufacturer considers it worthwhile to produce a three or four station preset receiver for the mass market. I have heard it stated in the past that the public will not buy a receiver that has no tuning scale. Perhaps this was true in the days when one receiver had to satisfy the needs of a household. In those days to invest in a receiver that would limit one's choice to a few stations had little appeal. Nowadays, with two or more sets per household becoming more the rule than the exception I should think there is a real market for a mains receiver that enables one to select at a touch the programme of one's choice so eliminating all the drudgery of turning a gang capacitor.

Dormant V.H.F.

This leads me on to another matter that has puzzled me for some time. The BBC has brought into operation a large number of v.h.f. transmitters, and all large areas of population in these islands are covered by this f.m. service. But how many people receive the Home, Light or Third on v.h.f.? What is required is a large scale campaign to encourage listeners to move away from the chronically congested medium wave band, and to share in the benefits of improved quality afforded by the v.h.f. band.

Don't let us hear any talk of sales resistance by the public. If the radio industry applied itself energetically to the promotion of v.h.f. reception, this could quite easily become "with it" as that current status symbol—the personal portable. But in those last two words, methinks; aye, there's the rub.

It could be that the industry has a vested interest in preserving the habit of medium wave listening. The enormous market opened up by the transistor portable and the rocketing sales to our prosperous teenagers has mesmerised quite a few firms.

These apart, there must still remain a host of listeners with (dare I say it) more serious tastes who confine their listening to the Home, Light and Third but who have yet to be converted to f.m. What could suit their requirements better than a preset v.h.f. receiver with a decent audio section and reasonably sized loudspeaker?

All Tastes Catered for

Coming back to these transistor portables, it does seem that with circuit design now very much standardised, the presentation of the package has assumed greater importance than the contents. Styling is paramount. The feminine customer is wooed with delightful confections in exotic colour schemes plus all the trimmings: cherry red with gold grille; flame and white with polished aluminium embellishments; lovat green with silver trim—these are a few examples. The cases are sometimes padded and, perhaps, reach the ultimate in "a moulded case studded with nearly 200 sparkling imitation jewels". For her mate, the outdoor sporting mood is exploited: less of the metallic trim, a predominance of leathercloth or, in the luxury class, an outer covering of real leather—saddle stitched of course.

I was amused by a technical achievement that some current models feature, namely slow motion tuning. This is certainly a boon for getting those tricky stations right on the nose; I think it might become very popular!

From a Surrey Wood

A reminder of yesteryear from an unexpected quarter. A few weeks ago the newly launched BBC-2 TV programme concluded its transmission one evening, somewhat surprisingly, by playing a recording of a nightingale singing in a wood as made during a live sound broadcast way back.

For the older viewers, this must have brought vividly to mind again those outside broadcasts of 30-odd years ago. Perhaps our younger contemporaries will smile indulgently as I hark back to those warm summer evenings when with hushed expectancy we would listen as the announcer broke into the programme to say that we were about to be taken over to a Surrey wood, to hear the nightingale. Coaxed by a suitable musical accompaniment played by a lady cellist concealed in the wood, the bird would as often as not give a performance. On these occasions the Corporation and the listening nation submitted to the caprice of this little unseen songster.

Very tame compared with a view of tomorrow's dawn at Tokyo brought via satellite—oh yes certainly, but a salutary reminder of the progress made in a mere three decades!

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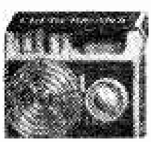

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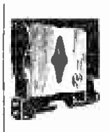

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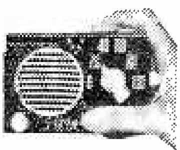

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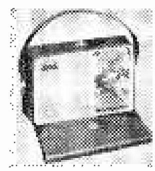

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An Audio Mixer

A SIMPLE TRANSISTORISED UNIT

BY G. R. ADDIS

THE following article describes the development and construction of an audio mixer employing the latest transistor circuit techniques. The circuit is such that it can be arranged to suit most needs, whether amateur or semi-professional.

Since it is likely that the equipment will be used for recording such items as live concerts or lectures, it will be appreciated that light weight, good performance and the utmost in reliability are very important factors governing the design of the unit. In order to keep the weight of the equipment to a minimum, it was decided that transistors rather than valves, should be used, hence dispensing with the need for large and heavy power supplies. Another desirable feature would be the facility to extend the number of channels as and when the

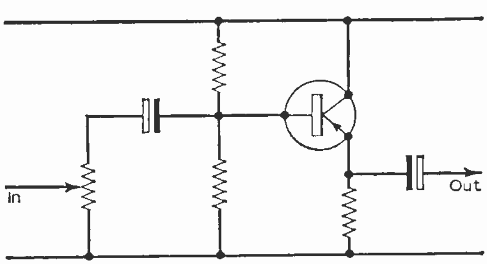


Fig. 1: A transistor in the emitter-follower configuration.

need arose with the minimum expense and trouble. In the final design these requirements have been fulfilled and the mixer meets the requirements admirably.

Preliminary experiments were carried out on a circuit based upon the emitter-follower configuration, Fig. 1. These proved to be unsuccessful, as expected, due to inter-channel modulation.

The first circuit being unsatisfactory, a circuit which is the combination of an earthed emitter stage and an emitter-follower was tried. A circuit

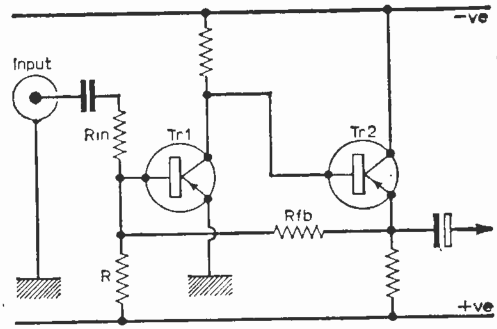


Fig. 2: The basic arrangement for a "Bow's brick" circuit.

such as this is known as a Bow's brick. The basic circuit is shown in Fig. 2

In this configuration, the brick requires both positive and negative power supplies with respect to earth. A more convenient arrangement is shown in Fig. 3, this requiring only a simple power supply such as a battery.

A circuit such as this gives a very stable voltage gain with negligible distortion. The voltage gain can be calculated from the formula:

$$V\text{gain} = \frac{Rfb}{Rin}$$

thus with a feedback resistance of say 22kΩ, and an input resistance of say 2.2kΩ, a voltage gain of 10 would result, i.e. a gain of 20dB. Conversely, if these two resistances were changed around, then there would be a voltage loss of 20dB.

The resistor R is for adjusting the bias conditions, since most of the current flowing through the feedback resistor also flows through resistor R, thus causing the output to be negative with respect to earth and so providing Tr1 with a negative voltage on its emitter.

The transistors chosen for use in the mixer were the type OC45. This was because of their availability, good frequency response and fairly quiet operation. It was decided that the mixer should operate from a 9V power supply. A suitable value of current flowing through Tr1 is in the order of

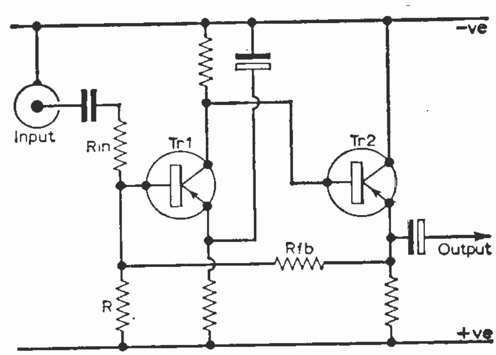


Fig. 3: An improvement on Fig. 2 requiring only a simple power supply.

0.5mA. and that through Tr2 being about 1mA. A suitable voltage on the emitter of Tr2 is 2V positive with respect to earth, thus the voltage drop across R6 will be 7V.

$$\text{Hence } R6 = \frac{7}{1 \times 10^{-3}} \Omega.$$

$$R6 \simeq 6{\cdot}8k\Omega.$$

Since the voltage on the emitter of Tr2 is 2V, then the voltage on the collector of Tr1 will be 2V, thus if a current of 0.5mA is flowing:

$$R2 = \frac{2}{0{\cdot}5 \times 10^{-3}} \Omega$$

$$R2 \simeq 3{\cdot}9k\Omega.$$

Allowing for a potential difference of 3V to be across Tr1, then the voltage on the emitter of this transistor will be 5V with respect to earth, i.e. the voltage drop across R4 will be 4V.

$$\text{hence } R4 = \frac{4}{0{\cdot}5 \times 10^{-3}} \Omega$$

$$R4 \simeq 8{\cdot}2k\Omega.$$

The value of the feedback resistor, Rfb, was chosen to be 1kΩ, and since the potential difference between the emitter of Tr2 and the base of Tr1 is in the order of 3V, then the current flowing through Rfb will be 3mA. This current flows from the positive rail via R3,

$$\text{hence } R3 = \frac{4}{3 \times 10^{-3}} \Omega$$

$$R3 \simeq 1{\cdot}2k\Omega.$$

Since Rfb is 1kΩ, then for unity gain the value of the input resistance must also be 1kΩ, i.e. Rin = 1kΩ.

A capacitor is placed in series with the input resistance in order to prevent d.c. voltage getting on to the base of Tr1 from the input source. A suitable value for this component is 50μF, thus a good low-frequency response is to be expected. Likewise, another capacitor, C3, is placed in the output circuit of Tr2, a suitable value for this component being 10μF. It is also necessary to decouple the emitter of Tr1 and an electrolytic capacitor having a value of 100μF is used for this.

Since the gain of the brick is proportional to the input resistance, Rin, it is necessary to use a variable resistor with anti-logarithmic characteristics in series with the input in order to provide a logarithmic increase in volume as the control is turned in a clockwise direction. If a variable resistance having a value of 1MΩ is used, then the output signal may be decreased by up to 60dB from the original signal level; this being adequate for most purposes.

The final circuit of the mixer is given in Fig. 4. It will be appreciated that if variable resistances having a smaller value than the "fade resistances" were placed in series with each input, then the level of each channel could be adjusted to give the same voltage output when its individual "fade resistor" was at minimum value. Likewise, another variable resistance could be placed in series with all the inputs so as to provide a master volume control.

Construction

Due to the relative simplicity of the mixer, the complete electronics, apart from the various input resistances, may be built on to a miniature 10-way tagboard. The diagrammatical layout is shown in Fig. 5. Since it is likely that the reader may have his own ideas on the final arrangement of the input circuits, it is not proposed to give comprehensive details on the mechanical side of the construction.

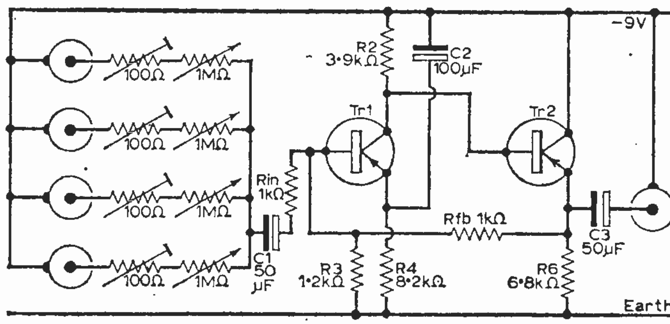


Fig. 4: The circuit finally arrived at for the mixer.

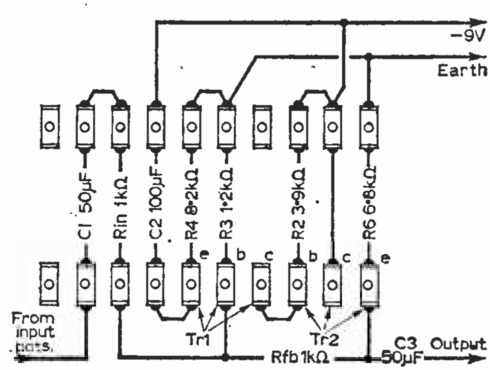


Fig. 5: Illustrating the layout of components when built on a 10-way tag board.

Performance

As stated earlier, the mixer is very reliable in operation, it has a good frequency response and a low signal-to-noise ratio. The measured figures below give a better indication of the performance.

Frequency response . . . .25c/s to above 200kc/s ± 0·5dB.
Harmonic Distortion . . .Not measurable.
Noise level . . . . .90dB below minimum signal output.
Power requirements . . . .9V at 2—3mA.

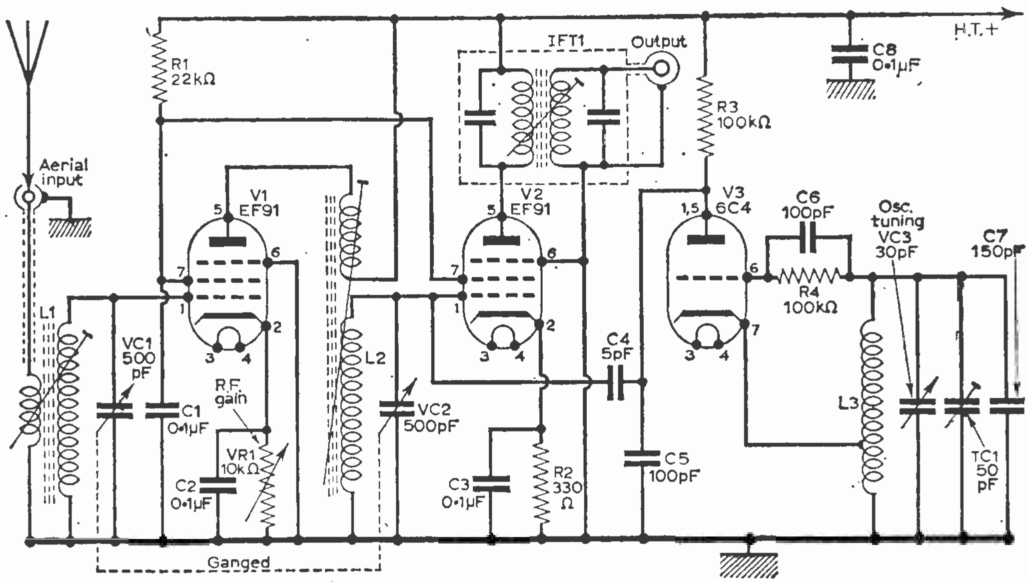


Fig. 1: The circuit of the unit.

A TOP BAND CONVERTER

THIS UNIT WILL ADAPT CERTAIN EX-GOVERNMENT RECEIVERS TO TUNE OVER THE 1·8—2Mc/s AMATEUR BAND

BY J. CALLOW G3RBH

THERE is on the market and in widespread use a large number of ex-government receivers which do not tune the 1·8-2·0Mc/s amateur band, most of them tuning only as low as 2·0Mc/s. It was for this group of receivers that this converter was designed, the prototype being used on a BC 454-B Command Receiver. The output of the converter is on 3·0Mc/s, and so it will be necessary for the receiver to tune this frequency.

Circuit Description

Fig. 1 shows the circuit of the converter. The oscillator is tuned independently of the r.f. stages, thus eliminating troublesome alignment and the need for a three-gang tuning capacitor. VC3 tunes the oscillator over the range of 4·8-5·0Mc/s and thus produces the required beat of 3·0Mc/s throughout the band. The oscillator circuit is a Hartley, which requires no elaborate setting-up procedure. The valve used a 6C4 triode.

The two EF91 valves function as r.f. amplifier and mixer respectively, and the grid circuits are tuned by a twin-gang 500pF capacitor (VC1, 2). Osmor range 4 (trawler band) aerial and h.f. coils are used. These coils have iron cores and so no external trimmers are necessary. The inductance of the tuned windings is in the region of 35µH. Selectivity in these circuits is of little importance, and it was only expense which prevented band-pass units being used.

The first EF91 is an orthodox r.f amplifier stage, having a 10kΩ potentiometer VR1 in its cathode to control the r.f. gain. For simplicity the screen of this valve is strapped to that of the mixer, and these screens receive their voltage through a single 22kΩ resistor, R1 decoupled by capacitor C1.

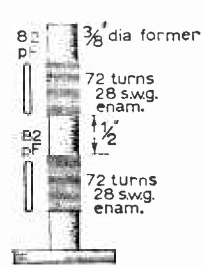


Fig. 2: Winding details of the 3·0Mc/s i.f. transformer.

The oscillator signal is applied to the grid of the mixer V2 via a 5pF capacitor C4, The output signal is derived from a 3·0Mc/s i.f. transformer (Fig. 2) which is wound in an old TV i.f. can.

No a.v.c. is applied to the converter, but if desired it can be applied by modifying the circuit

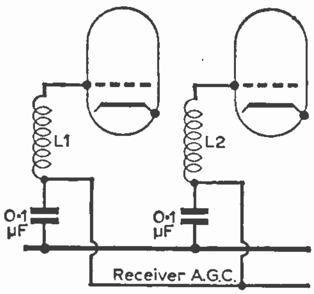
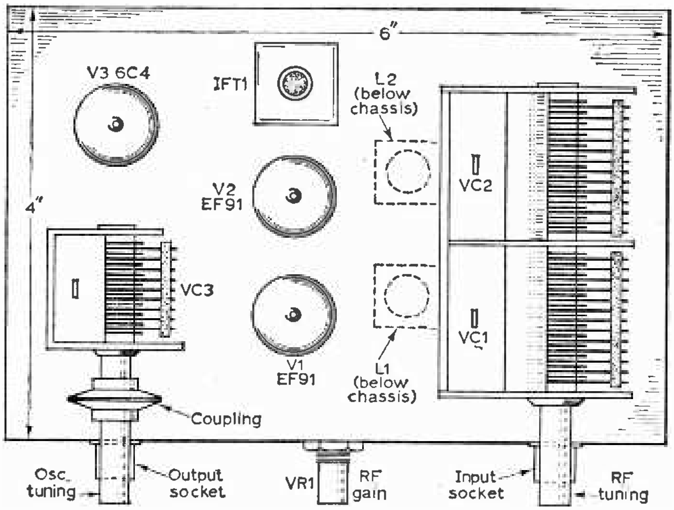


Fig. 3 (above): A modification to incorporate a.v.c.
Fig. 4 (right): The above-chassis layout of components.



as in Fig. 3, but it will be found necessary to connect the converter to the receiver with 4-core cable, the extra conductor being connected to the a.v.c. line of the receiver.

Construction

The prototype was constructed on an open-ended chassis 6in. x 4in. x 2in. Fig. 4 shows the arrangement of components, though this is not critical, and need not be followed exactly as long as care is taken to avoid any feedback. It must be noted however that the EF91's have a high gain, and so only a little feedback is necessary to cause oscillation.

Owing to the superior selectivity of the converter, it was found necessary to use a slow motion

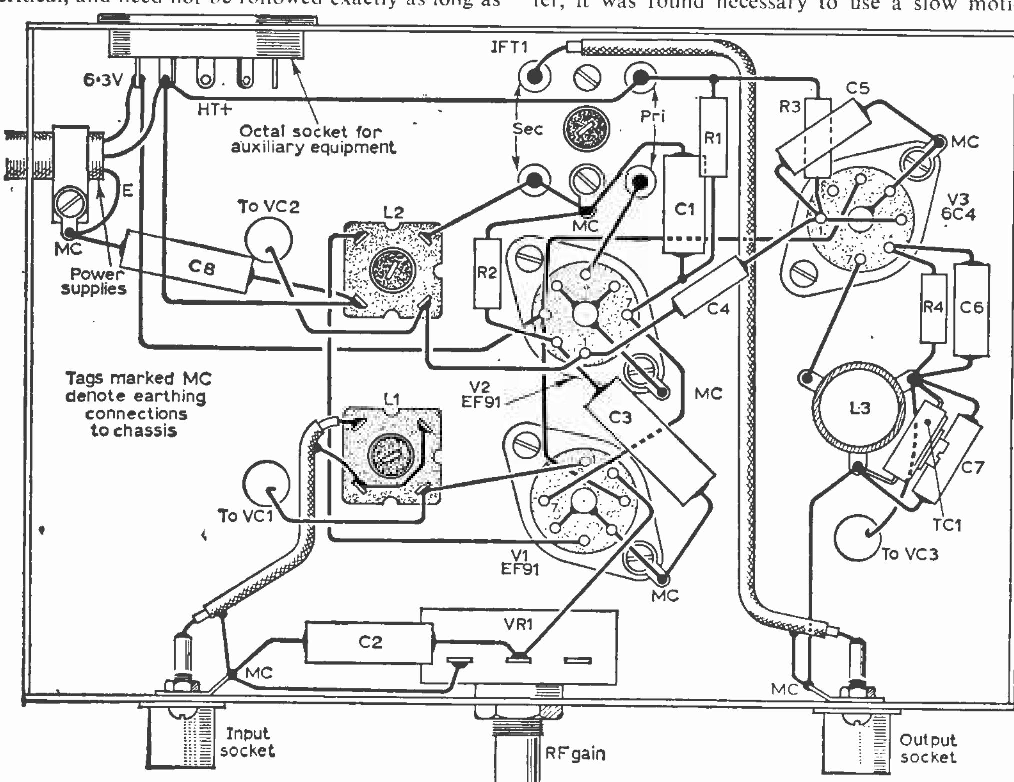


Fig. 5: The complete underchassis wiring diagram.

drive on the oscillator tuning capacitor, and even with this it was found easy to tune past a signal.

Winding the I.F. Transformer

Details of the output i.f. transformer IFT1 are shown in Fig. 2. All components for this were acquired from an old TV i.f. transformer, which was carefully cleaned of wax with methylated spirits. The former was of ⅜in. diameter with iron cores. The windings consist of 72 turns of 28 s.w.g. enamelled copper wire, and are wound in two layers at each end of the former. Each winding is tuned with a 82pF silver mica capacitor.

COMPONENTS LIST

Resistors:
R1 22kΩ ½W R3 100Ω ¼W
R2 330Ω ½W R4 100Ω ¼W
VR1 10kΩ potentiometer, wire-wound

Capacitors:
C1 0·1μF paper
C2 0·1μF paper
C3 0·1μF paper
C4 5pF ceramic
C5 100pF mica
C6 100pF mica
C7 150pF ceramic
VC1, 2 500+500pF 2-gang variable
VC3 30pF variable
TC1 50pF trimmer

Inductors:
L1 Aerial coil 70-230m (Osmor QA4)
L2 H.F. coil 70-230m (Osmor QHF4)
L3 Oscillator coil (see text)
IFT1 3Mc/s i.f. transformer (see text)

Valves
V1 EF91 V2 EF91 V3 6C4

The tuned circuit in the oscillator consists of a 30pF tuning capacitor VC3 (such as obtained from an RF27 unit) shunted with a fixed capacitor of about 150pF, C7, and an inductance L3. This inductance consists of 17 turns of 24s.w.g. enamelled copper wire close wound on a ½in. diameter former, tapped 5 turns from the earthy end. The inductance value is about 6μH.

