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JANUARY 1964

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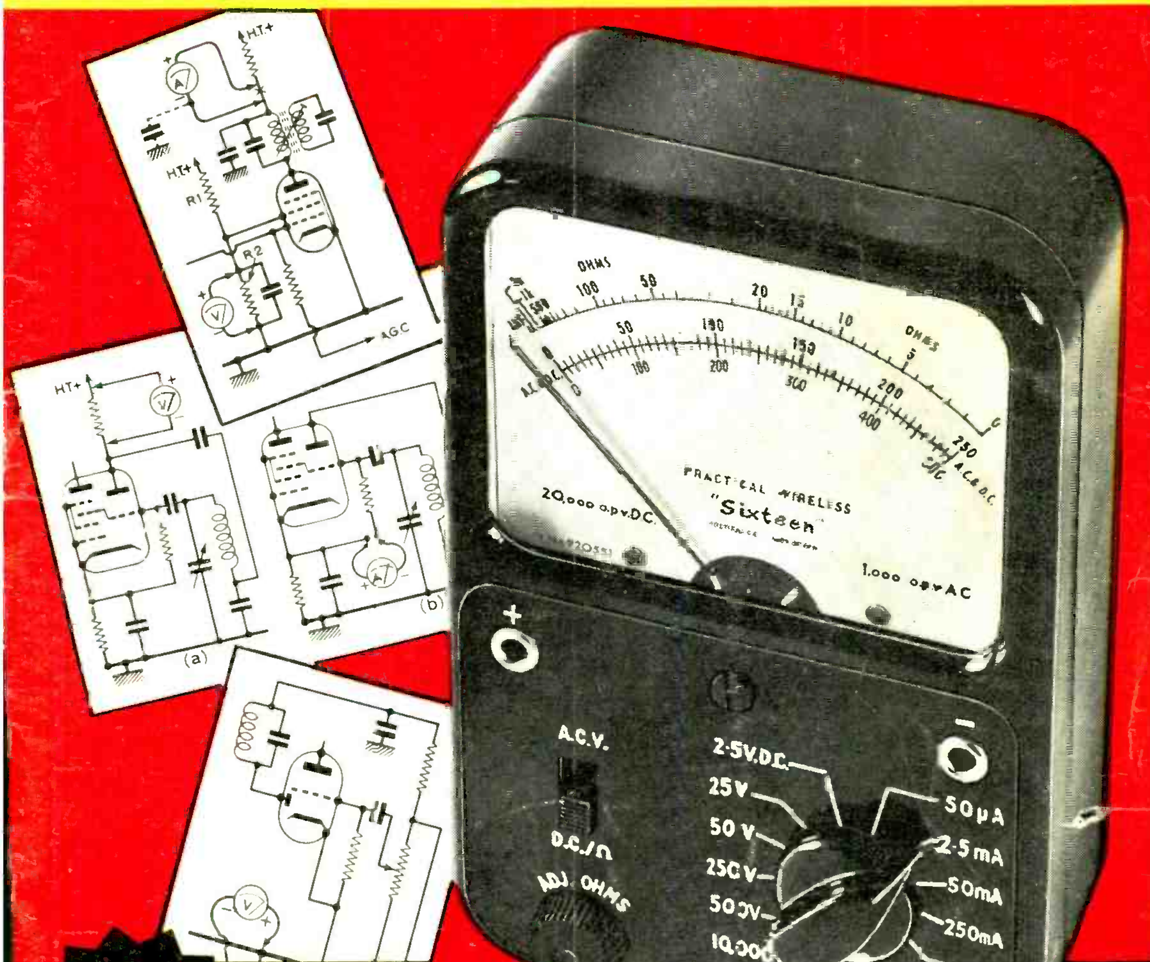

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Kit of new parts, consisting chassis, mains and output transformers, valves (P61, 6G6G, 6X5G) and all components. With full instructions for making high gain amplifier with separate bass and treble controls, negative feed-back, etc. Truly unusual value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