Setting Up

The converter requires 6·3V at 0·9A and 200-300V h.t. at about 30mA. Such requirements can be furnished by the power pack on most receivers.

When the converter has been allowed to warm up for about 15 minutes, set the oscillator tuning capacitor VC3 to the half meshed position, tune the station receiver to 4·9Mc/s, and "zero" the oscillator in on this frequency by means of the oscillator padder TC1.

Then tune the receiver to 3·0Mc/s, connect an aerial to the converter, and couple the output of the converter to the receiver. The twin-gang tuning capacitor should be adjusted so that it is a little more than half meshed. The cores of the i.f. transformer are then peaked up. Next peak up the twin-gang tuning capacitor, and finally the cores in the aerial and h.f. coils. When all the cores have been properly adjusted they should be sealed with a drop of wax.

The 30pF oscillator capacitor VC2 is the main tuning control of the converter, the twin-gang capacitor being used to peak up the signals. With a little practice and experience the converter will function well, and the selectivity of the combined equipment will be found far superior to that of any single conversion set. ■

—continued from page 228

TRANSISTOR "25WATT P.A. AMPLIFIER"

The transistors are fitted to the printed circuit board and heat sink as shown in the following table:

No.	Type	Base	Emitter	Collector
Tr1	NKT223	To K	To L	To M
Tr2	NKT223	To N	To P	To R
Tr3	NKT228	To R	To T	To Driver Transformer
Tr4	NKT228	To P	To S	To Driver Transformer
Tr5	NKT404	Fitted to Cooling Fin		
Tr6	NKT404	,, ,, ,, ,,		

The printed circuit board and driver transformer can now be mounted in the case, earthing the case, if desired, to point W.

Connect the collectors of Tr3 and Tr4 to the start of one primary winding of the driver transformer and the finish of the other primary winding. The other end of the winding to which the collector of Tr3 is connected goes to the flying lead from point D. The other end of the winding to which the collector of Tr4 is connected goes to the flying lead from point C.

The centre tap of the driver transformer secondary should now be connected to the flying lead from point V, and the remaining two connections taken to the bases of the output transistors.

The flying lead from point B should be taken to the emitters of both output transistors, and the collectors of the output transistors connected to the output transformer, together with the flying lead from point A, in accordance with the diagram Fig. 6. Connect the flying lead from X to the collector of Tr3. The flying lead from point G should not be connected at this stage.

Check all wiring carefully and when satisfied that all is correct connect to a 12V accumulator (observing polarity) via a 1A fuse.

The amplifier should now work, and if satisfactory the fuse can be exchanged for one of 5A rating and the feedback loop connection from point G connected. To establish the correct point of connection test the flying lead from point G on the base of each of the output transistors in turn. The correct connection will produce a reduction in amplifier sensitivity while the incorrect connection produces a vigorous howl. It will be observed that a small internal feedback loop containing a 1MΩ resistor and a 47pF capacitor connected to the base of Tr4 already exists. This is to balance out the internal collector to base feedback of Tr4 and ensure stability of the Tr2, Tr3, Tr4 network. ■

on the Short Waves

A MONTHLY COMMENTARY BY J. GUTTRIDGE

AS mentioned last month, several stations broadcast special programmes giving details of reception conditions and frequency changes. Here are details of some of them. All times are in GMT.

Radio Australia carries a programme called "Australian DX-ers Calling". This deals exclusively with broadcast band stations and lasts ten minutes. It is beamed to Great Britain at 0715 on Sundays over 9,570kc/s and 11,710kc/s. This programme is especially useful for keeping up to date with Asian and Far Eastern developments.

Ham band enthusiasts are catered for by Radio Sofia, Bulgaria, on Friday evenings at about 1945 and 2145. Best reception at both times is on 6,070kc/s. A similar type of programme is broadcast by Radio Prague, Czechoslovakia, on the first Monday of each month at 1915 and 2215. The 1915 transmission comes in well on 7,345kc/s, whilst the 2215 transmission is on 1,286kc/s medium wave.

One of the best programmes on the broadcast bands is that transmitted by Radio Denmark. Information is usually supplied by O. Lund Johansen, the World Radio/TV Handbook editor. Transmission times are Tuesday at 1920 on 15,165kc/s and 2035 on 9,520kc/s, Wednesday 0220 on 9,520kc/s and Thursday on 15,165kc/s at 0950 and 1520. Reception, unfortunately, is often difficult as none of the transmissions are beamed to the British Isles or Europe.

Both ham and broadcast band listeners are catered for by Radio Nederland's programme "DX Juke Box". This is transmitted in all its English transmissions on Thursdays. Details of these transmissions are given in this month's schedule change news.

"Sweden Calling DX-ers" is one of the most comprehensive DX programmes. It is transmitted by Radio Sweden during the last 15 minutes of its English transmissions on Tuesdays. These are beamed to Europe from 2200—2230 on 6,065kc/s and 2330—2400 on 1,178kc/s medium wave. Some of the other beams can also be picked up in the U.K.

The second half of the Swiss Broadcasting Corporation's English transmission on Saturdays is given over to a programme called "Swiss Short Wave Merry-go-Round". On the first and third Saturdays each month there is a report on stations in the broadcast bands, whilst on the others amateur band topics are dealt with. The U.K. transmission is from 1845—1945 on 7,110/9,665kc/s.

The programmes mentioned so far are those which will probably be of most use to the average listener. There are also programmes from the Canadian Broadcasting Corporation, Radio Finland, Deutsche Welle, BBC, Radio Budapest, N.H.K. (Japan), Radio Warsaw, Radio New York Worldwide and the Voice of America.

Jamming

Good news for all broadcast band listeners comes in an announcement from the BBC on the subject of jamming. It says that all its East European transmissions, except those in Bulgarian, are now free of jamming. Let's hope this spreads and other stations' transmissions go unblocked. The trouble with jamming is that it is non-selective and often blocks out stations other than the one it is aimed at.

Ham Band News

According to Radio Sofia the 21mc/s ham band is now good for working to the Far East. If you want to hear a station in Franz-Josef Land, Sofia suggests trying 14,040kc/s or 14,060kc/s, where UA1KUD is working in CW. This station will QSL through the Russian bureau, P.O.B.88, Moscow. A blot in the ham world is a report that the Lebanon has suspended all licences.

VR4CN in the Solomon Islands will be working from 1200 on single sideband around 14,320kc/s for about the next eight months according to the Swiss Broadcasting Corporation. They also report 20m as the best DX band at present.

B.C. Band News

In the broadcast bands more summer schedules have come to hand. Radio Nederland (P.O.B.222, Hilversum, Holland) is completely rearranging its schedule with the commencement of transmissions from its relay station in the Netherlands Antilles. New frequencies being used are 17,720/15, 440/15, 435/11, 960/9, 705/7, 210/7, 165/7, 110kc/s. European English transmissions are from 2000—2050 on 6,020kc/s repeated from 2100—2150 in the 19 and 25m bands. "Happy Station" programmes on Sundays have also been extended. A full schedule is available free of charge from this station.

Bernard Attrell, of Winchester, reports that the Windward Islands Broadcasting Service is back again to the U.K. on 15,085kc/s from 2130—2230. The signal is a very good one, especially when you remember the station is using only 5kW. When reporting to this station there is no need to send reply postage. Its address is St. George's, Grenada, W.I.

The Canadian Broadcasting Corporation, P.O.B. 6000, Montreal, is now using 5,970kc/s and 9,625kc/s for the whole of its English transmission to Australasia. This is on the air from 0715—0850.

—continued on page 274

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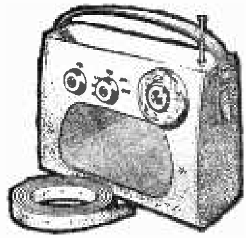

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Covers Medium and Long Waves. Trawler Band and two Short Waves to approx. 17 metres. Push-pull output for room filling volume from rich toned heavy duty 5in. speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M & L waves and telescopic aerial for S Waves. Simulated hide case with gilt trim and shoulder and hand straps. Size 9 x 7 x 4in. approx. **The perfect portable and the ideal car radio.** (Uses PP9 battery available anywhere).

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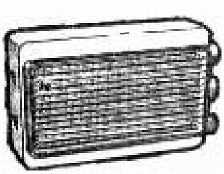

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Fully tunable over medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic 2¾in. speaker etc. Attractive case. Size 6¼ x 4½ x 1¼in. with red speaker grille. (Uses 1289 battery available anywhere).

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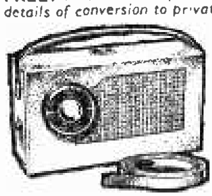

● **8 stages—6 transistors and 2 diodes**

Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¾ x 3¾ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps

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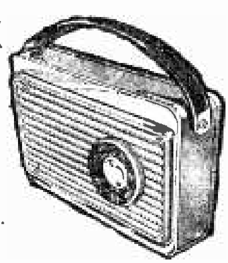
TRANSONA SIX



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

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade Ferrite magnet 3in. speaker makes listening a pleasure. Push-pull transformers for ample power. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6¼ x 4½ x 1½in. (Uses PP4 battery available anywhere). (Carrying strap 2/- ex.).

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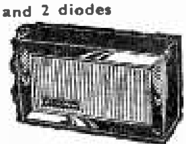
● **7 stages—5 transistors and 2 diodes**



Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2¾in. moving coil speaker, built into attractive black case with red speaker grille. Size 5¼ x 1¼ x 3¼in. (Uses 1289 battery available anywhere).

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SUPER SEVEN

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Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car, or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 RF Stages, push-pull output. 3in. speaker (will drive large speaker). Size 7½ x 5½ x 1½in. (Uses 9v battery, available anywhere).

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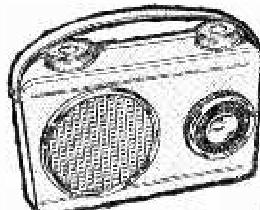
FREE! *Miniature Earpiece, plug and socket (value 9/6) and details of conversion to private listening*

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



Listen to stations half a world away with this 5 waveband portable. Tuneable on Medium and Long waves, Trawler Band and two Short waves. Sensitive ferrite rod aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings. Size 3¾ x 4¼ x 1¼in.

Parts Price List and easy build plans 1/- Total cost of all parts now only **£4.19.6** P. & P. 3/6

All components used in our receivers may be purchased separately if desired. Parts price lists and easy build plans supplied free with sets of parts or available separately at fixed prices stated.

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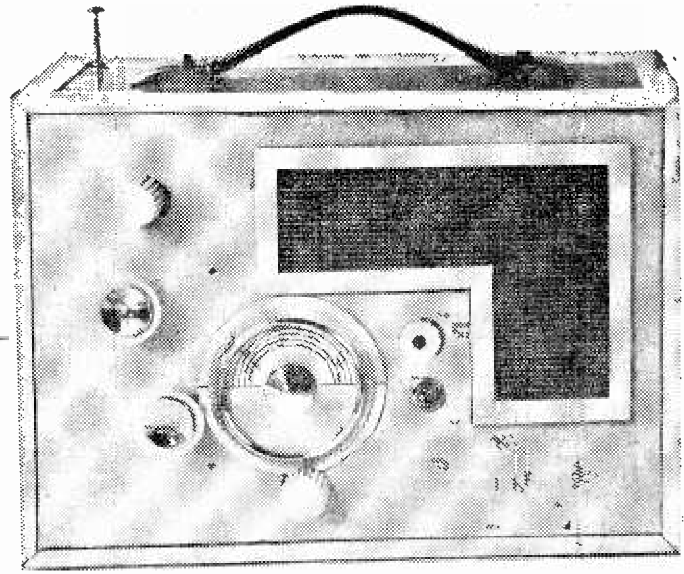


A 4-VALVE, 4-BAND, ALL-DRY SUPERHET PORTABLE

By L. R. Repage

The CHELMER 4

TO many readers this article may seem to be going back a few years, and in a way this is true, for the first preliminary layout experiments of components was made by the author quite two years ago.

The small miniature components were purchased with the intention of constructing a portable of modest size which would be capable of good reception on the three main BBC transmissions, using a frame aerial, and also to be capable of picking up short-wave transmissions by the inclusion of the appropriate short-wave coils and a tubular-type aerial.

These aims have been achieved and under good reception conditions quite a good selection of short-wave stations can be received on the two short-wave bands, whilst with a good aerial, wire twisted round the aerial tube, long-distance American transmissions have been received at, of course, the appropriate times.

The author must admit that the chassis presents a somewhat "dreadnought" appearance but the whole is the outcome of a series of additions which have taken place during the two years' work on the set. It is, in fact, a prototype of an amateur constructor. The mechanical construction could no doubt be simplified in many respects but not with regard to the general layout of component parts, which has received much thought, particularly in the designing for short and direct wiring, a necessity for the short wave bands.

So the author gives herewith drawings and constructive notes of this quite useful portable in that it may tempt some readers to give these grand little valves a go again.

CONSTRUCTIONAL DETAILS

As the author anticipated quite a lot of experimental work in connection with coils and frame aerials it was decided to make the design such that the main tuning components were easily dismantled and replaced after the various modifications. For this reason a separate coil unit, complete with switching, was designed.

The several capacitors and resistors forming the automatic volume control circuit were made in a unit form, as also the padding capacitors, these being neatly arranged in a "bank" immediately adjoining the coil unit.

Again, for ease of removal the chassis was fitted with bottom flanges to engage into recesses in the frame aerial unit. With this arrangement and with but four soldered connections necessary, and with the two batteries in position, the set is completely self-contained and workable. It can be slipped into the cabinet in a few seconds, however, by removing the tuning dial and the three control knobs. By the way, an extension spindle with coupling is necessary for the main tuning capacitor.

THE CIRCUIT

The theoretical circuit diagram is shown in Fig. 1 and is a conventional superhet arrangement of four valves: frequency changer, intermediate

COMPONENTS LIST

Resistors:

R1	33kΩ	R6	2MΩ
R2	5kΩ	R7	4·7kΩ
R3	100kΩ	R8	33kΩ
R4	1MΩ	R9	500Ω
R5	1MΩ		

All $\pm$10%, $\frac{1}{4}$W carbon

VR1 1MΩ carbon potentiometer, miniature button type

Capacitors:

- C1 180pF silver mica
- C2 0·01μF paper
- C3 0·1 μF sub-miniature type
- C4 0·01μF miniature type
- C5 150pF silver mica
- C6 150pF silver mica
- C7 0·01μF miniature type
- C8 0·01μF miniature type
- C9 100μF electrolytic 25V
- C10 8μF electrolytic 150V
- VC1 500pF, VC2 500pF } midget twin gang, with centre screen and long shaft
- VC3 25pF, VC4 25pF } twin gang
- TC1-4 500pF compression type trimmers

Transformers:

- T1 L.F. transformer (Radiospares Midget 3-1)
- T2 Output transformer (Elstone Type MO/T)
- IFT1, 2 Miniature 465 kc/s i.f. transformer (Repanco)

Inductors:

- L1 Long wave frame aerial } see text
- L2 Medium wave frame aerial } see text
- L3 Short wave 1 aerial coil (Osmor QA2)
- L4 Short wave 2 aerial coil (Osmor QA1)
- L5 Long wave oscillator coils (Osmor QO9)
- L6 Medium wave oscillator coils (Osmor QO8)
- L7 Short wave 1 oscillator coils (Osmor QO2)
- L8 Short wave 2 oscillator coils (Osmor QO1)

Switches:

- S1 Single pole, 4-way wafer switch
- S2 Three pole, 4-way wafer switch with long shaft
- S3 Double pole on/off toggle switch

Valves:

V1	DK92	V3	DAF91
V2	DF91	V4	N1/

Miscellaneous:

Four BG7 valve holders with screening cans. Aluminium for chassis. etc. Perspex, $\frac{1}{8}$ in. thick for coil unit. Tagboards. Dial $2\frac{3}{4}$ in. dia. (push-on type). Three knobs. Wire for coils (see text). Paxolin tubing $\frac{1}{2}$ in. dia. Plastic covered connecting wire. Loudspeaker 2 in. dia.

frequency amplifier, detector and audio frequency amplifier and pentode output stage.

The input from the long or medium wave frame aerials goes to the control grid (G3) of V1, the frequency changer, whilst for the two short wave bands two coils are switched in and work in conjunction with a tubular aerial rod.

Four oscillator coils are used, the oscillator grid and oscillator anode windings of these being switched by S2b and S2c.

The intermediate frequency is the normal 465kc/s and is fed to V2 via the miniature i.f. transformer IFT1. Here the 465kc/s signal is amplified and the output at IFT2 is then

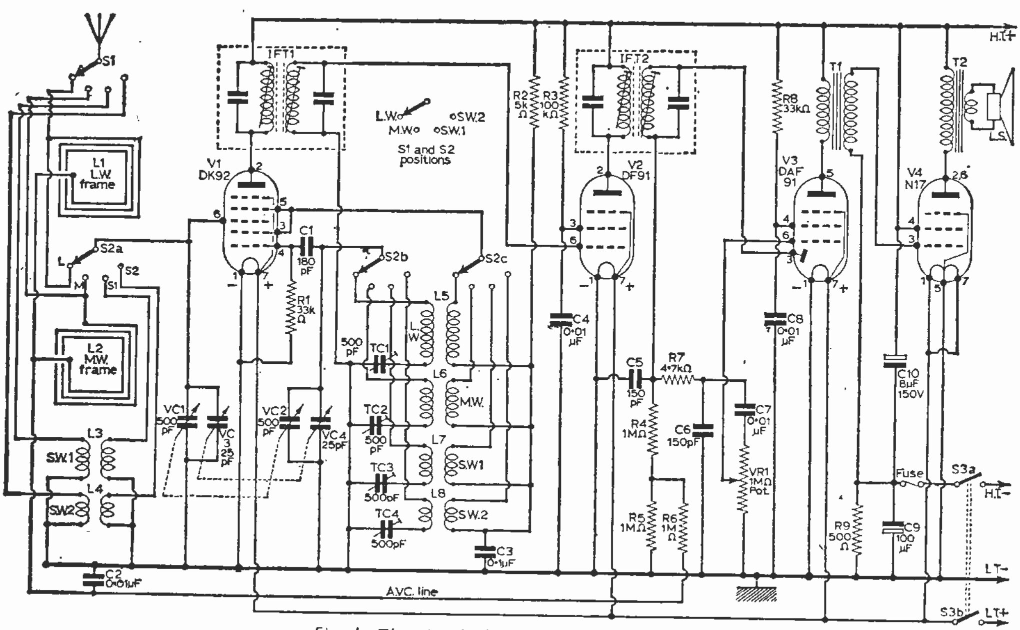


Fig. 1: The circuit diagram of the Chelmer.

passed to the diode of V3 via the volume control VR1.

A miniature audio transformer T1, ratio 1:3, couples V3 to the power output pentode V4.

Automatic bias voltage is developed across R9. It will be noted that h.t.− and l.t.+ are both switched off and on by the two-pole switch S3, thus preventing battery drain when the set is off.

It will be seen from the diagram that switch S1 is separate from S2.

S1 is used primarily for connecting the tubular aerial to the two short wave aerial coils, L3, L4, as it was found that the frame aerials were adequate for the medium and long bands without any aerial. However, there is a slight gain, particularly on some of the Continental stations, by using the tubular aerial and, if desired, two wires can go from switch S1 to the grid ends of the frames, thus making a four-point change for the aerial.

It was not found desirable to use a.v.c. for the short wave coils, but if the reader wishes to include this the bottom end of the grid coils in the coil unit will have to be joined to the a.v.c. line instead of being earthed.

Above the main tuning (ganged) capacitor VC1, VC2, will be seen two smaller (ganged) vernier capacitors, VC3, VC4, for each of the two sections. This vernier will be found most useful for the short wave bands.

The author tried resistance coupling from V3 to V4, but transformer coupling was found much more satisfactory with the 90V h.t. only available. A good-quality component is desirable both for T1

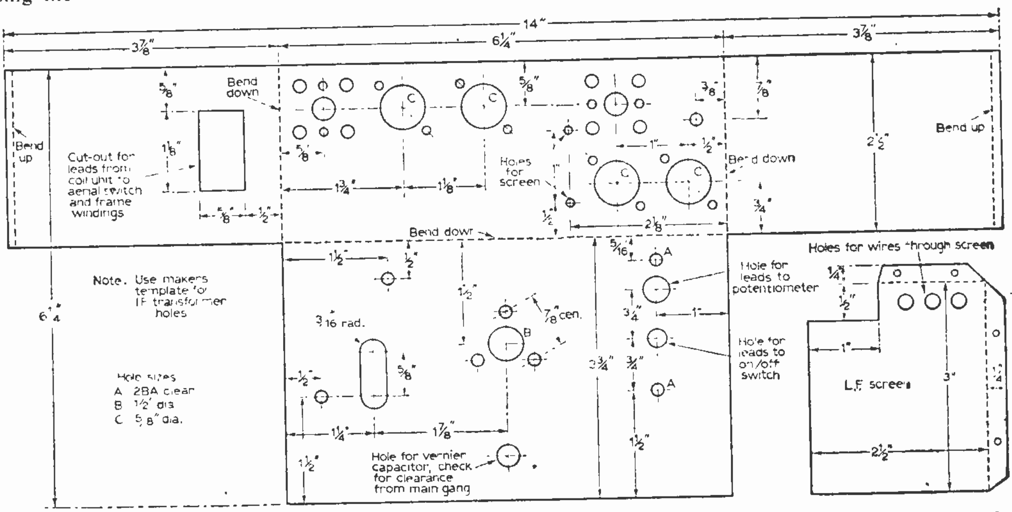
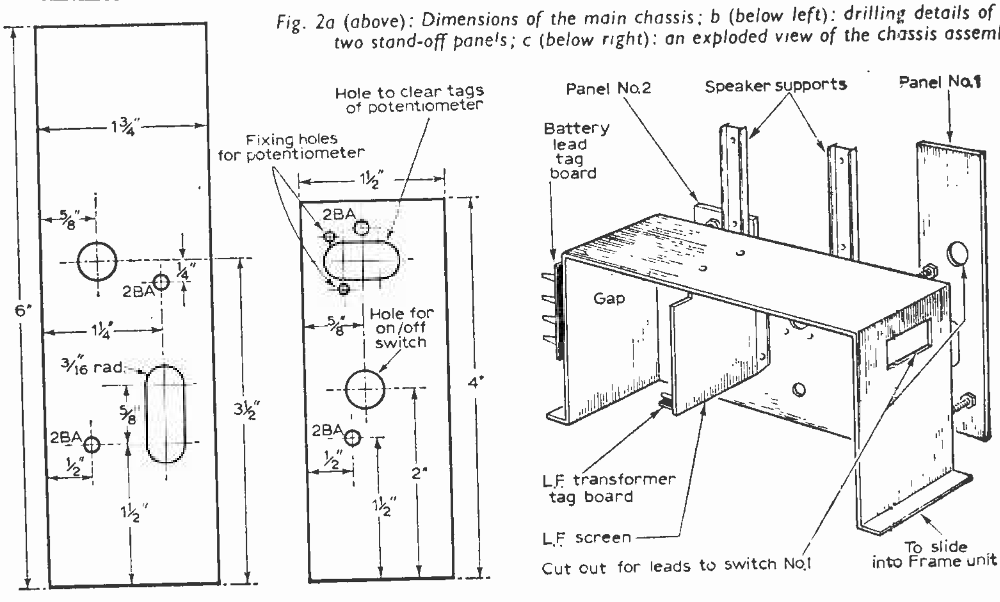


Fig. 2a (above): Dimensions of the main chassis; b (below left): drilling details of the two stand-off panels; c (below right): an exploded view of the chassis assembly.



and for the matching transformer T2.

Note particularly the filament connections to V4. The pentodes in this series of valves have a tapped filament for either 1·4V or 2·8V working. The circuit shows as connected for 1·4V use.

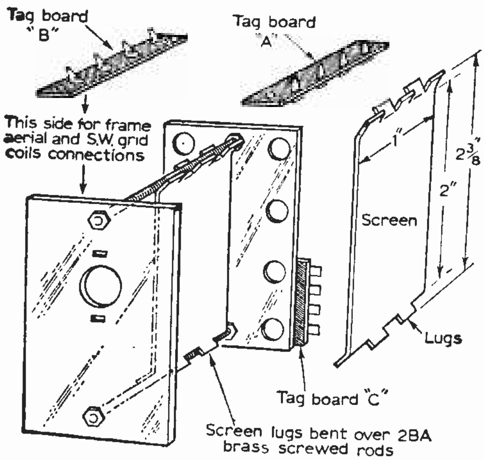
MAKING THE CHASSIS

The original chassis was formed on a standard aluminium box type chassis measuring 6in. x 2½in. x 2½in. and to this stand-off legs and panels were added during the various stages of modification.

Many constructors will no doubt prefer to make up the chassis from a single sheet of aluminium and so full details are given in Fig. 2. The aluminium should be about $\frac{1}{16}$in. thick.

It will be seen that in addition to the main chassis piece there are two stand-off panels (Nos. 1 and 2 in Fig. 2b) and an I.f. screen.

The stand-off panels might possibly be dispensed with but the trouble of cramping below the chassis deck would have to be reckoned with if the on/off switch and potentiometer were fitted inside.



The diagrams are fully dimensioned, although generally sizes have been given for centres. Diameters of holes should be checked with the actual components to be used. Sometimes makers provide templates and these should be used for marking—this applies particularly to i.f. transformers.

An "exploded" view of the chassis assembly is given in Fig. 2c.

The loudspeaker part is mounted on two lengths of aluminium curtain runner section bolted to the chassis, the speaker unit being secured to them by four lengths of 2B.A. screwed rods. The speaker can thus be adjusted to the required projection from the chassis. It will be seen that the twin vernier capacitor is mounted immediately below the main ganged capacitor, allowing very short connections and ease of operation. Both gangs require short extension spindles.

The aerial switch is just above the coil unit switch. It would be possible to combine the aerial and coil-change switches, using a four-pole, four-way switch in the coil unit, but such a switch will be found rather complicated, having tags on either side of the wafer, whilst a ganged-type wafer switch takes up too much room for the coil unit.

The miniature loudspeaker is in the centre, mounted on its supports.

THE COIL UNIT

Many readers may feel that this rather awe-inspiring unit is quite beyond their scope. However, when once the framework of this unit is made up, with the wafer wavechange switch fitted, the wiring is progressive and, if a definite procedure is adhered to, it is not beyond the average

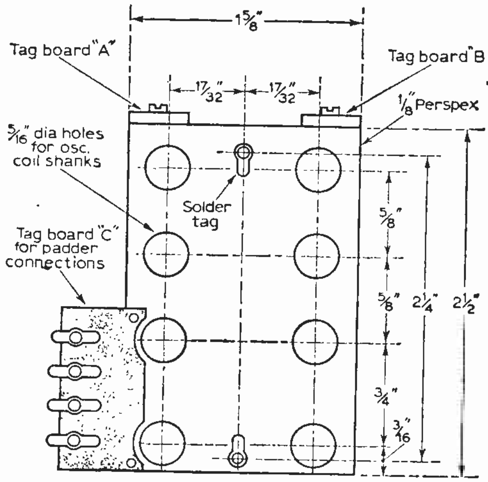
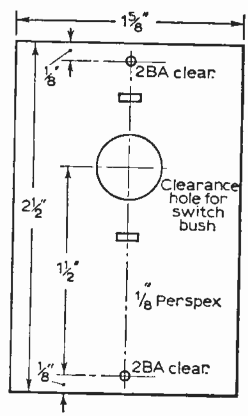


Fig. 3a (left): A general assembly view of the coil unit; b (above): details of the end piece of the unit carrying tag board "c"; c (right): details of other end piece.



radio amateur. This procedure will be given later.

Full dimensions are given in Fig. 3 for the framework of the coil unit, including the screen.

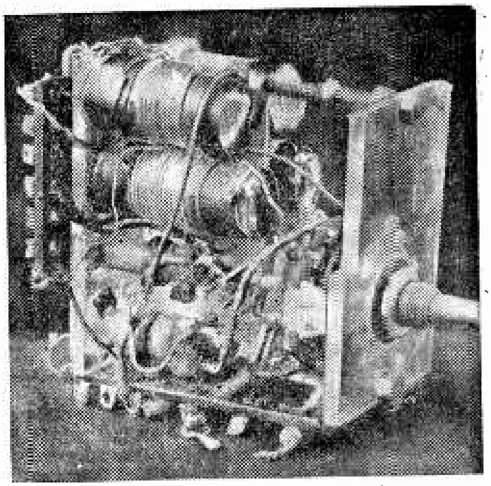
Perspex sheet is a nice material to work with, although there is no reason why aluminium sheet could not be substituted, apart from the problem of fixing the tag boards A and B.

The general assembly is shown in Fig. 3a. Two lengths of 2B.A. brass screwed rod act as tie bars to the front and back plates and also form support for the aluminium screen, the lug pieces of the latter being pressed tightly over the screwed rods with pliers. This screen is, of course, situated at the back end, leaving a space at the front end for the switch and the wiring from it and from the coils.

When the two tag boards A and B have been fitted the wiring-up of the coil unit can be commenced and it is wise to mark on the tag boards the connecting labels first. Thus "grid" (control), "OSC A", "OSC grid" and "h.t.". Also the tag board B should be labelled: "Aerial," "Long", "Med.", "Short 1", "Short 2". The "Long" and "Med." are, of course, frame aerial connections in this instance.

First, by trial with a small battery and flashlamp, find the correct set of four contacts on the switch for each pole if this cannot be ascertained by visual means. Each set of tags should be colour spotted with four different colours, with the same colour for the pole tag itself. Thus we will have, say, red spots for OSC/anode connections, green for OSC/grid and white for control grid. This is a great help when wiring the coils, but care should still be exercised to get each coil correctly connected to the right tags for long, medium, short 1 and short 2 changeover.

Commence with wires from each of the main



A view of the completed coil unit.

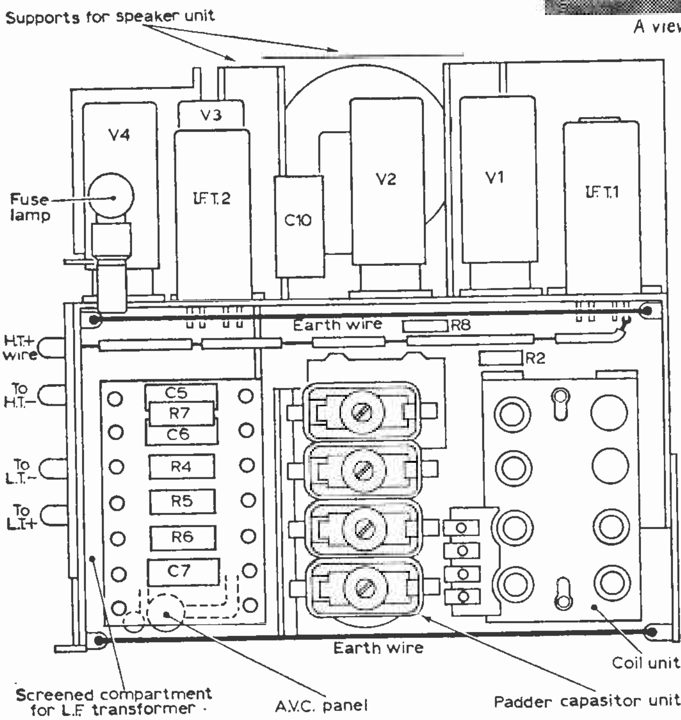


Fig. 4: A rear view of the assembled chassis showing positions of major components.

poles of the switch to control grid. "OSC anode" and "OSC grid" tags on tag board A, using fairly large gauge flex or stranded wire. A plastic insulated flex is less bulky than electric wiring type flex. Then continue by fixing the long wave coil flex, followed by the medium wave oscillator coil.

A good hot electric soldering iron of the pencil pattern is useful and it is advisable to wrap a small piece of wet or damp fabric round the coil tags as the plastic material used does not take heat kindly. Once securely soldered, however, the material is quite strong and a good insulator.

THE MAIN ASSEMBLY

The back view given in Fig. 4 shows clearly the neat arrangement of components and these, being in the form of separate units, simplifies the below-chassis wiring. The units are also quickly removed, necessitating only a few minutes with the soldering iron.

A main h.t. positive bar has been fitted from the tag board on the left and is soldered to the appropriate h.t. leg of the first i.f. transformer. This bar, which has short lengths of sleeving threaded on, allows various h.t. positive points available for connections. If red sleeving is used it will not be confused with the nearby chassis wire (earth), also a useful arrangement.

This latter bar, together with its duplicate at the bottom of chassis, should, of course, be very thick gauge tinned copper wire. Certain wires, however, will be more conveniently connected direct to chassis. Holes will be drilled for these and soldering tags bolted to the chassis. Such points are shown for V3 and V4 in the wiring view. Others could be so connected, if preferred, to common earth points.

On the right is seen the coil unit and from the small tag board on it go wires to the appropriate padder capacitors, the other ends of which are to chassis.

CONTINUED NEXT MONTH

IMPROVED RELAY CIRCUITS

THE greatest enemies of the amateur radio and electronics enthusiast are (1) financial limitations, (2) lack of availability of components on the commercial market and (3) limitations in the operating characteristics of many of the components that are available.

Relays are typical components that can be considered as falling into all three of the above categories in that while some of the not very sensitive types may be purchased for only a few shillings, the price of those that will work from only a volt or two and have a resistance of thousands of ohms is quite prohibitive to many readers.

Situations often arise in which the experimenter requires a relay that can be operated from a current of only a few micro-amperes, but such components are just not available although they are, in fact, manufactured for the industry. Moving coil types are available on the surplus market, but these generally require a current of between one and two hundred micro-amperes to make them operate—which is too heavy a current to satisfy the above requirement.

Critical On/Off Ratio

One of the most severe limitations in the characteristics of relays is the wide difference in the pull-on and the drop-out voltages. For example, it is found that a typical relay may pull on at 8½V and drop out again only when the voltage is reduced to 1½V, an on/off ratio of nearly 6:1.

In many cases this on/off ratio, which generally lies between 3:1 and 4:1, may prove to be too high to give satisfactory operation of a piece of equipment. In a light-operated unit, for example, where a photo-transistor or cadmium sulphide photocell is used to turn on a light when the daylight falls below a certain intensity and is intended to turn the lamp off again when the daylight rises back to that intensity, it is often found that due to the large difference in the relay on/off voltages the lamp often stays on almost permanently.

In this article it is intended to show simple circuits which are designed to overcome to a large degree these three enemies of the enthusiast when applied to relays.

Increasing the Sensitivity

Transistors may be used to increase the effective sensitivity of both moving coil instruments and ordinary relays. Fig. 1 shows three circuits that may be used to this end. It can be seen that no biasing networks are included in the circuits and these have been found to be quite unnecessary in this particular application.

In the circuits used as prototypes a relay with a coil resistance of 670Ω was used which required a current of 14mA to "drop in", and sensitivity figures quoted will refer to this relay. It must, however, be pointed out that any relay that has characteristics falling within the practical voltage and current ranges of the transistor with which it is used will be found to work satisfactorily using the circuits shown. Red Spots (a very cheap and excellent general purpose transistor) were used, but many other transistors are suitable.

The relay is shown connected in the emitter circuit of the transistors, but it can equally well be used in the collector circuit with no noticeable change in performance.

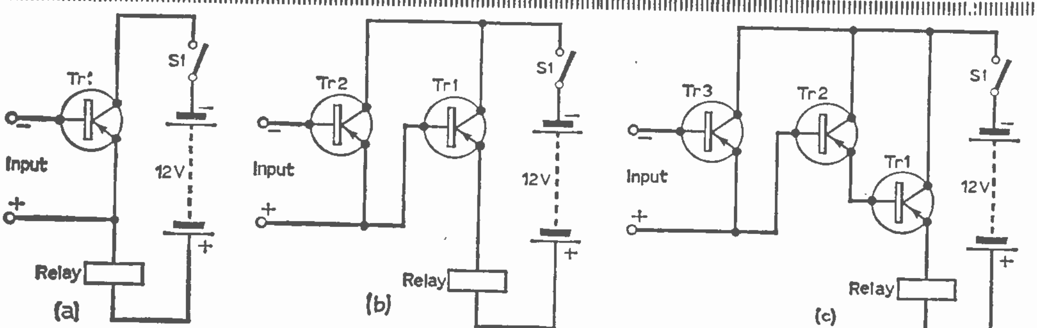


Fig. 1: Increasing the sensitivity of a relay with the aid of transistors.

for the Constructor

R.M. MARSTON

Referring to Fig. 1a, the circuit must be connected up as shown and the triggering voltage applied between the base and emitter. It is important to notice this point as if the trigger voltage is connected between the base and the positive supply line a very much greater voltage will be needed to cause the relay to operate.

In the test circuit it was found that the relay operated with a trigger voltage of 310mV and a current of 2·6mA. The drop-out voltage was 250mV which represents a very low on/off ratio.

The circuit in Fig. 1b, using two transistors, was found to operate from a voltage of 150mV at 20μA with the trigger voltage applied between the emitter and base of Tr2, while the circuit using three transistors shown in Fig. 1c operates from a mere 50mV at 10μA.

All voltage readings were taken using a 20,000Ω per volt meter on its 2·5V range. It can be seen that at these low operating voltages and current the input to the transistors presents quite a high impedance.

Triggering Polarity

Three points must be noted in particular about these circuits. First, they will only operate from one polarity of trigger signal, the base forming the negative connection and the emitter the positive.

If it is required that the circuit operates from either positive or negative signals, a bridge rectifier must be connected across the input, as shown in Fig. 2a. Alternatively if the circuit is required to operate from a.c., a bridge rectifier and smoothing circuit must be used across the inputs as shown in Fig. 2b. The smoothing circuit is necessary to prevent relay chatter, the component values being selected to suit the frequency of operation.

The second point to note is that if a number of relay circuits of this kind are to be used in an instrument, then each one must have its own separate power supply—and in any case no relay unit must have a supply common with the rest of the instrument circuitry.

If a large number of such units are to be used in one instrument it would be as well to build a rectifier and smoothing network into each unit and drive each one from its own secondary of a transformer or inverter unit.

The third point is that all transistors used must have very high resistance between emitter and collector, otherwise a small current in one transistor may be sufficiently high current to flow through succeeding transistors to prevent the relay from dropping out once it has been operated. If a "leaky" transistor must be used then it should be used in the Tr1 position, and then only if the leakage current is well below the relay drop-out current.

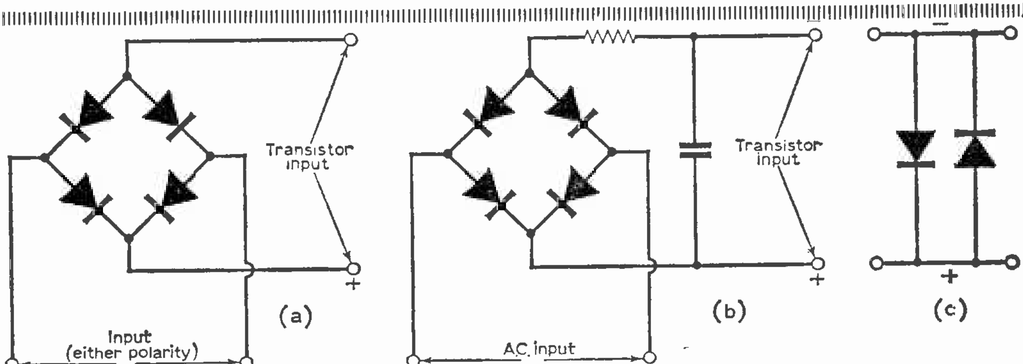


Fig. 2 (a): An arrangement to suit either positive or negative input signals; (b): to suit a.c. inputs. (c): Diodes arranged as trigger voltage limiters.

Checking the Transistors

It would be as well to check all transistors before connecting them in circuit in the usual way.

This can be performed by using an ohmmeter or a battery, a limiting resistor and a sensitive current meter in series. Check that (1) a high resistance exists between the emitter and collector with the check leads in both polarities; (2) that with one lead connected to the base a high resistance exists between it and both the emitter and the collector; (3) that when the other lead is connected to the base giving a reversal of polarity a low resistance exists between it and both the emitter and the collector.

The voltage ratings of the transistor must not, of course, be exceeded during these tests. A not very "with it" friend of mine once tested half-a-dozen transistors in this way with a 250V Megger and was quite disgusted when none of them passed the test.

Safety Diodes

A simple precaution to prevent trigger voltages of excessive amplitude from causing excessive current to flow in the transistors, with subsequent damage, is shown in Fig. 2c.

Here two germanium diodes are connected in parallel, anode to cathode and shunted across the input. When only a few millivolts are applied to the diodes they act as a very high resistance and have almost no shunting effect, but as the voltage is increased their resistance falls, with a subsequent increase in shunting effect until when about half a volt is applied they act almost as a short circuit.

If the trigger voltage is to be applied with one polarity only, with no danger of a reversal of polarity, only one diode need be connected across the input as a precautionary measure.

It is often required that a time delay be incorporated so that either the relays will not click in until a certain time has elapsed from the moment of the trigger voltage being applied, or alternatively, they will click in as soon as the voltage is applied but drop out again after a certain time has elapsed.

With the more sensitive relays it is simply a matter of connecting a resistor and a capacitor of the correct value and in the correct configuration directly to the relay in order to achieve this, but such relays are generally rather expensive and it is with methods of saving the amateur money that this article is primarily concerned.

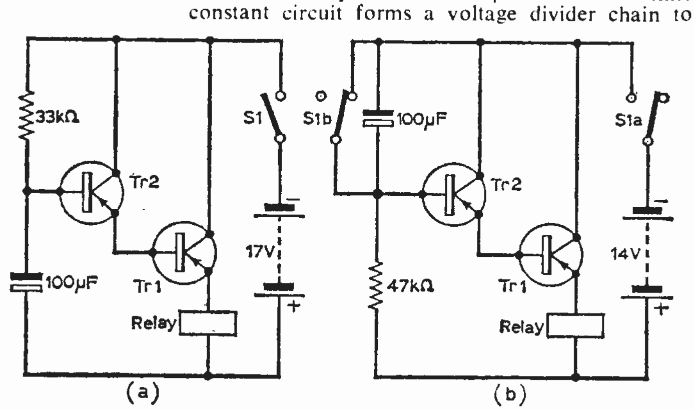


Fig. 3: Raising the input impedance still further by the use of two transistors; (a): a "delay-before-operate" circuit; (b): an "on-delay-off" arrangement.

Very cheap relays that require a comparatively high operating current may be used in conjunction with a couple of Red Spot or similar transistors to achieve the same or even better results at a fraction of the cost. In the circuits to be described the same type of relay as used in the earlier circuits was employed, that is, a 670Ω 14mA operating type.

Time Constant Circuit

The normal method for obtaining the time delay with a transistorised circuit is to wire the relay in series with either the emitter or collector of the transistor and connect a time constant circuit, which consists simply of a resistor and capacitor in series, between the positive and negative supply lines with the junction of the two components wired to the transistor base.

If the capacitor is wired to the negative line, then the relay will come on as soon as the operating voltage is applied to it but will drop out again after the required time delay; whereas if it is the resistor that is connected to the negative line then the delay will occur before the relay operates.

In practice the input or base to emitter impedance is fairly low, in the order of a few hundred ohms, when sufficient voltage is applied to it to cause a current of several milliamps to flow in the collector circuit. This low impedance acts as a shunt across the time constant circuit, with unfortunate results.

An approximation of the time constant given by a series resistor and capacitor is given by the formula $T=RC$, where T=time in seconds, R=resistance in ohms and C=the capacitance in Farads. Thus a resistance of 100,000Ω must be used with a capactor of 100µF in order to obtain a delay of ten seconds.

If the transistor input impedance shunts the resistor down to a value of only 100Ω then a capacitor of 100,000µF will be needed to give the ten second delay, an impractical value.

Another way of looking at the problem is to say that a certain voltage must be applied to the base in order to cause a sufficient voltage to appear across the relay to make it operate, but the time constant circuit forms a voltage divider chain to the base. With the resistor shunted to a value of a 100Ω or so in the "delay before make" type circuit and using the specified 100µF capacitor it would probably be necessary to apply over a hundred volts across the chain in order to reach the required base voltage.

The way round this difficulty is to connect the relay in the emitter line, in which case the base voltage is applied between the base and the positive line and not base and emitter, with the result that the input impedance is raised in much the same way as happens with the valve type cathode follower circuit. Roughly speaking the input impedance then becomes the product of the transistor current gain and the resistance in the emitter line, in this case the relay coil resistance.

Raising the Input Impedance

The input impedance gained in this way may still be low enough to cause severe difficulties, but it can be raised still further using two transistors, as shown in Fig. 3.

Here it can be seen that the emitter of a second transistor, Tr2, is connected to the base of the first and that the collectors of both Tr1 and Tr2 are connected to the negative line. The operation is as follows:

Assuming the rough calculation of input impedance above to be correct and the gain of the transistors to be 30, then if a relay with a coil resistance of 1,000Ω is used it is found that the input resistance at the base of Tr1 = 30,000Ω. The base resistance of Tr1 also forms the emitter load of Tr2, so that its input impedance becomes 30 × 30,000 = 900,000Ω or so. In practice impedances of several hundreds of kΩ can be expected. This is sufficiently high to cause negligible shunting to most time constant circuits.