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s.a.e. enquiries.
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6A6	3/9	6X5G	4/9	50C5	6/9	ECF80	6/9	P61	2/6	UCC84	9/-
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6A8G	6/9	7B6	8/9	53KU	9/6	ECH21	10/9	PC86	10/3	UCF80	11/9
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6AK5	4/9	7R7	14/-	80	5/3	ECL80	5/9	PCC89	7/6	UCL83	9/6
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6AM6	2/9	7Z4	5/-	185BT	19/6	ECL83	9/9	PCF80	5/9	UF42	5/3
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6AT6	5/-	10C1	9/6	807(A)	8/-	EF22	6/6	PCF84	9/3	UF85	7/-
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6AV6	5/6	10F1	6/9	813	49/-	EF37A	6/9	PCL82	6/6	UL41	6/9
6B7	8/-	10F9	10/-	832	14/-	EF39	4/6	PCL83	8/-	UL44	14/-
6B8G	3/-	10F18	9/6	866A	11/6	EF40	9/9	PCL84	6/9	UL46	8/9
6BA6	5/6	10LD11	12/6	954	3/6	EF41	6/9	PCL85	8/6	UL84	6/9
6BE6	5/-	10P13	8/3	955	2/3	EF42	5/9	PCL86	9/6	UM80	8/6
6BG6G	13/-	10P14	9/6	956	2/-	EF50-BR	1/3	PEN25	3/6	UR1C	6/9
6BH6	5/6	10P18	6/9	1625	5/6	EF50(A)	2/6	PEN45	7/9	UU6	9/9
6BJ6	5/6	12A6	2/3	5763	7/6	EF54	3/3	PEN46	4/3	UU7	8/6
6BR7	8/-	12AH8	9/-	9001	3/-	EF80	3/9	PL33	9/6	UU8	11/6
6BR8	8/-	12AT6	6/6	9002	4/3	EF85	5/6	PL36	8/3	UY1N	10/6
6BW6	6/6	12AT7	3/9	9003	5/9	EF86	6/9	PL38	15/-	UY21	8/6
6BW7	5/-	12AU6	7/6	ATP4	2/-	EF89	5/9	PL81	7/9	UY41	5/9
6C4	2/3	12AU7	4/3	AZ31	6/9	EF91	2/9	PL82	5/3	UY85	4/9
6C5	5/6	12AV6	6/9	AZ41	6/6	EF92	2/6	PL83	5/3	VP4B	9/-
6C6	3/-	12AX7	5/6	B36	6/9	EF183	8/9	PL84	5/9	VP23	2/3
6C9	10/6	12BA6	6/6	C1C	8/-	EF184	8/6	PL820	7/9	VP41	5/3
6CD6G	18/6	12BE6	6/6	CCH35	12/6	EK32	5/9	PM84	9/3	VR105	5/6
6CH6	5/-	12BH7	7/-	CL33	9/-	EL32	3/6	PX4	9/-	VR150	4/9
6D2	2/3	12C8	3/9	CY31	6/9	EL33	7/-	PX25	8/9	W76	4/9
6D3	8/6	12E1	16/-	D77	2/3	EL34	9/9	PY31	6/-	W81	5/9
6D6	3/-	12H6	1/9	DA30	11/6	EL35	7/6	PY32	9/-	X61M	11/-
6F1	6/6	12J5GT	2/9	DAC32	8/-	EL38	11/6	PY33	9/-	X63	5/-
6F6	6/9	12J7GT	7/9	DAF91	4/6	EL41	7/6	PY80	5/6	X65	5/6
6F6G	4/6	12K7GT	4/6	DAF96	6/9	EL42	7/9	PY81	5/3	X66	7/3
6F13	4/9	12K8	9/9	DF33	8/-	EL81	8/9	PY82	5/-	X76M	11/-
6F14	9/6	12K8GT	8/9	DF91	2/9	EL84	5/6	PY83	6/-	X78	21/-
6F15	6/9	12Q7GT	4/6	DF96	6/9	EL85	7/9	PY88	8/-	X79	21/-
6F19	5/6	12SA7	6/9	DF97	7/6	EL91	2/3	PY800	7/3	Y63	5/-
6F32	4/-	12SG7	3/9	DH63	5/6	EL95	6/-	PZ30	9/6	Z63	4/9
6F33	4/-	12SH7	3/6	DH76	4/6	EM34	8/6	R18	9/6	Z66	7/6
6H6	1/6	12SJ7	5/6	DK32	8/-	EM80	6/9	R19	7/9		
6J5	4/9	12SK7	4/6	DK91	4/9	EM81	7/6	SP41	2/-		
6J5G	3/-	12SN7GT	6/9	DK92	6/9	EM84	8/-	SP61	2/-		
6J5GT	4/3	12SQ7	8/-	DK96	7/3	EM85	9/-	SU25	16/-		
6J6	3/-	12SR7	4/9	DL33	7/3	EN31	9/6	SU2150	4/6		
6J7GT	4/6	13D3	5/6	DL35	7/-	EY51	6/9	T41	6/6		
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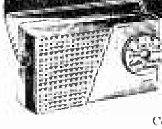