It is found in practice that the time delay required is best found by experiment as it depends not only on the theoretical resistor and capacitor values, but also on the characteristics of the relay, the transistors and on the voltage of the supply.

In the circuit shown in Fig. 3a, which is of the "delay before operate" type, it was found that with the relay already stipulated a delay of six seconds occurred using a resistance of 33,000Ω and a capacitance of 100μF and a battery voltage of 17V. The relay is started by switching the supply on to the unit via S1. When the supply is turned off again the unit resets almost at once, a delay of a small fraction of a second occurring while the capacitor discharges itself. The reason for the fairly large battery voltage is that the transistor used would only pass a little over the required 14mA to operate the relay from a 12V supply even when the base of Tr2 was connected to the 12V negative line directly. 17V is, of course, well above the recommended maximum rating for Red Spot transistors and although the writer has used such voltages many times in the past without a single failure it is possible that break-down may occur in some cases.

It is therefore recommended that in cases where it is decided to use a transistorised delay circuit on a relay which requires an operating current of greater than 14mA within the voltage ratings of the transistors, Tr1 be replaced either by an OC72 or OC81, or preferably, with a view to keeping the cost down, by two or more Red Spots in parallel, that is, wired emitter to emitter, collector to collector and base to base.

On-Delay-Off Circuit

The circuit shown in Fig. 3b is the arrangement for the on-delay-off type of unit. In the prototype circuit a delay of five seconds was obtained using a capacitor of 100μF and a resistor of 47,000Ω with a battery voltage of 14V.

It should be noticed that with this circuit once the relay has dropped out the circuit does not automatically reset itself, as the capacitor retains its charge even if the battery supply line is broken. It is therefore necessary to use a two pole, two way switch for operating the circuit, with one switch bank in series with the supply and the other wired across the capacitor so that when the power is turned off the capacitor is automatically short circuited and discharged. Resetting then becomes automatic. There may be occasions when time delays or increased sensitivity are not required at all, and the only problem presented by the relay under consideration is its wide on/off voltage ratio. As already mentioned, this ratio generally lies between about 3:1 and 4:1 which is large enough to present many problems in what can be described as servo-operated equipment where the relay is intended to come on only when a sound, light, heat or other quantity reaches a certain value and to drop out again when the quantity falls below that value again.

Reducing the On/Off Ratio

A simple solution to this problem is to wire a Zener diode in series with the relay, as shown in Fig. 4. The reduction in the on/off ratio is a function of the ratio of the Zener voltage/relay voltage ratio.

The action of the Zener is to more or less raise the on/off voltages of the relay by the value of its own voltage. For example, in a test circuit it was found that a relay came on at 8½V and dropped out at 1½V, giving a ratio of about 5·7:1, a little wider than average. When an 8V Zener was connected in series with the relay it was found that the on voltage became 15 and the off voltage 8½, giving a ratio of between 1·7:1 and 1·8:1, a great improvement.

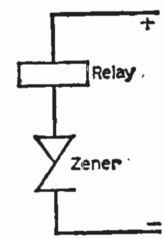


Fig. 4: Using a Zener diode to reduce the on/off ratio.

In a second test a 1,000Ω relay with an on voltage of 10½ and an off voltage of 3 was used, giving an on/off ratio of 3·5. When the 8V Zener was connected in series the voltages became 16½ and 10 respectively, giving a ratio of 1·65.

A third test used a 10,000Ω relay with on/off voltages of 10 and 3 with a ratio of 3·3:1. When the 8V Zener was used these became 18 and 10·5 giving a ratio of about 1·8:1.

The higher the Zener voltage used the smaller becomes the on/off ratio, so that the ratio can be made to be determined only by the maximum available supply voltage and the sensitivity of available relays.

If for example, a relay with on/off voltages of 10 and 2½ is available, giving a ratio of 4:1, and is to be used in a valve circuit where an operating voltage of say 200 may be used, then a number of Zener diodes may be wired in series to give a Zener voltage of 190. It will then be found that when the relay is put in series with them the on/off voltages will become about 200 and 197 so that the on/off ratio is then reduced to virtually 1:1.

It must be realised, of course, that it is only the on/off *voltage* ratio that is altered in this way, the on/off current ratios remaining the same. ■

A tape auto stop

BY K. A. CARR-GLYNN

MANY less expensive tape recorders are not fitted with automatic tape stops to halt the drive mechanism when the tape has run to the end of the spool, but the device to be described enables practically all such tape recorders to be modified for "auto stop".

Most tapes have stop foils at the ends. before the last leader, and this foil is used to actuate the tape stop. The circuit as shown in Fig. 1 is a very simple one, though very effective.

MR1 is a meter rectifier of the bridge variety, though, as it is only the heater voltage that is being rectified and in normal conditions there is no drain on it, there is nothing against the use of germanium diodes here.

When running the tape normally, the negative potential from MR1 is applied to both grids of V1, which is consequently cut off. The reason a double triode is used is the need to provide a large current increase to operate the relay RL1. When the valve is cut off the relay is de-energised and supplies are made to the tape amplifier and drive motor. This state is indicated in Fig. 1.

However, when the metal leaders on the tape short out the two contacts "x" and "y" the grids are earthed, and a large current flows through the valve and the relay becomes energised. Thus the motor supply is broken, and also, in order not to increase the current drain on the h.t. rectifier, the amplifier supply is broken also.

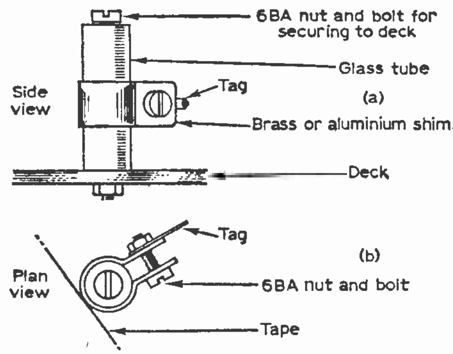


Fig 2: A brass shim fitted to a tape pressure guide.

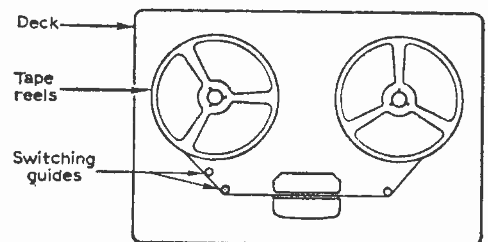


Fig 3: A suitable arrangement for the 'switching guides'.

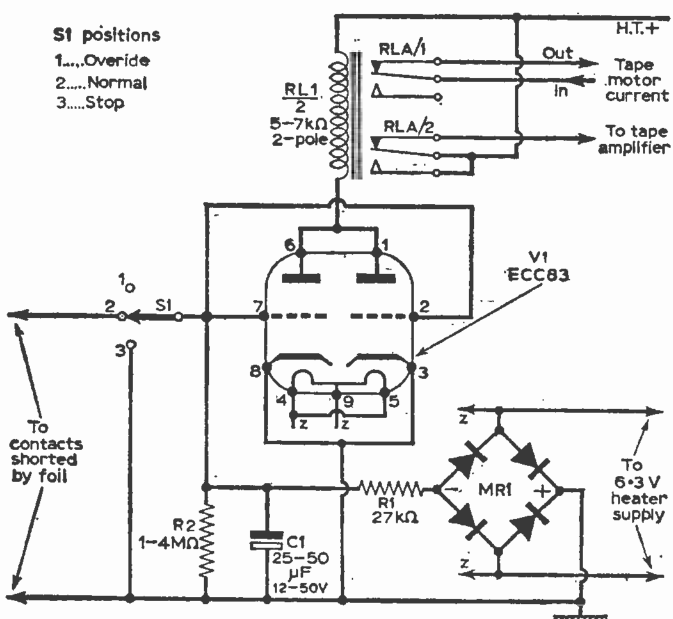


Fig. 1: The simple circuit of the device.

It can be seen from this, however, that the *beginning* of the tape will also stop the tape, and to prevent this action a three-way switch can be inserted, shown as S1 on the diagram.

When S1 is placed in the "override" position the foil does not actuate the stop device, and when placed in the "stop" position the grids are earthed and the motor and amplifier supplies broken.

In order to operate this device two contacts are needed which will be shorted together by the metal foil. In the Philips recorder which the author possesses, one of the tape guides was a glass tube. This was covered with a brass shim and one of the tape pressure guides was used as the other contact as indicated in Fig. 2.

Two of these contacts or "switching guides" could be fixed on to the deck at any convenient point (Fig. 3).

It is essential to ensure that brass shims are perfectly flat on the glass. The shims should be well polished with grinding paste, then with "Brasso" to ensure a perfectly smooth surface. ■

a voice-operated Baby ALARM

This piece of equipment will operate on a baby's cry and will relay the output through the audio stages of a television receiver.

By G. G. Scott

THIS alarm device consists of a voice operated switch and it was designed to work in conjunction with the output stage of a television receiver.

The television receiver audio circuit is broken between the volume control and the grid of the a.f. amplifier. Connection is taken from the centre slider on the volume control to a relay which is mounted on the baby alarm unit.

In the de-energised condition of the relay, the television sound is switched back to its own amplifier. When the relay is energised due to a signal in the alarm, the audio output from the television receiver is switched off and the audio output from the baby alarm is switched to the television set.

This system was designed as the normal baby alarm with its own output stage and speaker and was found to have certain disadvantages.

(1) Difficulty was found in detecting whether the sound was coming from the alarm or the TV set.

(2) If it was a good programme on TV, one waited a minute or so before seeing to baby, while

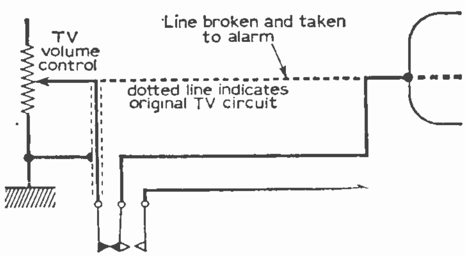


Fig. 1: The necessary connections from the television receiver.

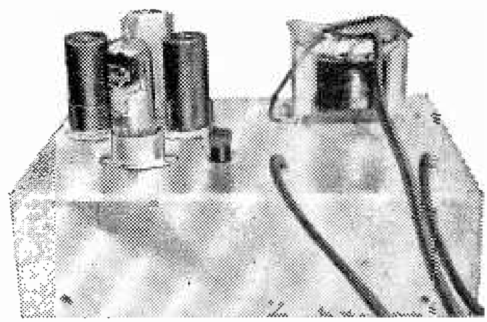
if a baby appeared on TV one was always running to see to baby!

The Circuit

The microphone pre-amplifier is of the simple double triode (ECC83) type, designed more for simplicity rather than quality.

Two outputs are taken from the second stage, V1B, one via the relay contacts to the television receiver, and the other to a square wave limiter.

A 1MΩ grid stopper (R10) is used in the limiter stage V2. When the signal on the grid of V2 is more positive than the cathode, grid current flows



The finished equipment.

so that the grid only goes slightly positive and is held at a more or less constant potential, thus squaring the positive peaks. On the negative half cycles, when the signal goes beyond grid base, the valve is cut off thus squaring the negative peaks.

A bleeder network, R8, R9, from h.t. is used so that the cathode potential is less dependent of valve current. It was also found that the screen produced a better square wave than the anode, so the screen is coupled through a 1500 pF capacitor C3 to a double diode, V3.

Operation of Diodes

On the positive half cycle the right hand plate of C3 follows the square wave output. This makes the anode of diode V3B positive, and it conducts, so charging up the 0·05 capacitor C4 in its cathode (to approximately 50V) as well as the 1,500 pF capacitor C3 (see Fig. 3).

On the negative half cycle the square wave voltage drops by about 200V thus the right hand plate of C3 drops to approximately 150V negative. As diode V3A cathode is now at 150V negative with respect to its anode, it conducts thus discharging C3 to its original state. As diode V3B anode is also negative this diode is cut off and C4 discharges through the 1MΩ resistor R14.

On the next positive half cycle the whole operation starts over again.

The 1MΩ resistor R15 and the 0·1μF capacitor

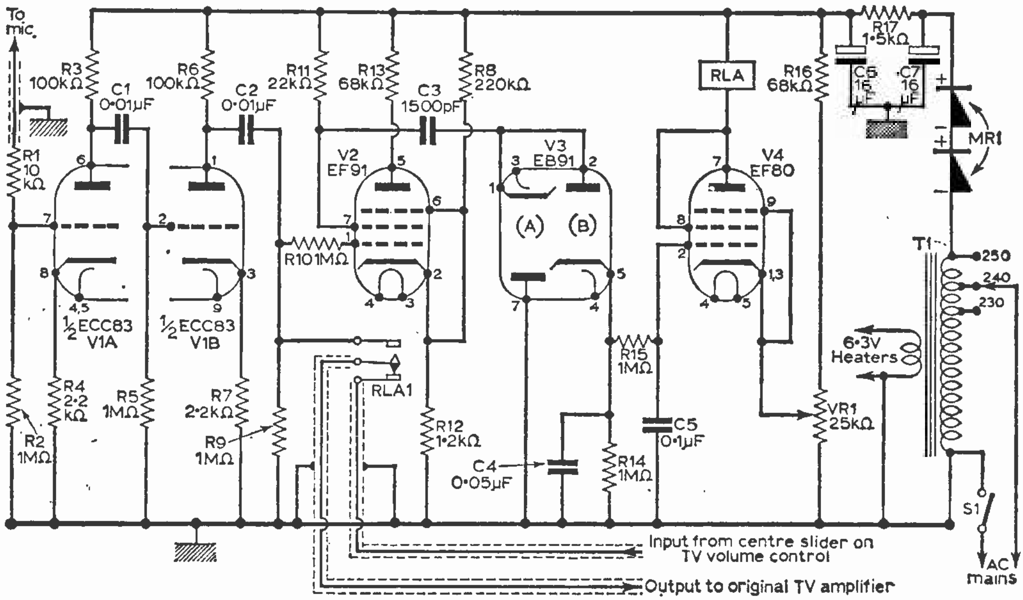


Fig. 2: The circuit of the unit.

COMPONENTS LIST

Resistors:

R1	10kΩ	R10	1MΩ
R2	1MΩ	R11	22kΩ
R3	100kΩ	R12	1·2kΩ
R4	2·2kΩ	R13	68kΩ
R5	1MΩ	R14	1MΩ
R6	100kΩ	R15	1MΩ
R7	2·2kΩ	R16	68kΩ
R8	220kΩ	R17	1·5kΩ 1W
R9	1MΩ		

All ±10% ½W carbon except where otherwise stated.

VR1 25kΩ wire wound potentiometer

Capacitors:

C1 0·01µF paper
C2 0·01µF paper
C3 1,500pF paper
C4 0·05µF paper
C5 0·1µF paper
C6 16µF electrolytic 350V
C7 16µF electrolytic 350V

Miscellaneous:

MR1, 2 Half wave metal rectifier 125V 60mA
T1 Mains transformer. 200—250V tapped primary 6V 1·5A
S1 Single pole on/off switch
V1 ECC83
V2 EF91
V3 EB91
V4 EF80

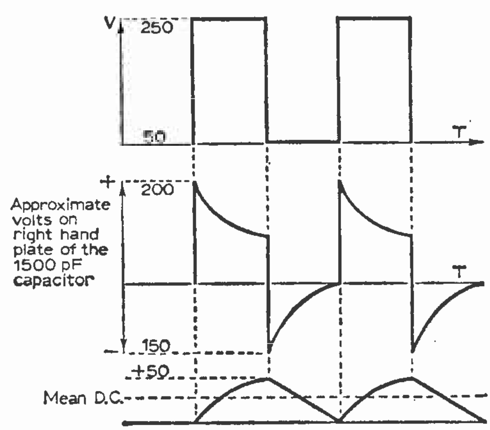
Fig. 3: This illustrates the operation of the diodes (see text)

C5 form a filter so that a d.c. proportional to the frequency is applied to the grid of the relay amplifier V4.

The cathode of the amplifier valve is connected to a bleeder network from h.t. The 25kΩ variable VR1 (wire wound) biases the valve to cut-off when no signal is applied. The correct bias is found by talking fairly quietly into the microphone and adjusting VR1 until the relay just energises.

As the d.c. voltage on the grid of the relay amplifier is proportional to frequency, then the bias on the cathode can be arranged to suit the frequency required.

The power supplies are derived from a 6V heater transformer and two RM1 half wave metal rectifiers connected in series. ■



BOOKS REVIEWED

RADIO, TELEVISION AND ELECTRICAL REPAIRS

Edited by Roy C. Norris; published by Odhams Books Ltd. 576 pages, 6in. x 9in. Price 50s.

THIS is the fourth edition of a well-known publication, but is by no means a rehash. A team of eight specialist contributors, under the guidance of Roy C. Norris, Technical Editor of "Electrical and Radio Trading", has completely rewritten the work.

The subjects range from water heaters, domestic appliances and electrical installations, through radio and TV adjustments and repairs to the latest u.h.f. innovations that pave the way to colour—and there is even a section specially prepared to explain the various colour TV systems. Also included is a comprehensive section on the servicing of gramophone and tape recorder mechanisms.

Whether the handyman wants information on electrical wiring, bench work, power supplies or refrigeration, or the practising engineer requires to brush up his knowledge of current techniques of radio and television repairing, an authoritative reference will be found in this comprehensive volume.

There are thirty chapters, each a dozen pages long, an initial table of abbreviations and symbols and an index that runs into five pages of small print. In the 576 page work there are no less than 470 illustrations.

It is perhaps on this last point that the reviewer might find cause to carp. There is a curiously old-fashioned flavour about the drawings and their presentation. No photographs have been used. The very annoying habit of omitting component values from circuit diagrams has been retained, except in the fault-tracing section.

But this is a minor defect in an ambitious publication that should not be absent from the bookshelf of anyone, amateur or professional, who is concerned with radio, television or electrical repairs.—*B.R.G.*

SHORT WAVE AMATEUR RADIO

By J. Schapp, PAOHH. 160 pages, 5¾ x 8¼ in. 7 fold-out diagrams, Price 21s.

Published by Philips Technical Library. U.K. Distributors: Cleaver-Hume Press Ltd.

THIS book is not a handbook which could be described as essential for experienced amateurs, nor is it a basic book for the novice, but tends to steer a middle course. Unfortunately, in a small volume such as this it does, of necessity, only offer a very brief discussion on the various technical aspects of amateur radio.

It omits any great discussion of single sideband, a mode which is becoming increasingly popular, and also makes no attempt at v.h.f., this being described as outside the scope of the book. It is felt that this book has a limited appeal on the British market although had values been included with all the circuits shown it might well have proved more useful. The preface warns that this is not an extensive practical manual and the brevity with which it deals with some topics may be judged by the fact that transmission lines are dealt with in two pages.

At the back are pull-out circuit diagrams of two transmitters and two receivers. The wire for the coils is not specified in s.w.g., but in actual diameter in millimeters. Although there are no layout diagrams and few constructional details there are photographs of the equipment, which would prove handy to the would-be constructor.

There are a number of useful appendices contained in the last twenty-eight pages. Included amongst these are bandspread calculations, coil calculations, amateur abbreviations, and an abridged version of the list of countries prefixes.—*D.G.*

DIODE CIRCUITS HANDBOOK

By Rufus P. Turner. 128 pages, 8½ x 5½ in. Price 18s.

INTRODUCTION TO ELECTRONIC SERVICING

By J. A. Stanley. 160 pages. 8½ x 5½ in. Price 24s.

Both books originally published by Howard W. Sams & Co. Inc., Indiana, U.S.A. Published and distributed in the U.K. by W. Foulsham & Co. Ltd.

THE diode is perhaps one of the simplest components to be found in the world of wireless and electronics. So simple, in fact, that many people tend to regard it as merely a glorified cat's whisker. It's the "small thing with two wires", and asked to name some uses of a diode, the average reader might reply; "rectification, detection and . . . ?"

For these who, like the writer, have sadly underestimated the humble diode a book has been written and in it Mr. Turner describes not two, but nearly a hundred uses for a diode. Not only describes them but furnishes with each a practical circuit diagram complete with values. Still not convinced? Then, let's flick through a few pages entirely at random, and see just how versatile and useful these "things with two wires" are:—

Page 35 shows two circuits, one of a c.w. transmitter and the other a 'phone transmitter. The valve line up—one diode. A diode capacitor memory cell is depicted; again only one diode is necessary. One could jump about the book and name circuits to suit all takes. The photo diode, tape or punched card reader, a "grid" dip oscillator (yes only one diode for this too) an a.f. milliameter, a diode matrix to name just a few.

In case some readers are still thinking in terms of "cat's whiskers", Mr. Turner includes many circuits which use the newer Zener diodes, tunnel diodes, and a newcomer called the Varactor, a device whose capacitance is dependent upon the voltage applied to it. A snag which might arise is the availability in this country of the particular

continued on the following page

A SIMPLE R.F. AMPLIFIER

BY J. ROBERTS

THIS unit is primarily intended for use with those domestic receivers which cannot be provided with an efficient outdoor aerial. It consists of an untuned radio frequency amplifier which can appreciably improve the medium and long wave performance of the usual four stage type of superhet receiver. The amplifier will also prove to be useful for most crystal sets and t.r.f. receivers.

The circuit is exceptionally simple and construction should therefore present no difficulty to less experienced constructors. Of course the usual care must be taken when soldering the transistor and when connecting the battery since errors will almost certainly destroy the transistor.

Economical Power Consumption

The circuit is very modest with respect to power supplies and works efficiently when taking a current of about 1mA from a 4½V torch battery. With long and therefore more efficient aerials the amplifier may tend to overload the receiver when it is tuned to powerful stations. It is thus necessary to be able to adjust the gain of the amplifier and this is achieved by reducing the current flowing through the transistor by means of VR1.

Connecting to the Receiver

With most receivers there will no difficulty in connecting up the amplifier. However very great care must be taken when dealing with receivers of the a.c.-d.c. (all mains) type. In such cases ensure that the neutral wire of the mains is connected to the chassis and also that the earth and aerial sockets of the receiver are isolated from the chassis via suitable capacitors. It is also advisable to disconnect such receivers from the mains supply when connecting the amplifier.

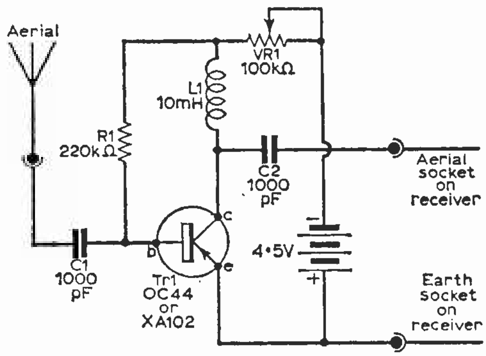


Fig. 1: The simple transistor circuit.

Performance

It is difficult to give an exact idea of the improvement likely to be noticed, as so much will depend on the particular receiver and aerial in use with the amplifier.

The amplifier has been tested with receivers other than the domestic type and this example of a test on a communications receiver may be of interest:

National 9 Valve superhet, 8ft. indoor aerial, time 11 p.m., medium wave band; 26 stations readable without amplifier; 51 stations readable when the amplifier was added. The results of this test were checked carefully and there is no error. ■

BOOKS REVIEWED

—continued from previous page

diodes indicated since this book is of American origin. Any reputable stockist would perhaps advise as to British equivalents, and of course, it is possible to send to the U.S.A. for the diodes with the happy knowledge that postage would be reasonably cheap.

Other than bearing this one point in mind the book would appear to be a useful addition to any Library. Since the majority of the circuits contain only one or perhaps two diodes the book should appeal to experimenters with a limited budget. Indeed, there is a separate chapter entitled "Experimenter's Circuits", which would be ideal for readers whose interests lie in this field.

WRITING a book strictly for a novice is no light task, especially when the subject is on a highly technical topic such as a branch of electronics. It is one thing for an author to be knowledgeable and highly skilled, but to write clearly and concisely so that a raw beginner will fully understand is a very different kettle of fish.

In "**Introduction to Electronic Servicing for the Beginner**", Mr. Stanley has proved beyond any shadow of doubt that he is able to write with great clarity and simplicity and in such a way that any novice will find it a very difficult task *not* to understand.

This book is thoroughly recommended and is excellent in every way. It takes the novice gently by the hand and guides a good reliable solid path through both theory and construction. It is profusely illustrated, and gives both circuit diagrams and actual drawings. When a new section or extra components are added, the existing wiring is shown "ghosted" and the new additions are shown clearly in black. It teaches how to read a circuit diagram, and by the excellent methods mentioned gives full details for the construction of a power unit, signal tracer, multimeter, and superhet tuner, together with full details of how to use, how to test, and how to repair. Although the price is 24s., there can be little doubt that it is a bargain.

The book is of American origin, but no risks are taken due to differences in electronic practice, and a two and a half page introduction is especially written for the benefit of British readers.

TEST GEAR accessories

Part 6

BY C. MACKAY

CONTINUED FROM PAGE 136 OF THE JUNE ISSUE

MOST experimenters will have in their workshop at least a good multimeter. A signal generator or grid-dip meter, possibly a bridge and an audio oscillator may also be available, and nowadays many of these individuals even own an oscilloscope.

However, there must be few experimenters who, at one time or another, have not wanted to take voltage or current readings at two different points in an experimental set-up and thus found that one multimeter is just not enough.

Although they have spent a large amount of money on, say, an oscilloscope, they are usually most unwilling to fork out an extra £2 for a low sensitivity though highly accurate second multimeter.

This kind of meter can be of the 1,000Ω per volt type (1mA f.s.d.) and, in conjunction with precision shunts and droppers, can give a result of as high an accuracy as one's good (say 20,000Ω per volt) multimeter—provided that care is taken to use this second meter in such a way that it does not noticeably affect the circuit conditions.

The circuit of a suitable multimeter built by the author is given in Fig. 22a. The meter used was of the 1mA f.s.d. type with an internal resistance of 100Ω.

If a meter with any other value of internal resistance is employed R7 becomes $\frac{Ri}{99}$ and R8 becomes $\frac{Ri}{9}$.

Seven ranges are available: 0—1mA d.c., 0—10mA d.c., 0—100mA d.c., 0—1V d.c. 0—10V d.c., 0—100V d.c., 0—1,000V d.c.

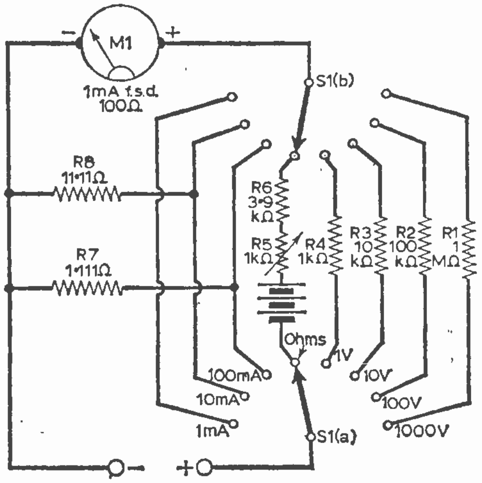
CONTINUITY/INSULATION TEST

No facilities are included for the measurement of a.c. voltages and currents as the "good" multimeter is generally adequate.

As shown above, a range for testing insulation and continuity is provided, though no separate calibration scale was given for this range. However, if required it could be calibrated as in Fig. 22b.

Good quality 1% tolerance components must be used for R1-R4, R7 and R8.

In order that the overall accuracy of the completed instrument should be maintained as high as possible the author advises that the shunts (R7 and R8) should be bought and not made up. These can be purchased at a reasonable price from the Planet Instrument Company, which advertises



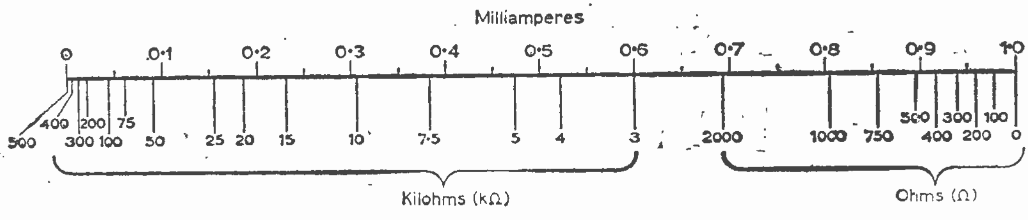
COMPONENTS LIST FOR FIG. 22a

R1	1MΩ 1%, 1W
R2	100kΩ 1%
R3	10kΩ 1%
R4	1kΩ 1%
R5	1kΩ wirewound
R6	3,900Ω 10%
R7	1·111Ω 1% wirewound
R8	11·11Ω 1% wirewound
M1	Moving coil meter. 1mA f.s.d. Internal resistance 100Ω
S1	1 pole, 8 way, 2 bank wafer switch
B1	4·5V flat battery

Miscellaneous:
Two terminals, one red, one black.

Fig. 22a (left): A multimeter circuit as used by the author;

b (below): calibrations for an ohms scale.



regularly in this magazine. R6 is for adjusting the meter to read full scale on the resistance range with the input terminals shorted out.

MOUNTING THE METER IN ITS CASE

The case used by the author was a rejuvenated wooden box used for protecting a large mains transformer in transit. Virtually any case, wooden, plastic or metal, can be used. If it is metal the terminals, which can be spade terminals or wander plug sockets, should be well insulated from the box. The matter of the cabinet will therefore be left to the ingenuity of the experimenter.

A few suggestions worth some consideration are using biscuit or sweet tins, lunch boxes (metal or plastic), Oxo cube boxes or baking tins with a separate aluminium baseplate.

This unit can be easily and completely constructed for under £2.

USING THE "SECOND" METER

If this meter is placed across a circuit wherein the current flowing is of the same order as that which will be taken by the meter itself, the extra load imposed upon the circuit by the meter will completely change the circuit conditions and all readings taken by the meter will be inaccurate if not completely false.

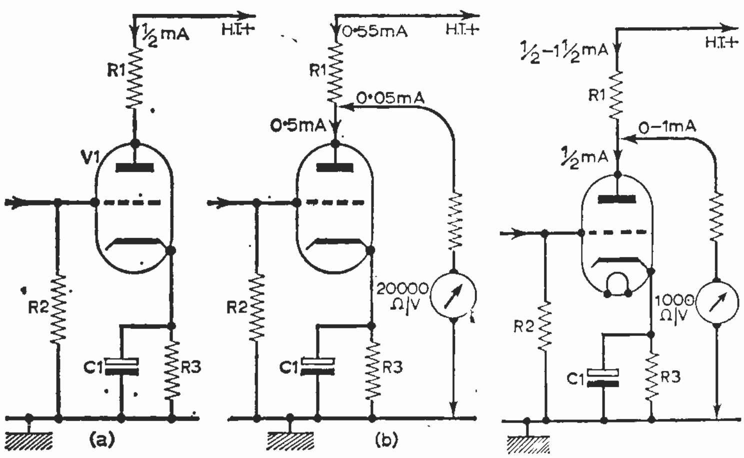


Fig. 23 (a): An audio amplifier; (b) measuring with a 20kΩ/V meter; (c) with a 1kΩ/V meter.

A meter which draws only say, 50μA, therefore, will not have nearly so drastic an effect as will one which draws 1mA.

This can be seen more clearly in Fig. 23a. Here, a valve, V1 is drawing 0.5mA from the h.t. + supply. In Fig. 23b a 20,000Ω per volt meter is connected across point A and chassis in order to measure the anode voltage. This meter will draw only 0.05mA from the circuit and the error of the reading will be only because the current has increased from 0.5mA to 0.55mA.

In Fig. 23c, a 1,000Ω per volt meter is connected between A and chassis. As this meter takes its maximum current of 1mA, the anode voltage will be greatly reduced (owing to the increased current through R1) and the error will be so great as to make the reading quite useless.

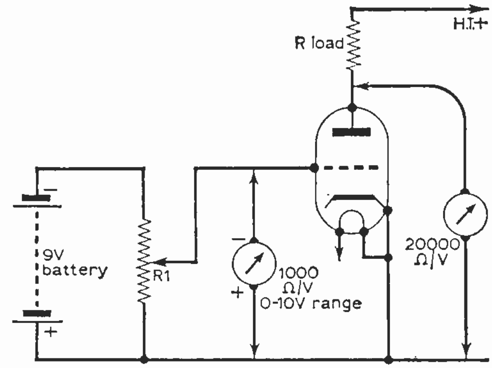


Fig. 24: "Cause and effect measurements" where a pair of meters is indispensable.

The reader by now, will probably be wondering why a meter of this sort has ever been used at all. The reason is that these meters can be used for voltage measurements where the current taken by the meter does not affect the performance. They may also be used for current measurement so long as the current to be measured is high enough to give a readable reading (usually 5% of f.s.d. is enough).

TWO METERS INDISPENSABLE

An example of a circuit test where two meters are indispensable is given in Fig. 24. Here, it is desired to measure the amplification of a triode valve with a given anode load. The "good" meter, which draws a low current, is used to measure the anode voltage, while the low sensitivity meter is used to measure the input voltage, which is adjusted by means of R1, a potentiometer attenuator.

The low sensitivity meter is also highly satisfactory for the measurement of current. For example, this meter could have been used to measure the anode current accurately in Fig. 23. As the anode load resistance would only be increased by perhaps one part in two or three thousand, the results obtained with the meter in that position would be most accurate. At the same time the "good" meter could be used for voltage measurement on the anode as in Fig. 23b.

This relatively simple meter will be found to be invaluable to the experimenter if it is used with only a little forethought. The instrument is of a well-tried and thoroughly reliable design and will give many years of reliable service. ■

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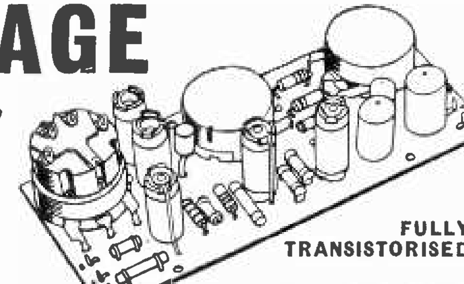

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CLUB NEWS

ACTON, BRENTFORD AND CHISWICK RADIO CLUB
Hon. Sec.: W. G. Dyer, G3GEH, 188 Gunnersbury Avenue, Acton, London, W.3.
The Club next meets on 9th June when members will review the experiences and results of their participation in National Field Day.

AMATEUR RADIO CLUB OF NOTTINGHAM
Hon. Sec.: R. W. Attenborough, G3RDJ, Beech House, Chapel Lane, Epperstone, Nottingham.
The meetings of this Society are held every Tuesday evening at the Sherwood Community Centre, Woodthorpe House, Mansfield Road, Sherwood.

BRADFORD RADIO SOCIETY
Hon. Sec.: E. G. Barker, G3OTO, 63 Woodcot Avenue, Baildon, Shipley, Yorkshire.
Members enjoyed a full programme of events for May, beginning with a discussion on N.F.D. arrangements on the 12th. In the same month a party from the club were the guests of the Spen Valley Radio Society, and on the 26th, J. Spivey (G2HHV) gave a lecture called "V.H.F. Operating."

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: P. J. Holland, "Field House," 19 Kingsley Road, Gt. Boughton, Chester, Cheshire.
Members attended the meeting for May 5th to hear a lecture. A week later, members were invited to bring any valves with them for testing on the valve-tester which G3EWZ had brought along for a demonstration. National Field Day arrangements were under discussion on May 26th.

IPSWICH RADIO CLUB
Hon. Sec.: R. J. Wells, 43 Clench Road, Holbrook, Ipswich, Suffolk.
This society's activities cover all aspects of radio and therefore any potential members are welcomed to the meetings which are held at Ipswich Civic College on the last Wednesday in each month, commencing at 7.30 p.m.

LICHFIELD AMATEUR RADIO SOCIETY
Hon. Sec.: V. Hickman, G3LXR, 143 Main Street, Stonnall, Walsall, Staffordshire.
The membership of this Society continues to grow with more and more licensed amateurs among its numbers. One honorary member, T. Painter (G3NEU), has recently presented the club with an inscribed silver cup which will become the trophy for forthcoming d.f. events.

MELTON MOWBRAY AMATEUR RADIO SOCIETY
Hon. Sec.: D. W. Lilley, G3FDF, 23 Melton Road, Asfordby Hill, Melton Mowbray, Leicestershire.
The only club event for May was on the 21st when J. L. Warrington (G2FNW) gave a lecture entitled "70 cms."

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax.
Society events for May began with a junk sale on the 13th. A fortnight later Mr. L. L. Cobb (G3UI) gave a talk on "Transistors."

PRESTON AMATEUR RADIO SOCIETY
Hon. Sec.: W. K. Beazley, G3RTX, 9 Thorngate, Penwortham, Preston, Lancashire.
On May 12th, a group of members enjoyed an interesting visit to the Ribble Generating Station. Later in the month, on the 26th, the final arrangements for N.F.D. were discussed.

READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven," 9 Holybrook Road, Reading, Berkshire.
Members G2FZI and G3EJA have both donated cups and T. Bingham a shield for Club trophies to be awarded to the winners of contests held during this year. The meeting for May 30th was devoted to a sale of surplus equipment.

SALOP AMATEUR RADIO SOCIETY
Hon. Sec.: Dr. K. E. Jones, G3RRN, Greystones, Shrewsbury Road, Church Stretton, Shropshire.
This Society reports an increasing membership with very good attendances at the meetings.

SCARBOROUGH AMATEUR RADIO SOCIETY
Hon. Sec.: P. B. Briscombe, G8KU, "Roseacre," Irton, Scarborough, Yorkshire.
A sale of members' surplus gear was held on May 7th. A talk on the SX111 receiver on May 14th was followed on the 21st by a display and demonstration of home constructed equipment. On May 28th, members attended a talk given on "Oscilloscopes."

SOUTH SHIELDS AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. I. Forster, G3KZZ, 41 Marlborough Street, South Shields, Co. Durham.
Members from this Society were among the visitors to the mobile rally held at Harewood House, Yorkshire, on 24th May. The Club is organising its own mobile rally on 5th July to be held at Bents Park Recreation Ground, Coast Road, South Shields.

SPEN VALLEY AMATEUR RADIO SOCIETY
Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Leeds.
"Missilemen 1964" was the title of the lecture given to members of this Society at their meeting on May 14th by Mr. M. A. Browne. On May 21st. members paid a visit to Research Electronics at Cleckheaton and on the 27th, David Pratt (G3KEP) gave a talk entitled "RTTY." Another visit was organised for the first event in June, when a group of members went to the Met. Office at Church Fenton.

WESSEX AMATEUR RADIO GROUP
Hon. Sec.: P. Cutler, 43 Langside Avenue, Wallisdown, Poole, Dorset.
This Society has recently decided to increase its meetings to two a month and also increase its amateur radio activities. To put into effect this latter decision, the Group elected to purchase a 20m s.s.b. transceiver and put a 2m station on the air.

WIRRAL AMATEUR RADIO SOCIETY
Hon. Sec.: A. Seed, 31 Withert Avenue, Bebington, Wirral, Cheshire.
A mobile week-end in Wales was organised by member G2AMV and was held successfully during May.

WORCESTER AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: G. W. Tibbetts, 35 Perdiswell Park, Droitwich Road, Worcester.
Activities for May consisted of a junk sale and a practice run for National Field Day. The sale was held on the 16th and the practice run on the 24th.

SEVENTH LONGLEAT MOBILE RALLY
Rally Organiser: E. C. Halliday, G3JMY, 4 Parkside Avenue, Winterbourne, Bristol.
This year's mobile rally at Longleat, near Warminster, Wiltshire, is to be held on June 21st and talk-in-stations will be G3JMY/A on top band and G3SJI/A on 2m. The entrance to Longleat House park and estate lies on the Frome-Warminster Road (A362). There will be the usual attractions; displays, competitions, demonstrations, etc. and once again this event promises to be a memorable occasion.

. . . AND FOR YOUR FURTHER ENJOYMENT why not get the June issue of Practical Television, on sale now?

Featured in this issue is a C.R.T. Tester and Rejuvenator.

Also details for converting receivers for reception of Continental programmes, and many more interesting articles and regular features.

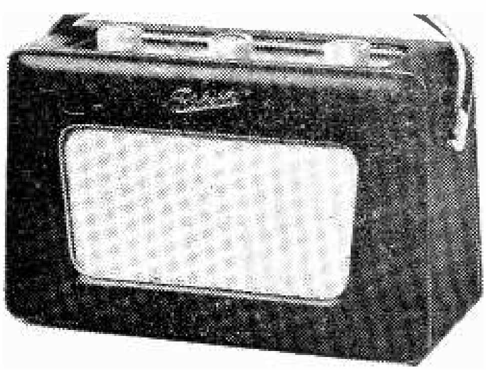
Trade News

New Portable from Roberts Radio

A NEW transistor portable, Model R.300 has recently been announced by *Roberts Radio Company Limited, Molesey Avenue, West Molesey, Surrey.* This set covers medium and long waves and incorporates six transistors and three diodes.

A coaxial socket for a car aerial is included in the design and a carrying cover made of strong grey waterproof material is available as an extra.

The size of the R.300 is 9¼in. x 5⅞in. x 4¼in., and its price is 15 gns. Power is provided by an Ever-Ready PP9 battery, and current consumption with no signal is 12mA.



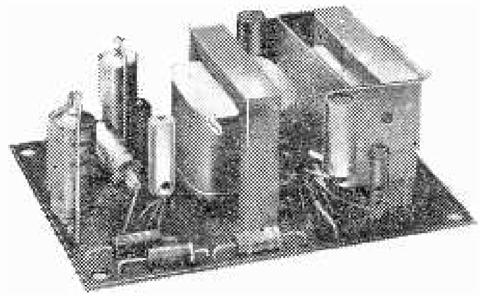
The R.300 portable receiver, new from Roberts Radio

The "Audio Heart"

MARKETED by *Technical Suppliers Ltd., 63 Goldhawk Road, London, W.12,* is a miniature high quality transistor amplifier designed to be used at the centre of any good audio assembly. The "Audio Heart" gives 1W undistorted output for an input voltage of 5 to 10mV. Input impedance is 1·5 to 2kΩ, and output impedance 3 to 5Ω. The operating voltage is 6V, and the signal-to-noise ratio is said to be below measurable level.

Among its numerous applications, the "Audio Heart" can be used with a radio tuner for use in a car, as a burglar or baby alarm, etc., and two of the units can be used for stereo applications.

The size of the "Audio Heart" is 3in. x 2·2in. x 1·2in. high, and it is available ready built and tested at a price of 59s. 6d., or in kit form with full building and operating instructions for 52s. 6d.



This is the "Audio Heart" marketed by Technical Suppliers Ltd.

Two New Receivers

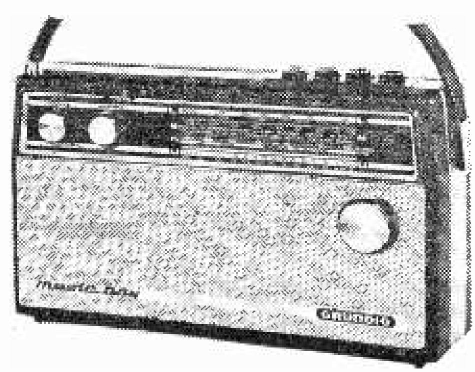
GRUNDIG (Great Britain) Ltd., announce the introduction of two new portables to their range of receivers. They are the "Music Boy 204", and the "City Boy 204". The Music Boy has a bandspread 49m band and is claimed to give crystal clear reception over a wide range of European short wave stations. Other bands covered are medium, long and v.h.f./f.m.

The circuit includes nine transistors, three diodes and one rectifier. Power output is 1W and power is provided by two 4·5V flat torch batteries or a 9V power pack. The speaker is an elliptical 4in. x 6in. model fitted with a ceramic magnet.

The Music Boy weighs approximately 4lbs. without batteries and measures 11in. x 6½in. x 2⅞in. Price is 39 gns.

The "City Boy" embodies nine transistors, three diodes and one rectifier, and covers medium, long and v.h.f. bands. Output is 1W and this is fed into a 6in. x 4in. elliptical speaker. Weight is approximately 3½ lbs. without batteries and the dimensions are 10¼in. x 6¾in. x 2⅝in. Price is fixed at 34 gns.

Grundig (Great Britain) Ltd., Newlands Park, Sydenham, London, S.E.26.



The Grundig "Music Boy 204".