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Stock No. 107—PRINTED CIRCUITS of 3 Transistor Reflex Radio made to fit above radio, **2/6**, plus 1/6 P. & P.

Stock No. 108—MINIATURE PRINTED RADIO CABINETS, $5 \times 3\frac{1}{2} \times \frac{3}{4}$in., **3/6** each to clear, plus 6d. P. & P.

Stock No. 109—BEAUTIFUL MINIATURE SIZE PLASTIC RADIO CABINETS. Size $5 \times 3 \times 1\frac{1}{2}$in. Printed and ready drilled. OUR PRICE **3/6**, plus 1/- P. & P.

Stock No. 110—MINIATURE PLASTIC RADIO CABINETS unprinted. Size $3 \times 2\frac{1}{4} \times \frac{3}{4}$in., **2/6** each to clear, plus 6d. P. & P.

Stock No. 111—BEAUTIFULLY MOULDED MINIATURE PLASTIC RADIO CABINETS, complete with tiny carrying handle and tuning knob. Size $4 \times 2\frac{1}{4} \times 1\frac{1}{4}$in. Price to clear **3/6**, plus 1/- P. & P.

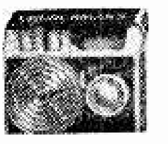
Stock No. 111a—Specially Printed Circuits for above cabinet of two transistor reflex radio, **2/6**, plus 6d. P. & P.

Stock No. 112—EXCEPTIONALLY GOOD LOOKING PLASTIC RADIO CABINETS "SLIM LINE". Size $6 \times 3\frac{1}{2} \times 1\frac{1}{2}$in. Clearance price **5/9**, plus 9d. P. & P.

AMAZING CIGARETTE RADIO

only **18/6**

Complete set of parts.



Amaze your friends!—this highly sensitive **TRANSISTOR "CIGARADIO"** receives all medium wave stations clear and crisp—holds ten cigarettes—weighs less than 3 ozs. with cigarettes! Tiny battery inside costs 3d. and lasts over three months. This brilliant little novelty personal phone radio is **ideal for Bedside, News, Sports, Office.** Can be built by anyone from our simple pictorial diagrams in an hour or two. All parts supplied for 18/6 (add 1/6 P. & P.). C.O.D. 2/- extra. (Parts sold separately, priced parts lists 1/-).

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Stock No. 114—MINIATURE RADIO CABINETS IN GOLD but undrilled. Size $4\frac{3}{4} \times 3 \times 1\frac{1}{4}$in. Give away price of **2/6**, plus 6d. P. & P. Special carrying cases for above at 1/6, plus 6d. P. & P.

Stock No. 115—RADIO CABINETS same as specified as above, but upright design, **2/6** each, plus 6d. P. & P.

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Stock No. 116—ANOTHER TYPE RADIO CABINET, horizontal, **2/6** each, plus 6d. P. & P.

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Stock No. 128—4in. PLASTIC CARRYING HANDLES with fixing screws, **6d.** each, plus 6d. P. & P.