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LG34. 4 watts, size 8½ x 4½ x 2½in. high, **£5.5.0.**
L45A. 5 watts, size 7 x 7 x 5in. high. **£5.19.6.** Protective cover **12/9.**
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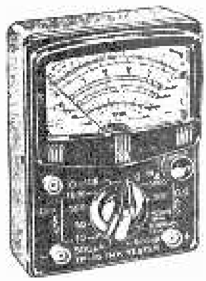
Diatonic 10 watts Hi-Fi Ultra Linear Push Pull, size 9 x 7 x 6½in. high, **£12.12.0.** Cover with carrying handles **19/6.**
L1/10. 10 watts Hi-Fi Ultra Linear, size 9 x 7 x 5in. high, **£13.13.0.** Cover with carrying handles **19/6.**
Conchord 30 watts Hi-Fi Ultra Linear, size 12½ x 9 x 7½in. high, **£16.16.0.** Cover with carrying handles **25/-.**
L50. 50 watts Hi-Fi Ultra Linear, size 14 x 10 x 8in. high, **£23.2.0.** Cover with carrying handles **32/6.**
All amplifiers for normal A.C. mains, and ex stock. Details on request.

Tripletone Convertible Amplifier, size 10 x 3 x 4½in. high. 4 watts output matched for 2-3 ohms, OR 2 amplifiers can be coupled together for STEREO, **£6.19.6** each.
Tripletone F.M. Tuner, size 11 x 6 x 3in. high. Coverage 86-104 Mc/s. **£13.19.6** (unpowered), or **£15.14.6** (self powered). Details on request.

TEST METERS FOR EVERY PURPOSE & POCKET



2,000 O.P.V. MODEL TP-10 Reads A.C. & D.C. Volts up to 1,000; D.C. Current to 500 mA; Resistance to 1 Meg; Capacitance to 1µF; Decibels from −20 to +36; Output jack for Audio Measurements. Size 3½ x 5in. x 1½in.
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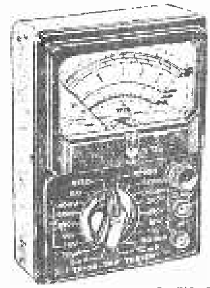

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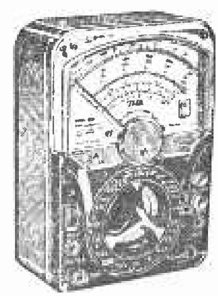

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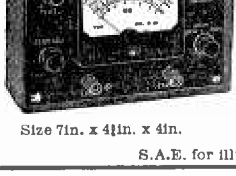

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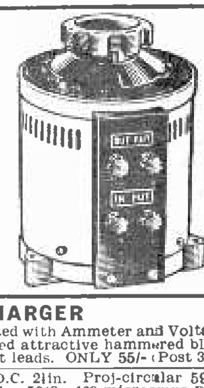

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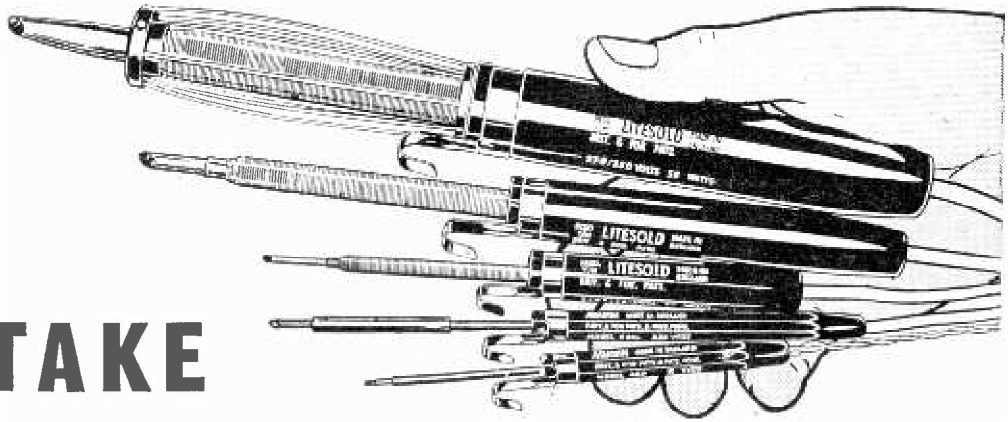

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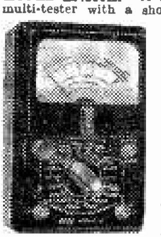

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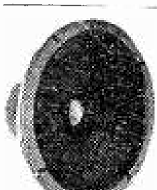

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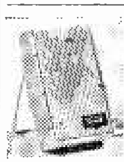

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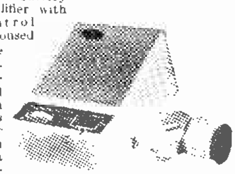

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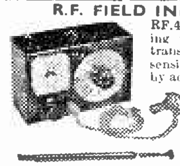

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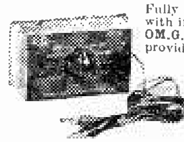

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Adding extra ranges to simple meter movements is one means of making

BY GEORGE WAREHAM | PART 2

inexpensive multimeters

CONTINUED FROM PAGE 149 OF THE JUNE ISSUE

LAST month some general hints were given on choosing a milliammeter and converting it to a multi-range instrument. In this month's article the conversion of a piece of surplus equipment containing a suitable meter is described.

The instrument described here was made from a piece of "surplus" equipment which rejoices in the name "Gear, Electric Firing Mark Two: Instrument, Testing, Mark 2 or 2A". It consists of a centre-zero milliammeter in a wooden case with an ebonite front panel.

The case contains one or two other components and in fact it turns out to be a Wheatstone bridge reading 0—25Ω, obviously intended for checking the continuity of detonating circuits of some kind. The circuit is shown in slightly simplified form in Fig. 4.

If anybody requires a single-range bridge for measuring low resistances the instrument may be used unmodified. (The average multimeter tends to be inaccurate below about 10Ω. One often wants to measure the resistance of transformer windings, such as the secondaries of output transformers, which may only be a few tenths of an ohm. For such measurements the unmodified unit would be a useful addition to the laboratory.)

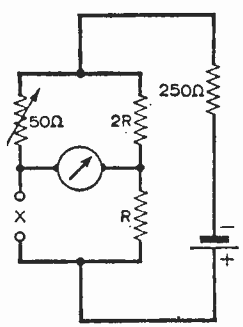

Fig. 4: The basic circuit (less the press-switch contacts) of the surplus unit referred to in the text.

However, the writer wanted a cheap multi-range meter. This surplus unit cost about 15s. and the finished article cost about 25s. The ranges in the writer's version are:

Current	0— 3,	0— 30,	0— 300mA
Voltage	0— 3V,	0— 30V,	0— 300V
Resistance	0—25,	0—250,	0—2,500Ω

Basic Information

Several of the units in the surplus dealer's shop had bent meter pointers. Evidently the sappers who had used them had disregarded the warning label telling one not to switch the meter into circuit with the firing dynamo going.

The dealer had affixed a label giving the sensitivity of the meter as "600—0—600μA". Examination of the meter itself revealed a rated f.s.d. of 660μA. Subsequent measurement revealed that the sensitivity was, in my particular specimen, 647μA. (The sensitivity was slightly different in the two directions of deflection: 647μA is the average.)

The meter scale reads 30—0—30 and has 30 small divisions each way. This means that, unless one rewrites the scale, the smallest f.s.d. current which fits the scale is 3mA. The damping of the basic movement was rather poor but good enough to permit an f.s.d. of 1·5mA, which is possible without rewriting the scale, at the expense of some simple mental arithmetic.

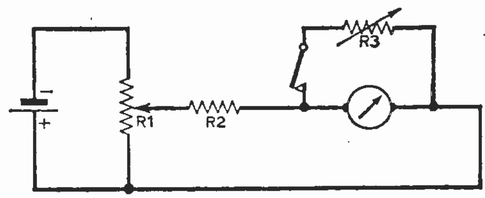

Fig. 5: Circuit arrangement for finding the coil resistance of a meter.

Meter Coil Resistance

A test with a 10Ω ± 1% resistor showed that the original Wheatstone bridge was quite accurate. This suggested the possibility of using the instrument to measure its own resistance, which was shown by a rough check (as described last month) to be within the range of measurement of the bridge.

The method of measuring the coil resistance is of quite general application. What one does is to adjust a variable resistor to the same resistance as the meter and then measure the variable resistance. The technique is illustrated in Fig. 5. Here R1 is any low-resistance potentiometer (say, less than 1,000Ω) and R2 is selected to permit f.s.d. with the available voltage.

With the switch open, adjust R1 for f.s.d. Leave R1 alone, close the switch, and set R3 so that the meter reading is exactly halved: R3 is now equal to the meter resistance and can be taken away and measured.

In the present case one takes the meter out of its original circuit and then, once R3 is set, one puts the meter back again so that the bridge can be used to measure the resistance. In the case of the writer's instrument the meter coil resistance turned out to be 23·3Ω.

General Design

All the necessary information for designing voltage multipliers and current shunts had now been obtained. The next step was to decide how to use them to obtain a multirange meter. There are two basic ways of doing this.

One is to connect all the multipliers and shunts permanently, as in Fig. 6, and select the ones needed by plugging the meter leads into the appropriate sockets. The other is to use only one pair of terminals and to switch the appropriate shunts and multipliers into circuit. (Combinations of the two systems are possible.)

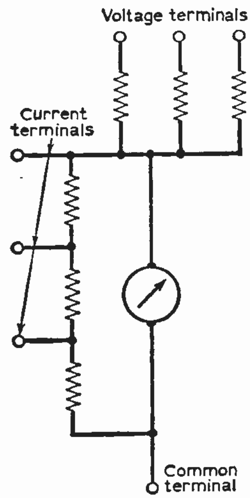

Fig. 6: A multi-range instrument using multiple terminals but no switches.

Current Ranges

It was decided to use switches and only one pair of terminals. The first problem was to choose between the alternative ways of obtaining different current ranges shown in Fig. 7.

The simplest method is shown in Fig. 7a.

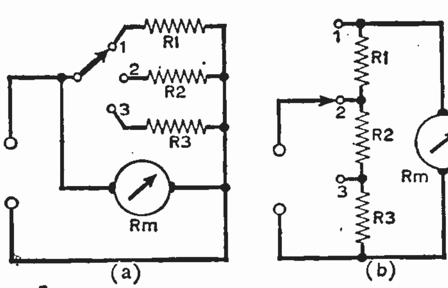

Fig. 7: Two arrangements for incorporating the current shunts.

It is simplest in that each current range is completely defined by one resistor. Thus R1 might set the 3mA range, R2 the 30mA range, and so on.

The use of this system is often deprecated for the following reasons. First, and most important, the contact resistance of the switch affects the accuracy. The effect may be very serious on high-current ranges. For example, the shunt resistance for, say, a 3A range may be only a few hundredths of an ohm. Even if the switch contact resistance is only a hundredth of an ohm it has an appreciable effect. Secondly, safety considerations impose limitations on the type of switch. It must have make-before-break contacts. Otherwise, when changing from one range to another, the full current goes through the meter coil.

The arrangement of Fig. 7b avoids both these difficulties. Variations in contact resistance have no effect on the way the current divides between shunts and meter, and during changeover the current is simply switched off. Disadvantages are a higher voltage drop on the higher current ranges and the fact that since all resistors are in circuit all the time, an error in one of them affects all the ranges (though not necessarily very much).

In the writer's opinion there is not much to choose between the two arrangements when only moderate currents are to be measured. Make-before-break switches are easily obtained and contact resistance is quite low with modern precious-metal-plated contacts.

The second system was adopted as a matter of convenience. The meter case of the "surplus" unit is rather shallow and only a single-wafer one-pole ten-way range switch could be accommodated: the second arrangement proved to be easier to use with such a switch.

Calculating the Shunts

For a Fig. 7a type of circuit calculating the shunts is easy. The voltage drop across any shunt is the same as the voltage drop across the meter. Knowing the resistance of the meter and the f.s.d. current, the voltage drop at f.s.d. is calculable. Thus a 30Ω meter with f.s.d. 1mA has a voltage drop of 1mA x 30Ω=30mV. To make the meter read 10mA f.s.d. we have to arrange that 9mA flows through the shunt when this voltage appears across the meter circuit. Thus the shunt resistance must be 30mV/9mA=3·33Ω. For a 100mA range 99mA must go through the shunt, so its resistance R100 (say) = 30mV 99mA=0·33Ω. In general if the f.s.d. has to be multiplied N times by the shunt, then,

$$\text{Shunt resistance} = \frac{\text{Meter resistance}}{(N-1)}$$

The Fig. 7b type of circuit is more difficult because the voltage drop across the circuit varies from range to range. With the switch in position 1 the drop across the meter is the same as across the three shunts in series. This enables us to calculate the total shunt resistance from the formula above:

$$R1+R2+R3 = \frac{\text{Meter resistance (Rm)}}{(N-1)}$$

But what happens in position 2? If we make the voltage drop across the circuit the same as the f.s.d. drop the meter will read less than f.s.d., since R1 is now in series with Rm. And in position 3 R1 and R2 are both in series with Rm. Thus the circuit drop at f.s.d. increases as higher current ranges are switched in.

Fortunately the various values can be arrived at by a process of elimination as follows:

Step 1. Total shunt resistance

$$R1+R2+R3 = \frac{Rm}{N1-1}$$

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1C3	6/3	6C8	3/-	7B7	7/-	25Y5	7/6	AC/PEN		EB41	4/9	EL84	4/9	LP2	9/6		54/-	U251	9/-	GET103	7/-
1C5	6/3	6C9	10/9	7C5	7/3	25Y5G	7/9	(7)	17/-	EB91	2/3	EL85	7/6	ME41	15/2	RK34	7/6	U281	8/9	GET104	10/-
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1D5	6/6	6C12	6/-	7D3	15/-	25Z5	7/8	AC/SG/VM		EBC33	8/6	EL91	2/6	MH4	3/6	SP4B	19/6	U301	11/3	GET111	12/-
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1FD9	3/6	6D3	9/6	7S7	14/6	30C18	10/6	ATP4	2/3	EBF83	7/3	EM4	17/9	MU12/14	4/6	SU61	5/9	U4020	6/6	GEX35	3/-
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1H5GT	7/9	6D8	15/-	8D2	2/6	30FL1	9/3	AZ31	6/6	EBL21	8/-	EM35	12/-	N37	23/3	TDD2	12/6	VMS4B	12/-	GEX45	6/6
1L4	2/3	6E5	9/6	9BW6	9/6	30FL12	11/-	AZ41	6/6	EC52	4/6	EM71	13/6	N78	26/-	TDD4	8/-	VP2	3/6	GEX64	11/6
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1LN5	4/6	6F6G	3/9	10C1	9/3	30P4	12/3	C1	12/6	EC70	4/6	EM84	6/9	P61	2/6	TH30C	14/6	VP4A	14/6	MAT101	8/6
1N5GT	8/6	6F6GT	7/6	10C2	12/3	30P12	7/6	C1C	12/6	EC81	27/6	EM85	8/9	PABC80	6/9	TH233	6/9	VP4B	20/5	MAT120	7/9
1P1	5/9	6F8	5/-	10D1	7/-	30P16	6/-	CCH35	12/6	EC90	2/3	EM87	7/6	PC86	10/3	TP22	5/-	VP13C	7/-	MAT121	8/6
1P10	4/6	6F11	17/9	10D2	11/6	30P19	12/3	CK506	6/6	EC92	6/6	EN31	10/-	PC88	14/7	TP25	5/-	VP23	2/6	OA5	6/-
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3Q4	5/3	6J7G	4/6	12AT6	4/6	50CD6G	40/6	DD4	12/6	ECF804	24/-	FW4/800	8/6	PLN4DD		UCL83	8/6	W101	26/2	OC29	25/6
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5Y4	9/6	6L6G	6/6	12E1	16/6	85A2	6/6	DH30	15/6	ECL82	7/-	HABC80	9/3	PEN453DD		UL84	6/-	X65	5/6	OC65	22/6
5Z3	7/-	6L6M	9/-	12H6GT	1/6	90AG	67/6	DH63	4/6	ECL83	9/6	HL2	7/6		10/-	UM4	15/2	X66	7/3	OC66	25/-
5Z4	7/-	6L7GT	4/6	12J5GT	2/6	90AV	67/6	DH76	3/6	ECL86	8/9	HL13C	4/-	PENA4	7/-	UM34	16/10	X76M	9/-	OC70	6/6
6/30L2	8/3	6L17	12/6	12J7GT	7/3	90CG	42/-	DH77	3/9	EF6	20/6	HL23	11/6	PEN B4		UM80	8/3	X78	20/6	OC71	3/6
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6AK5	4/9	6P25	6/9	12SH7	3/-	220B	10/6	DK96	6/3	EF42	4/9	HVR2	8/3	PL82	5/3	UY1N	10/3	Y63	5/-	OC81	4/-
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6AQ5	5/9	6R7GT	11/-	12Y4	2/-	306	13/-	DL75	30/-	EF85	4/6	KF35	12/6	PX4	9/-	U16	15/-	Z749	6/3	OC139	12/-
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6B7	5/-	6SJ7	4/6	14S7	19/6	5763	7/6	DL810	10/6	EF97	11/8	KT32	5/6	PY80	5/-	U24	12/6	AC107	14/6	OC201	29/-
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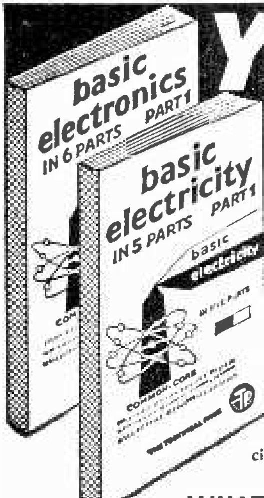

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where N1 is the current multiplication required on the lowest current range. In the writer's case the lowest range was 3mA and the f.s.d. 660μA, giving N1=3.000/647, and Rm was 23.3Ω. So, in this particular case,

$$R1+R2+R3=23{\cdot}3/\left(\frac{3{,}000}{647}-1\right)=6{\cdot}4\Omega$$

Step 2. $$R2+R3=\frac{Rm+(R1+R2+R3)}{N2}$$

For example, to turn the writer's meter into a 30mA meter,

$$R2+R3=\frac{23{\cdot}3+6{\cdot}4}{30/(0{\cdot}647)}=0{\cdot}66\Omega$$

It follows that R1=6·4−0·66=5·74Ω.

Step 3. $$R3=\frac{Rm+(R1+R2+R3)}{N3}$$

$$=\frac{23{\cdot}3+6{\cdot}4}{300/(0{\cdot}647)}=0{\cdot}066\Omega$$

for 300mA in the case in point. Thus R2=0·66−0·066=0·594Ω. Clearly the method can be extended to any number of current ranges. Thus a 3A range would require an extra resistance R4 of 0·0066Ω and so on.

Making the Shunts

The largest shunt resistance (5·74Ω) lies in the range of resistance which can be measured reasonably accurately by the original unit. However, the writer decided to try his luck without actually measuring the resistance but instead to cut suitable lengths of wire of known resistance. In fact the only wire available was ordinary copper wire, but this proved to be quite satisfactory. (Resistance values are given in standard wire tables.)

It is necessary to use a reasonably long piece of wire, because one can never say within a quarter of an inch or so what the final length is, because a certain amount of wire is in effect lost in the connections. (It is reasonable to allow an extra half-inch.) If the length is short, say, a couple of inches, this uncertainty accounts for rather too high a proportion of the total. On the other hand, it is tedious to wind huge lengths of wire. A search in the wire box revealed some 43s.w.g. (2·359Ω/yd) which would serve for the 5·74Ω resistor (87·5in.) and some 36s.w.g. (0·594Ω/yd) which would do for the 0·66Ω resistor (38·4in.). These resistors were made up and connected in series across the meter. If correct the meter must read very nearly 3mA, since the third resistor (0·066Ω) has little effect on the 3mA range.

A current of 3mA was obtained from a 3V dry battery and a 1kΩ resistor (later to serve as the 3V "multiplier") and the meter registered very nearly f.s.d., showing that the shunts were correct. No suitable single wire was available for the third shunt so a piece of 7/0·0076 (i.e. seven strands of 36s.w.g.) connecting wire was tried. The length, calculated on the assumption that the resistance was one-seventh of the resistance of 36s.w.g., was 31·2in. It turned out that the meter read 25% *high* in the 300mA range. This seemed odd until it was realised that to use stranded wire one has to allow for the twist!

The length was adjusted, using a 30mA standard current (3V, 100Ω) so that the meter read f.s.d. on the 30mA range and one-tenth f.s.d. on the 300mA range.

Voltage Ranges

By leaving the 3mA shunt permanently in circuit a range of 3V was obtained using 1kΩ, 30V with 10kΩ, and 300V with 100kΩ. Close tolerance resistors should be used (± 1%) and the power rating should be adequate. Thus at f.s.d. the 100kΩ resistor must dissipate 3mA x 300V= 900mW, so a 1W resistor is required.

In addition a 300mV (0·3V) range was included:

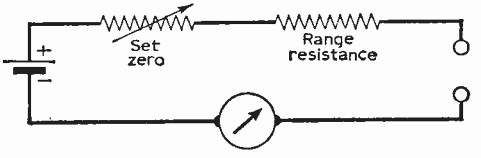

Fig. 8: The conventional ohmmeter which with a non-linear scale produces inaccuracies at the low-resistance end.

this is useful for work with transistors. On a low range like this, the meter resistance (5Ω with the 3mA shunt) becomes significant. However, a 100± 1% resistor was used as it was the nearest standard value and the 5% error was felt to be tolerable on this range.

Resistance Ranges

An ordinary ohmmeter (Fig. 8) has a non-linear scale and is only accurate for resistor values which produce about half-scale deflection. Since the surplus unit had a good calibrated 50Ω resistor in it (actually calibrated 0—25Ω) and since the meter was centre-zero it was decided to use a

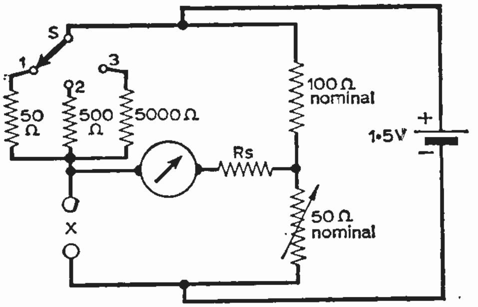

Fig. 9: A three-range bridge circuit for resistance measurements.

bridge circuit for resistance measurements.

The original instrument was a single-range one, but it is possible to make use of the calibrated resistor in a multirange instrument. To do this the circuit has to be rearranged as in Fig. 9. Here the 100Ω nominal resistor should be exactly double the value of the 50Ω nominal variable resistor. To make sure that this was so use was made of some of the components in the original circuit.

Referring to Fig. 4 it will be seen that the right-

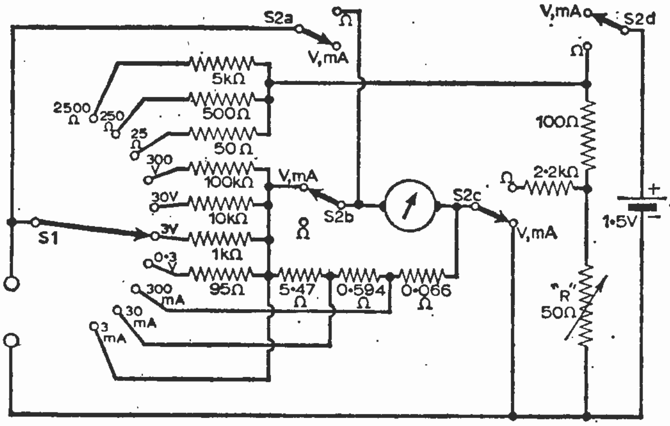

Fig. 10: The complete multimeter circuit.

hand ratio arms are in the ratio 2:1. The technique is to use them as standards to select a suitable 100Ω nominal resistor. To do this the positions of the 50Ω variable and the X terminals are exchanged. The 50Ω resistor is set to maximum and left alone. Then various resistors of 100Ω nominal value are tried until one is found which balances the bridge. This resistor has twice the value of the variable resistor and is used in the final circuit.

The resistance standards (Fig. 9) should be close-tolerance components. RS is a safety resistor to protect the meter against overload. A study of Fig. 9 will show that the meter receives the largest current when on the 25Ω range with nothing connected to the X terminals and with the 50Ω variable resistor set to zero. Then, if there were no RS, only the 50Ω standard would be effectively in the meter circuit. RS is chosen to limit the current to a safe value under these conditions.

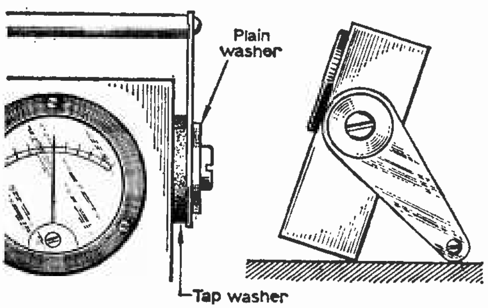

Fig. 11: Illustrating a suitable handle for the meter which may double as an inclined support.

It was originally intended to use the meter with its 3mA shunt for the bridge, but the sensitivity was poor on the 2,500Ω range. So in the final circuit it was arranged to disconnect all the meter shunts when measuring resistance. This meant having an underdamped meter but it takes a few seconds to find the null anyway, so the disadvantage is not so great.

Complete Circuit (Fig. 10)

Two switches are used. S1 selects the range on all measurements. S2 rearranges the circuit to measure either volts and milliamps or ohms. It is theoretically possible to do everything with one multi-wafer switch but there was not room for one in the rather shallow meter case.

Construction

The original meter box had a separate battery compartment. The partition which created this was removed to provide more space. The front panel is big enough for mounting all the components. For the battery use a Terry clip, which also provides contact with the negative terminal (the zinc case) if the outer paper is removed. Contact to the positive terminal (the carbon rod) is made by soldering a lead to its brass cap—crude but effective.

The original instrument had various bits of webbing attached to it. These were removed and a simple handle screwed to the sides. This handle swivels and is proportioned so that it can just be tucked away below the bottom of the case for storage. The pivots are deliberately made stiff by means of friction pads (rubber tap washers) so that the handle can be positioned (Fig. 11) so as to prop the meter in a convenient attitude. ■

ON THE SHORT WAVES

—continued from page 240

An undisclosed 25m band frequency has replaced 15,265kc/s for the transmission from 1830—1925 of the Radio Voice of the Gospel, P.O.B. 654, Addis Ababa, Ethiopia.

There are new frequencies for all the English transmissions to Europe of Radio Warsaw, Warsaw, Poland. The new schedule is 1830—1857, 1930—2000 and 2130—2155 on 7125/7,285kc/s, 2030—2100 on 6,135/7, 270kc/s, 2230—2300 on 7,145/7,270kc/s and 1,502kc/s medium wave. There are also multilingual music transmissions from 1900—2030 on 7,145/1,502kc/s and 2330—0100 on 9,675/7,125/1,502kc/s.

Cairo Radio's transmission to East and Central Africa from 1545—1830 is now on 17,920kc/s, where it is giving good U.K. reception. English is at 1745. This station wants reports, which should be sent to Propagation and Monitoring Department, U.A.R. Broadcasting and TV, Maspero Cairo, Egypt.

Finally N.H.K., Tokyo, Japan, now uses 11,780/15,135/17,870kc/s for its European transmission from 0615—0845. The English portion is from 0800—0845.

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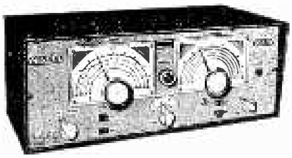

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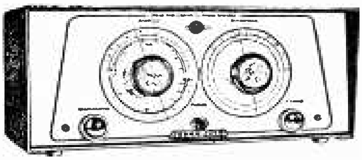

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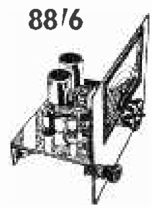

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LETTERS TO THE EDITOR

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of the cover.

The Editor does not necessarily agree with the opinions expressed by his correspondents

SINGLE SIDEBAND RECEPTION

SIR,—I wonder if users of simple short wave receivers have noticed how well single sideband transmissions can be tuned in with these sets. A test, and a little practice in tuning such s.s.b. signals, is best first made on the 80m amateur band. With an ordinary superhet, or with a t.r.f. receiver adjusted so that the detector is not quite on the point of oscillation, any s.s.b. signals will be quite unintelligible. If regeneration is then advanced very slightly, so that the detector is just oscillating, the s.s.b. can be received very well. Receiver tuning is adjusted so that the detector frequency is near the frequency of the eliminated carrier of the s.s.b. transmission. On the 14Mc/s band, many USA and other amateurs will be heard, using this system.—F. G. RAYER (Upton-on-Severn, Worcestershire).

IF YOU CAN'T BEAT 'EM—JOIN 'EM

SIR,—With reference to the Leader Competition entry from Mrs. Joyce Burdett (page 62, May issue) who claims to be a "wireless widow". Why should she feel like this? The old adage, "If you can't beat 'em, join 'em" is the best cure for the XYL's blues. There are now well over thirty YL'S and XYL's in this country with their own callsigns and I don't think there is one amongst us who could be described as a blue-stockinged technical type; a R.A.E. pass does not require brains, only a little application of effort and is within the reach of all.

With her own ticket Mrs. Burdett would be in a position much envied by the unmarried licensed YL's and those XYL's who have their own ticket but whose OM's have no knowledge of radio to help them. She would have her (or even his) equipment built and maintained and her aerials rigged for her, unlike some XYL's with licenses who have to do their own construction and maintenance, and are even called in by the OM to mend a fuse!

Many radio societies, like our own, welcome YL's and XYL's and even the OM's of amateurs as members, though there are as yet, a few societies who have not seen the light and condescend to welcome their ladies only to the annual dinner as decoration (or more correctly, to ensure that the OM's do not get into trouble for being late home!)

How would your correspondent feel if she were the OM of a lady amateur—with strange men calling on her as the result of a mobile QSO, various men collecting her at odd hours to do a stint of Field Day operating or all night on a Scout Jamboree station?

I am sure that if some OM's can be tolerant of their wives' hobbies, whether they be knitting, bingo or amateur radio, then it is up to the XYLs to do the same. I joined my husband's hobby (not radio) because I couldn't hope to beat it and he now even tolerates mine! After all, amateur radio is a hobby which can, to a large degree, be pursued at home, as long as the XYL doesn't drive the OM to the last resort of the henpecked ham—namely, mobile operation on his way to work!—"G3XYL" (name and address supplied).

MODIFICATIONS FOR P.W. SIXTEEN MULTIMETER

SIR.—I have recently completed the P.W. 16 Multimeter (described in your January 1964 issue) including modifications to extend the ranges available to eighteen. I am very pleased with the results achieved, and the general professional appearance of the completed instrument.

Construction of the instrument was straightforward, provided care was taken and the job not rushed. This applies particularly to the installation of switch S2, which is PVC insulated and very difficult to solder without damage. However, this was successfully accomplished by using a heat shunt and by not keeping the iron in contact after the solder had run.

The two additional ranges included in my meter extend the voltage readings up to 1,000V a.c./d.c. (Messrs Lasky Radio supplied the additional components required for seven shillings.) Two additional terminal sockets were fitted by drilling the escutcheon plate in line with existing holes to be found in the left-hand corner of the meter case when viewed from the rear. These two sockets then became the common positive and negative terminals of the published design. The original sockets of the meter are then used for the 1,000V ranges.

The positive socket becomes the 1,000V d.c. positive, and the negative the 1,000V a.c. The new common negative socket is used for all ranges.

Two additional 5mΩ resistors are wired in series between the 1,000V d.c. positive socket and terminal 5 of S1 and two 250kΩ resistors are wired in series between terminal 5 of S1B and the 1,000V a.c. socket. These additional resistors are housed vertically either side of the insulated posts used for holding the case together The double solder tag "B" is not required and the connections originally taken to this point are soldered directly to the common negative terminal.

These modifications, besides making the meter more versatile, will enable use to be made of the Taylor HV probe which extends the range up to 25kV.—L. J. LYON (Lexden, Colchester, Essex).

TRIMMING TOOL OR TUNING TOOL

SIR,—I wish to thank you for the really valuable Trimming Tool Set which accompanied the April P.W. It will obviously be most useful for its intended purpose, but I have found that in an emergency, I can also use the No. 4 tool as a tuning-fork—as its shape, but not its material might suggest.

As a violin player, I always carry in my case a 440c/s tuning fork, but I have now found that if I grip the No 4 tool by the "plug" and gently hold the tines of the fork between finger and thumb of my other hand and then slide these digits off the fork, a tone equal to A-flat; i.e., just a semi-tone below the now standard pitch for "A" (A-natural); is emitted.

The sound is very quiet, of course, and I have to hold the tool close to my ear whilst stroking the tines, to hear the note. — L. F. HUNTER (Rugby, Warwickshire).

A CLOSED SHOP?

SIR,—I feel that I must object to one point in H. Naylor Caley's letter in May P.W. Although his suggestions for further study at evening classes are sound, I fear he gives the impression that all radio clubs are kinds of secret societies in the mystic of radio, and are restricted entirely to "ham" radio.

I would point out that most radio clubs are strictly "amateur radio societies", and although one of the main interests is usually ham radio, you will find members with interests in all fields of radio and electronics.

I joined my local club (Eccles and District) only six months ago, but in that time I have received encouragement and assistance in building an 11-valve double conversion receiver, more than doubled my technical knowledge, and become a member of the R.S.G.B. Hardly an example of a closed shop of licensed amateurs with very restricted interests. — W. R. BANNERMAN (Flixton, Manchester).

P.W. GUITAR AMPLIFIER

SIR,—I was rather puzzled to read in the article on the 35W Guitar Amplifier (P.W., May 1964), that many thousands of volts are present at the top cap of the 807 valves when the signals are present.

High anode voltages may be expected with inductive anode loads, (cf. line output transformers), but with an output transformer correctly loaded, the transformer behaves as an impedance matching device and not as an inductance. The anode load is therefore resistive and is equal to the transformer secondary load reflected back to the primary.

807 valves commonly exhibit internal fluorescence, which could give the impression of very high anode voltages when only relatively low voltages are present.

If the secondary load on the output transformer were removed, then it would not only be possible to break down the transformer insulation due to the generation of high potentials by what would be now an inductive load, but also cause risk of damage to the valve. There is the possibility of flash-over in the valve due to high voltages but also the possibility of increased screen dissipation due to a lowering of anode voltage.—F. W. ADAMS, B.Sc. (Sheffield, 10).

SIR,—With reference to Mr. Adams' letter, I would like to clarify the paragraph referred to in my article.

To recapitulate, the sentence under discussion reads: "... keep away from the 807 top caps, high peak voltages of many thousands are present here when a signal is present, and severe burns can be had if they are accidentally touched during use".

What is meant by this is that, should the caps be touched (especially if the other hand or a part of the body is in contact with the chassis) a spark will be drawn between the top cap and the person's hand. Due to the spark comprising an alternating current component, the back e.m.f. across the output transformer primary winding is extremely high. The actual voltage developed depends upon the spark frequency, and the level of signal present in the amplifier at the time.

Placing part of the body across this circuit point, puts a relatively low resistance across the transformer, which of course upsets its matching. Once contact has been made and a spark drawn as the unfortunate constructor endeavours to move away, the transformer behaves as an inductance purely, and as stated, due to the increasing back e.m.f. produces a vicious circle with the spark voltage increasing until the gap is too large or the external resistance of the person's body has increased to a point where the current flow is too low to sustain the spark. I have had first hand experience of this effect, and nursed a nasty burn on one thumb for quite a few weeks afterwards.

Incidentally, Mr. Adams is quite right in his remarks—"high voltages are not present whilst the amplifier is operating normally", the anode voltages of the 807's being 450V under all conditions.—BRIAN L. PHILLIPS (Preston, Lancashire).

Sir—I would be grateful if any reader could sell or loan me ...

... the February, March and September 1962 issues of P.W.—P. CUNNINGHAM, 20 Kenwood Gardens, Gants Hill, Ilford, Essex.

... details about the Ekco Car Radio, No. CR74, especially of the external connections to the sockets.—P. BAYLISS, 18 Stuart Road, East Barnet, Hertfordshire.

... the February, March and April 1962 issues of P.W.—B. J. COLLINS, 54 White-Lion Road, Amersham, Buckinghamshire.

... the issues of P.W. dealing with the 19 set.—D. SYMONDS, 66 St. Barnabas Road, Cambridge.

... the information regarding the R1155: power, output, etc. All data received returned within 48 hours.—T. L. SADLER, 10 Sheaf Avenue, Abbeydale Road, Sheffield 7.

... data on the 19 set Mk. 3 (Canadian), particularly the Mk. 3 No. 2 supply unit.—R. AUBREY, 11 Addersley Road, Norton, S.o.T., N. Staffordshire.

... the service manual for the Sobell RS402 a.m./f.m. receiver.—F. CLARKE, 57 Woodcroft Road, Smithdown Road, Sefton Park, Liverpool 15.

... circuit, valve line-up and any information on ex-government type No. MCR1.—R. DAVIS, 11 Bishop's Lane, Robertsbridge, Sussex.

... written or printed notes leading to the MOT "Radar—Maintenance Certificate" standard or any other material on the subject.—M. FAHY, 1 Castle Street, Limerick, Eire.

... the circuit and any other data concerning the R107 set ZA3050.—R. WILD, 140 Nansen Road, Alum Rock, Birmingham 8.

... the September 1956 issue of P.W.—B. DODDS, 42c Alma Place, North Shields, Northumberland.

... circuit and/or manual of the Romac Radio Corporation Television set, Model 179/T.—J. McGRAIL, 494 Rochester Way, Sidcup, Kent.

ADVERTISEMENT

sinclair NEWS

No. 3 JUNE/JULY 1964

ANOTHER ACCESSORY FOR THE MICRO-6

Because of the enormous interest in the Micro-6, we at Sinclair Radionics have been devoting much of our time to the development of accessories which add to its usefulness. The first of these, the TR 750 power amplifier was introduced last month. This remarkably low priced high performance design has, of course, a great many applications but in conjunction with the Micro-6 or the Slimline it can form a really powerful car, home or portable radio.

The latest Micro-6 accessory is just as exciting! We have designed and produced an elegant nylon wrist strap which clips straight on to the Micro-6 converting it into a wrist radio—the first of its kind in the world! The earpiece lead may then be run up the sleeve and the radio listened to without any sign of trailing wires.

The wrist strap may be removed instantly when desired, but in use it is firmly attached and the set cannot come loose. It will add immensely to the pleasure and usefulness of your Micro-6, particularly when out of doors.

THE MICRO-6 CIRCUIT

Many readers may be curious to know how we achieve the high performance we claim for the Micro-6 in a set of such tiny size. That our claims are genuine is, of course, proved by the countless constructors' letters we receive, more of which we give below, but you may like to know more about the design. The circuit is a completely new one based on our micro-alloy transistors (MATs). These transistors have higher gains than any other types at low voltage levels and, as they are also very small, are ideal for miniaturised equipment. The Micro-6 has two high gain stages of R.F. amplification, a double diode detector and three stages of A.F. amplification. Thus we have used exactly the same number of stages of gain as are employed in conventional 6 transistor superhets.

We are able to do this because we use genuinely micro-miniature components not normally available to the home constructor. For example all the resistors are only ⅕" in length. These tiny components help to make the Micro-6 simple to construct because we don't have to pack them so closely together. If you would like more details just send 1/- for our booklet on the Micro-6 which gives the complete circuit diagram and technical description.

BRITISH BEATS THE WORLD!

We recently launched an export drive for all our products. We have already received enquiries for the Micro-6 from over 30 countries and samples are now going to agents throughout the world. One company in the U.S.A. has ordered 1,000 TR750 amplifiers and 1,000 micro-amplifiers. We were particularly pleased by this result as the orders were obtained in the face of very tough Japanese competition.

★ FROM OUR POST BAG

Enthusiastic letters continue to reach us unabated. A constructor from Aylesbury writes:—

"Many thanks for having dispatched my order of your little receiver the Micro-6. I built the set on Saturday evening and in less than two hours; the results being obtained straightaway. Home, Light, and Third, received on more than ample strength, and at least 12 foreign stations, such as Luxembourg, Paris, two German stations, and others, all these at more strength than needed, with good selectivity. Clarity is very good; and no fading on Luxembourg. Truly a remarkable achievement, to be heard and seen, indeed to marvel at less than a Match Box,"

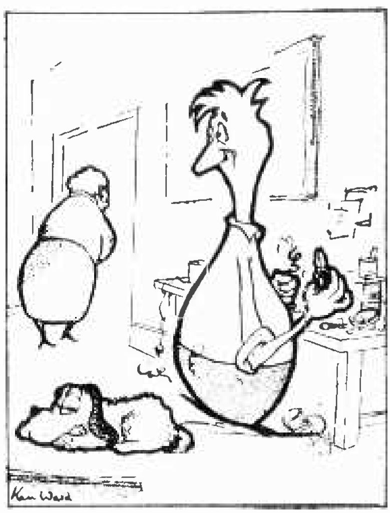
(Signed) J.G.

D.M.F., Southport, states:—

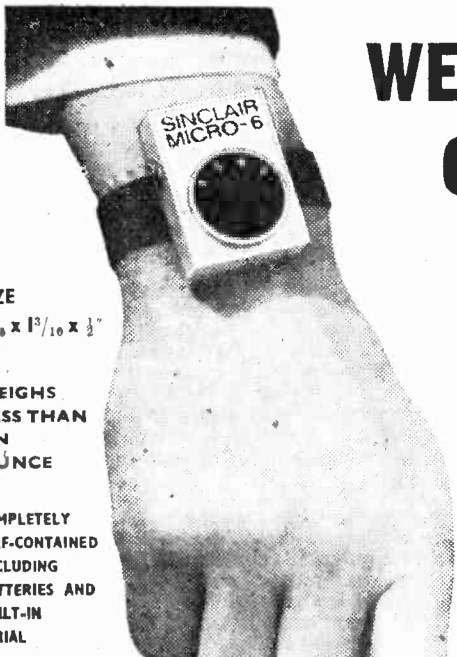
"As one who remembers the days of bright-emitter valves and has seen radio grow from that to colour television I can still marvel at the design and performance of your amazing little Micro-6. Having built it, I find it hard to be without. I seem always to have use for it, and I find it absolutely fascinating that so much entertainment can be had from so tiny a set."

(Signed) D.M.F.

This time our devoted enthusiast **MIKE FARAD** says *"I've made two for me, one for Uncle Bert, one for Mabel, two for the kids and one for Grandma. The dog will have to wait!"*



sinclair MICRO-DESIGNS



WEAR THE MICRO-6 ON YOUR WRIST!

SIZE
$1\frac{4}{8} \times 1\frac{3}{10} \times \frac{1}{2}$"

WEIGHS LESS THAN AN OUNCE

COMPLETELY SELF-CONTAINED INCLUDING BATTERIES AND BUILT-IN AERIAL

The unbelievably small size and fantastic power of the Micro-6 make it possible to wear it like an ordinary wrist watch, and for this we introduce our special "Transrista" reinforced nylon strap. The Micro-6 can be attached to it instantly and removed whenever required. This opens still further new and exciting approaches to radio listening and ensures your obtaining enjoyment such as you have never known before from any radio receiver.

You can build the Micro-6 and have it working within the space of a single evening! With a "Transrista" strap for using your set out of doors you will indeed have the radio of tomorrow today.

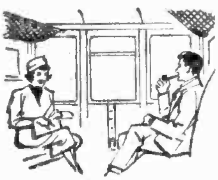
THIS IS THE SPEC THAT GETS SUCH WONDERFUL RESULTS

The Micro-6 uses Micro-Alloy Transistors in a completely new circuit. Two stages of R.F. amplification are followed by an efficient double diode detector which drives a high-gain 6-stage A.F. amplifier. Powerful A G.C. applied to the first R.F. stage ensures fade-free reception from the most distant stations tuned in.

Everything including ferrite-rod aerial and batteries is contained within the elegant tiny case.

SPORTS EVENTS

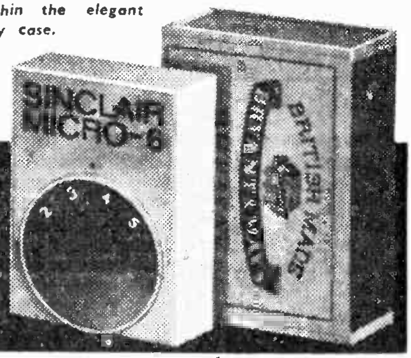
MOTORING



TRAVELLING

CYCLING

SINCLAIR
MICRO-6
THE SMALLEST SET IN THE WORLD



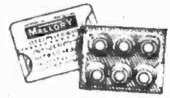
BUILD IT IN A SINGLE EVENING!

The Micro-6 is simplicity itself to build when you follow the meticulously detailed instructions. All parts including MAT transistors, printed circuit board, micro-miniature components, case, dial and light-weight earpiece and instructions come to **59/6**

MALLORY MERCURY CELLS FOR THE MICRO-6 ... 1/11 each

MICRO-6 "TRANSRISTA" WRIST STRAP **7/6**

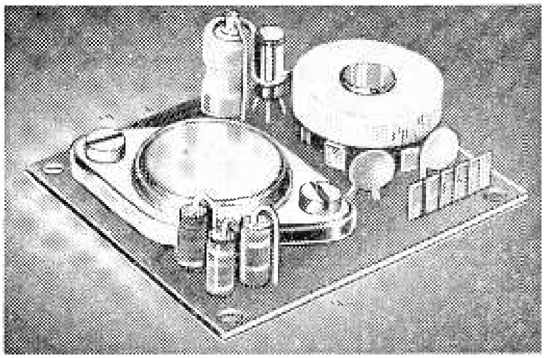
Stylishly finished, strongly made Nylon strap, black or grey, ready to take Micro-6,



MALLORY 6-CELL PACK OFFER

Always have power on hand for your Micro-6 with a Mallory 6-cell pack—you save, too, buying this way **10/6**

BRING 1970 STANDARDS TODAY!



ACTUAL SIZE—2" x 2"

THE TR750 HAS TREMENDOUS POWER

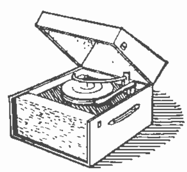
This latest Sinclair power amplifier builds on to a printed circuit board 2in. square and includes its own volume control with on-off switch. With a transformerless output of 750 milliwatts, the TR.750 is primarily intended to provide powerful loudspeaker reproduction from the Sinclair Micro-6 or Slimline receivers, thus enabling owners of these sets to use them also for car-radios, loudspeaker portables or domestic sets. The TR.750 has many other applications. It makes an excellent record reproducer, singly for mono or paired for stereo. It can make the heart of an efficient intercom or baby alarm system and its tremendous power in relation to its size greatly enhances its usefulness.

BRILLIANT FEATURES OF TR 750 POWER AMPLIFIER

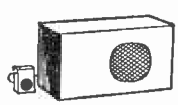
The performance characteristics are brilliant—**3/4 W. transformerless output with frequency response ± 1dB from 30 to 20,000 c/s**—hi-fi by any standards. Input—10mV into 2K ohms for 750 milliwatts output for any standard 25 to 35 ohm loudspeaker. Operating requirements from 9 to 12 volts. Full building instructions are supplied with parts for the TR.750, which include latest type Micro-Alloy driver transistor, exciting new "Magnagain" output transistor.

All parts including printed circuit board, transistors, components and instructions come to a total of **39/6**

Ready built and tested **45/-**



AS A RECORD PLAYER

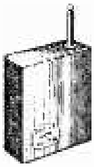


RADIO REPRODUCER WITH MICRO-6 OR SLIMLINE

AS A CAR RADIO

★ OTHER OUTSTANDING SINCLAIR DESIGNS

SINCLAIR MICRO-INJECTOR



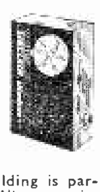
Using two MATS it generates and injects a test signal into any part of equipment at any frequency from 1 kc/s to 30 Mc/s to locate faults rapidly.
1 1/5 x 1 3/10 x ½in. excluding probe. All parts with instructions come to **27/6**

Ready built and tested **32/6.**

SINCLAIR MICRO AMP.

Smaller than a 3d. piece. Frequency response 30 to 50,000 c/s ± 1dB, power gain 60dB (1,000 000 times)—makes a superb broadband R.F. amplifier also a subminiature hi-fi ampl. with an output suitable for any earpiece or even loudspeaker. With MAT transistors and all parts. **28/6**

SINCLAIR "SLIMLINE"



Has self-contained ferrite rod aerial and takes standard PP5 battery, yet measures only 2 15/16 × 1 11/16 × ¾in. Tunes over the medium waveband Great power and quality. Building is particularly easy. *All parts, including royal blue and gold case, earpiece, and instructions come to* **49/6**

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Whatever you buy from Sinclair Radionics is sold to you on a complete satisfaction or money refunded guarantee. Subject to goods being returned as received.

FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

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TO SINCLAIR RADIONICS LTD., 69 HISTON ROAD, CAMBRIDGE
PHONE: 53965

Please send items detailed below £ s d

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TOTAL £

For which I enclose cash cheque money order

NAME ....

ADDRESS ....

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BLOCK LETTERS P.W.7

RECEIVERS & COMPONENTS

TRANSISTORS! Give-away price. NKT124/5 Power Type. 6 for **10/-**, 2SO17 4W, up to 60mc/s, **5/-** each. Post free. G F MILWARD. 17 Peel Close, Drayton Bassett, Staffs.

BRAND NEW Boxed Valves. Guaranteed twelve months. PCF80 **9/6**, PCL83 **10/6**, PCL84 **9/6**, EY86 **7/6**, U26 **11/-**, EF80 **7/6**, PY801 **11/6**, 30P12 **11/-**. Cash with order only please. Add post one valve 6d., three valves 1/-, six valves and over 2/-. RAYAUDIO ELECTRONICS, Dept. P1, Harley Road, Gt. Yarmouth, Norfolk.

RESISTORS! You can't resist this! $\frac{1}{2}$W, 1W, 2W Polythene wrapped on cards of 10. Mixed values and wattages. £2/10/- per 1,000. Your selection 10/- per 100. G. F. MILWARD, 17 Peel Close, Drayton Bassett, Staffs.

Used E.F.80 Valves (guaranteed), 2/6 each, Post Free. S.A.E. for other types.

J. BARKER, Radio Dept.,
163 LAKE ROAD, PORTSMOUTH.
HANTS.

"HEATHKITS" can now be seen in London and purchased on easy terms. Free brochure. DIRECT TV REPLACEMENTS LTD., Dept. PW7/9, 126 Hamilton Road. West Norwood, S.E.27. GIPsy Hill 6166.

SPEAKER REPAIRS, cones fitted. Satisfaction guaranteed. L. S. REPAIRS, Pluckley, Ashford, Kent.

TRANSISTORS now half price, unmarked but tested packets of 16, unmarked untested packets of 40: duds suitable as diodes, packets of 80. All packets **10/-** each, postage 1/-. Four packets post free C.W.O. K. R. WHISTON (Dept. PWT), New Mills. Stockport.

NEW MULLARD Transistors. OC70 **6/-**, OC71 **6/-**, OC72 **7/-**, OC44 **8/9**, OC45 **8/6**, OC170 **9/-**, OC171 **10/-**. Post free in U.K. Cash with order. Full range of Mullard Transistors in stock. S.A.E. for list. ARKAY ELECTRONICS LTD., 38 Church Road, Aldershot, Hants.

GWM RADIO LTD.

POWER UNITS. For 200/250 volt A.C. mains Outputs, 250 volts D.C., 100 M.A., 6.3 volts A.C., 4 amps. Double choke and paper capacitor smoothing. Fully fused. Size 19in. rack panel x 7in. x 10$\frac{1}{2}$in. deep, complete with dust cover. Suitable for R1392, P104 and R1132 receivers. In good condition. **£2/5/-**. Carriage 10/-. Useful Two Metre Unit. Transceiver SCR522. 100 to 150mc/s, crystal controlled (no crystals). Receiver section valves, 3 **of** 12SG7, 12C8, 12AH7, 12J5, 3 of 9003, 9002, 12H6. Transmitter valves, 6SS7, 3 of 12A6, 6G6, 2 of 832. Very useful modulation and driver trans**formers for** push pull 12A6 (or 6V6). Price only **50/-** with all valves. No attachments.

40/42 PORTLAND ROAD. WORTHING

RATES: 7/3 per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton St., London, W.C.2.

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(continued)

DIRECT TV REPLACEMENTS LTD., largest stockists of TV Components in the UK. Line Output Transformers, Frame Output Transformers, Deflector Coils for most makes. Official sole suppliers for many set makers. Same Day Dispatch Service. Terms C.O.D. or C.W.O. Send S.A.E. For quotes, Day and Night Telephone GIPsy Hill 6166. 126 Hamilton Road, West Norwood, S.E.27.

THE FINEST and cheapest mail-order service in Britain now supplies everything Electronic/Electrical. S.A.E. brings details of genuine bargain offers. HANDLEY, 112 Baysham St., Hereford.

R & R RADIO & T V SERVICE

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44 MARKET STREET, BACUP
Telephone 465

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ECL80	3/6	EB91	1/-	30FL1	5/-	PY81	3/6
30F5	5/-	EF85	5/-	PY32	6/-	U301	6/-
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Speakers, Ex-TV. 5in. round, 6 x 4in., **3/6**; 8in. round, 6/-, post 2/-.

Line Output Transformers available. State set model No.

Turret Tuners, 8/-, post 2/-.

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A really beautiful effect easily applied by brush. Air dries in 20 minutes. 100% fuel, water and weather proof. 2$\frac{1}{2}$oz. tins in blue, green, pewter or brick red 3/6, 1 pint 15/-, all post free.
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FINNIGAN SPECIALITY PAINTS.
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240 volt ELECTRIC POWER ANYWHERE ANYTIME! from 12 volt CAR BATTERY with the AMERICAN DYNAMOTOR UNIT

Input 12v output 200/250v. at 150 to 220 watts. Perfect for TELEVISION, POWER TOOLS and all universal AC/DC ELECTRICAL EQUIPMENT, gives wonderful results. Price ONLY £8 + 12/- carriage. Send stamped envelope for full illustrated details W SCIENTIFIC PRODUCTS. CLEVELEYS. Lancs.

5-TON FACTORY CLEARANCE, Radio, TV. Electrical Components. in mixed parcels. Example: 28lb. mixed parcel **£1**, pp 5/-. Speakers, grills. valves, bases. i.f.s, covers, condensers etc. Hundred other items. S.A.E. List and Postal Orders to P. NEWTON, 16 Shalcross Crescent, Hatfield, Herts.

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Dept. PW47 78-80 HIGH STREET, GOSBERTON SPALDING, LINCS. Tel: Gosberton 458

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6 Assorted ex-government valves.
6 Wander plug sockets—sorry no plugs.
1 Electro magnetic counter 10 imp. per sec.
3 Assorted Mains Dropper Resistances.
3 Yards of insulating sleeving.
1 Post Office telephone fuse box with fuses.
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20/- Post Free, Two Parcels for 35/-.

19in. RACK FITTING CABINET. 34" high by 21" deep with telescopic drawer slides. Louvred sides, back and top. Brand new Swedish make, £4.0.0 only, plus B.R.S. delivery.

ECR Tube with Screen and Base with ECR 35 data, 25/-.

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This item is brand new in varnished wood case original packing. Makes a good timer for exposure. Infinitely variable up to one minute. 24 volt operation. Containing motor, solenoid, clockwork mechanism. Driven by motor. 30/- post free.

Copper Laminate Board, single or double sided, 5/- per square foot panels, either type 3ft. by 4ft., 33/-.

High Stab Resistors. 5% 6d., 2% 9d., 1% 1/-. Every six packed in 7-compartment linen finish component box. Unmarked.

Assorted Resistors, 50 carbon plus 50 high stab. My choice 7/6.

Reflected Power Meter or Standing Wave Ratio Indicator Unit, and other kit including 500 micro amp. meters, plugs, sockets, leads, switch, circuit, instructions, 144 meg. Complete 35/-.

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Trade enquiries invited for large quantity OC201 Transistors, Printed Circuit Board.

U.K. ONLY

E. R. NICHOLLS

Mail Order and Retail Shop:
46 LOWFIELD ROAD
off SHAW HEATH, STOCKPORT
CHESHIRE

FOR SALE
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TESTED TRANSISTORS

1/- each, Red or White Spots.

2/- each, XA101, XA102, XB103, XB104, OA90, OC430.

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4/- each, AF114, AF115, AF117, OC170, OC171.

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10/- each, OC35, OC26, GET571.

ZENER DIODES 4.7 v. to 33 volt $\frac{1}{4}$ watt, 3/6 each. 1.5 watt, 5/- each, 7 watt, 6/- each.

Send 3d. stamp for Full Price List, and Free Equivalent Chart.

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Any type, or quantity

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Remote Control Unit Type F. New in sealed cartons, containing P.O. Relay 2,000 ohms Resistance, 100 volt Plessey Hand Generator, Telephone Ringing Bell A.C., 8 amp Morse Key on base, 2 D.P. D.T. Key Switches, Double Phone Jack, moulded, 5 position 6 pole Yaxley Switch, Induction Coil tapped 1-17-33 ohms, 7 Brass Screw Terminals on panels, plus Resistors, Condensers, Pointer Knobs. All in a handy metal box with hinged lid and side fasteners. Also web carry strap. Size 10½in. x 10in. x 7in., 25/-, post free. Or items may be purchased separately. Relay 5/-, Hand Generator 7/6, Bell 5/-, Morse Key 4/6, Key Switches 5/- pair, Double Phone Jack 2/6, Yaxley Switch 2/-, Ind Coil 2/-, Terminals 7 for 2/-, all post free.

Also available Key Switches. 4 pole 2 throw 3/6 each or 3 position D.P. plus D.P. centre off 5/- or rotary switch 6 pole 3 way 3/-.

Bank of 4 Pye Sockets with plugs and leads 5/- set. Ever Ready Batteries, 90 volts plus 4½ volts 4/6 each.

Plessey 2-4-12-25 way plugs and sockets, all 5/- pair.

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R.F. Coax R.F. Switch with 3 matching Plugs, 12/-.

Special Lightweight 7in. x 4in., 3 ohm P.M Speaker, 6/-.

Murphy Radio Transformer, mains input—output 220 volts at 27 m/a twice 6.4 volts at 3.5 amp, 35 volts at .3 amps, 14/6.

Component Boxes 4½in. x 3in. x 1in., linen finish, White, 7 compartment, 10 for 2/6, 60 for 12/6.

Transformer PL1102 mains input, output 550-0-550 at 120 m/a. 5.7 volts at 2 amp twice, 5.7 volts at 4 amp, 7 volts at 4 amp, 7.2v at 125 m/a, 30/-.

Transformer PL1103 mains input-output 520-0-520 volt at 300 m/a. plus 170-0-170 volts at 1 amp, 22/-.

Metal Frames, suitable for stock, Job Cards, Bins, Crates, 2½in. x 5in., 12/6 per 100—£4 per 1,000.

Packing List Envelopes, eyelet at each corner with fastener for flap, waxed, 4¼in. x 5¾in., 27/6 per 1,000. Samples both 6d. Tag Panels containing 150 items, 10/-.

150 kc/s Unit Motor Driven with crystal, slow motion drive gears, valves, variable condensers, etc. Brand new, boxed. B.R.S. delivery, 35/-.

U.K. ONLY

E. R. NICHOLLS

Mail Order and Retail Shop:
46 LOWFIELD ROAD
off SHAW HEATH, STOCKPORT
CHESHIRE

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SITUATIONS VACANT
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ST. JOHN STREET, LONDON, E.C.1

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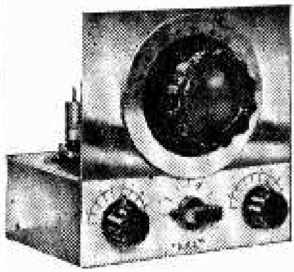

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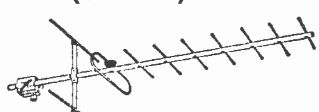

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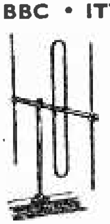

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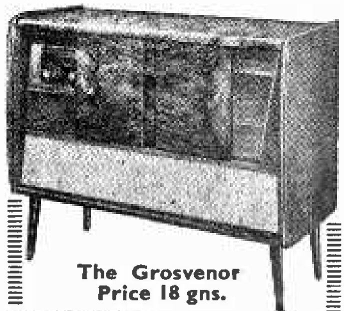

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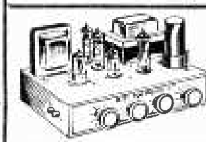
A brilliant application of transistor technique to benefit every owner obliged to leave his car standing at night for long periods. As daylight goes, the Parking Light switches ON automatically, and OFF when daylight returns. The chrome finished lamp (showing red and white) clips securely to window which is left locked. The electronic "brain" attaches inside windscreen. SAVES BATTERY DRAIN. CONFORMS WITH POLICE REQUIREMENTS. EASILY FIXED. *"SUNDOWN" PARKING LAMP WITH BULB, LEADS AND SELF-OPERATING CONTROL UNIT* **45/-**



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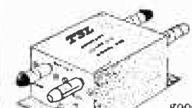

This remarkable new TSL development enables quality almost as good as the finest professional magnetic pick-ups to be obtained from crystal or ceramic types. With it, even cheap record players become first-class instruments. With good equipment results are astonishing. Ideal for B.S.R., Collaro, Garrard and Acos. With plugs for mono or stereo. 3 years guarantee. Ready for use. **30/-** Thousands sold. POST FREE

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Transistor ferrite rod aerial with medium and long wave coils with circuit. 7/6.

Oscillator Coil and set of 3 I.F. transformers for transistor set with circuit. 12/6.

Midget 3in. P.M. Loudspeaker 3 ohm 12/6. 8 ohm 13/6.

Midget 208 pF +176 pF two-gang Tuning Condenser with trimmers for transistor set Price 9/-.

Push-Pull Transformer. Sub-miniature 8/6.

0005 mfd. Single Tuning Condenser. Solid diaelextric $\frac{1}{4}$in. spindle for transistor of Crystal set, with spindle tapped 6 BA. 2/6.

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Pre-Amplifier. Made to Mullard design to suit the 10 watt amplifier made to specification. New Unit. Simply needs valves. Type EF86. 37/6 each.

46 Sets (Receiver/Transmitter pack set). Unused sets complete except for crystals. Packed with parts and easily rebuildable into ber gear. 19/6 each. Post 3/-.

Battery Charger Kit. Comprises 5 amp. transformer, 5 amp.rectifier, metal case and meter to charge 6 or 12 volt batteries up to 5 amps. With variable charge rate, 39/6 each. Post and insurance, 3/6.

Mains Transformer. 250-0-250 at 80 mA. 6.3 volts, 5 a. (normal mains input). 12/6 each. Carriage 2/6.

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Battery Charger Rectifier—selenium 12-15 v. 5 amp. 9/6.

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Tat Panels. Ideal for constructors, experimental circuits. etc. 3 of each of 12 different types, 5/-.

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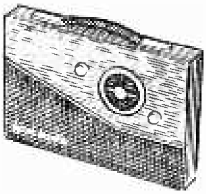
Metal Rectifier. 250 v. 60-80 milliamps ideal for mains set or instrument or to replace that expensive valve. 4/6.

Where postage is not definitely stated add 2/- all orders under £3.

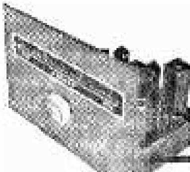
GOOD COMPANION Mark III



The 6 transistor set with the 8 transistor performance.
Incorporating all the latest requirements Anyone who can solder can make it. Many thousands already in use all over the country.
Full coverage of Long and Medium wavebands.
Fine looking cabinet, size 11" x 8" x 3". Q.P.P. Output approx. 750 mW. Excellent reception of difficult stations like 208.
Variable feed back gives excellent tone. ONLY **£5.19.6**

Plus 3/6 post and insurance.

F.M. TUNER



This is a high fidelity unit which although moderately priced has a performance equal to the highest priced. Its stability is very good and extremely good results have been received with the simplest of aerials as far away as Eastbourne. The unit has its own power supply for A.C. mains.
Less valves only otherwise ready to use. **39/6**

Plus 3/6 post and insurance.

CABINET & PICK-UP

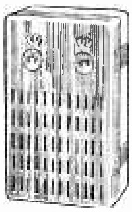
Made for a famous company intending to make a Battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a Cosmocord pick-up with crystal cartridge and sapphire stylus. Both items new and perfect. Only 19/6, plus 4/6 post and insurance.

THIS MONTH'S SNIP

Complete kit of parts to build this transistor 2 wave receiver at only 39/6.

Post and insurance 2/6.

"CORONET" MK. III



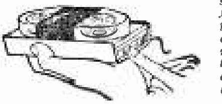
It fully covers the medium wave band and that part of the long waveband to bring in B.B.C. Light. The circuit includes a highly efficient slab aerial and Plessey tuning condenser. Overall size approximately $4\frac{1}{2}$ x $2\frac{1}{2}$ x $1\frac{1}{4}$in. Supplied complete with carrying case.

YAXLEY SWITCHES

Full range still available
as our advertisement last month.

DO YOU EVER FORGET?

This Pocket Secretary could eliminate the trouble (often embarrassment) your forgetfulness causes you—she will stay in your jacket pocket and as fast as you can think she will capture and store — ideas — notes — formulae — appointments — anything you can say or sing! then at your command she will play them all back to you.

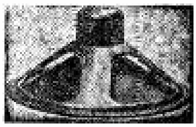


Undoubtedly one of the smallest precision tape recorders made. Entirely controlled by push buttons, you can record and play back with the instrument in your pocket. It is a full-function machine using standard $\frac{1}{4}$in. tape and easy to replace batteries. Speaking and playing back is from the same (crystal) microphone.
Specifications: Dimensions: $6\frac{1}{4}$ x $2\frac{1}{2}$ x $1\frac{3}{4}$in. Weight: 14 oz. Recording time: 12 mins., rewinding time 4 mins. Recording system: D.C. Bias. Erasing system: Magnetic erasing wow and flutter. Within 2% and frequency response: 500-1,200 c/s (within —6dB).
Price £6.19.6 Complete ready to work.

Cabinet Snip

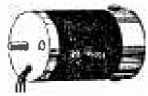
This fine cabinet as illustrated but less control knobs is available this month at a special snip price of 12/6, plus 4/6 post and insurance. Size $13\frac{1}{2}$in. x 9in. x 4in. and it is nicely covered in two tone I.C.I. fabric.

Speaker Bargain



12in. High-fidelity loudspeaker. High flux permanent magnet type with standard 3 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 27/6 plus 3/6 post and insurance.

Make a Fan

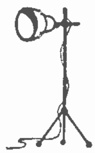


Miniature motor $2\frac{1}{2}$ in. long x $1\frac{3}{4}$in. diameter, laminated poles. Operates off 20-30 v. D.C. Original cost at least £3 each. 8/6 plus 1/6 postage and insurance. Mains model 9/6 plus 2/6 postage and insurance.

TRANSISTOR SET CASE

Very modern cream cabinet, size $5\frac{1}{2}$ x 3 x $1\frac{3}{4}$in. with chrome handle, tuning knob and scale. Price 7/6 plus 1/6 postage.

Flood Lamp Control



Dim and full switch for controlling photo flood lamps: Gives two lamps in series, two lamps full brilliance and lamps off. Similar control of other appliances. With circuit 3/6 plus 9d. postage.

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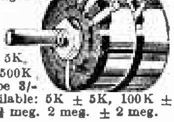

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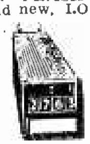

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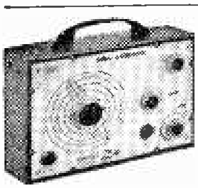

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PRACTICAL WIRELESS, JULY, 1964.

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