Stock No. 129—BRAND NEW ASSORTED RADIO KNOBS including pointer types, **6/-** a doz plus 9d. P. & P.

Stock No. 130.

AUTOMATIC CIGARETTE LIGHTER

Instantly provides ready lit cigarette, without the driver taking his eyes from the road. Heavily chromium plated case holds 10. Easily and simply fitted to any car's dashboard. Works off 6 or 12 volts. Retail Price 44/9. **Special Clearance offer only** **10/6** ea. sold in minimum lots of 6. Carriage free.

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Stock No. 118—SPRING TERRY CLIPS for holding Miniature Valves. Price for 3. **1/-**, plus 6d. P. & P.

Stock No. 119—72 ONLY MINIATURE 6 TAG COILS covering Medium Wave and Long Wave with reaction winding. Price to clear **3/-** each, plus 6d. P. & P.

Stock No. 120—SIMILAR TO ABOVE but Medium Wave only **2/-** each, plus 6d. P. & P.

Stock No. 169.

"VOLKSRADIO" POCKET RADIO

ONLY **15/-**

Take - Over Bid makes this Fantastic Offer possible—the beautifully compact **"5 Star Volksradio"** measuring $4\frac{7}{8} \times 2\frac{7}{8} \times 1\frac{1}{2}$in. receives perfectly—in the bedroom, office, garden—over all medium waves (incl. Luxembourg). **Under 1d. hour running cost.** Anyone can assemble it in 1 or 2 hours, using our simple A B C plan. Complete set of parts. **Only 15/-, plus 1/6 P. & P. C.O.D. extra.** (Parts can be bought separately).

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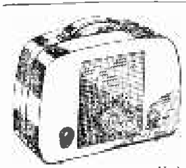
Stock No. 141—IL4 BRAND NEW VALVES, **1/9**, plus 6d. P. & P.

Stock No. 142—BRAND NEW B7G VALVE HOLDERS, **6d.**, plus 4d P. & P.



THE MINUTE TRANSISTOR RADIO

MIAMI

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Stock No. 124—SUB-MINIATURE DIODES, all brand new and tested. Clearance price 3 for **1/-** plus 3d. P. & P.

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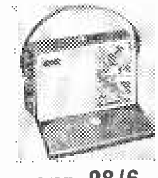

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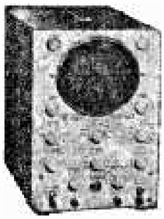

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5in. OSCILLOSCOPE. Model 0-12U. Laboratory quality at utility oscilloscope price. Wide band amplifiers essential for T.V. servicing, F.M. alignment, etc. T/B covers 10 c/s-500 kc/s in 5 ranges.

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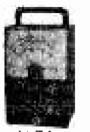

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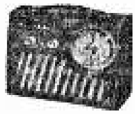

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6 TRANSISTOR PORTABLE. Model UXR-I Prealigned I.F. transformers. Printed circuit, 7in. x 4in. high flux speaker. Real hide case. Very easy to build.

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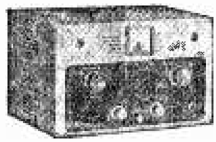

DX-40U

AMATEUR TRANSMITTER Model DX-40U. Covers 80-10 m. Power input 75 w. C.W., 60 w. peak C.C. phone. Output 40 w. to aerial. Prov. for V.F.O.

£33.19.0 Kit

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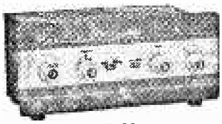

S-33

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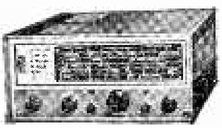

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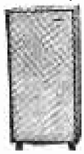

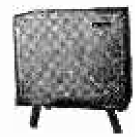

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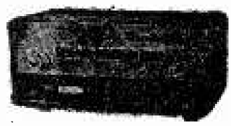

FM-4U

AM/FM TUNER. Covers FM 88-108 Mc/s. AM. 16-50, 200-550, 900-2,000 m. Tuning heart (£4.13.6 inc. P.T.). and I.F. Amp.
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1F7	15/-	6D3	9/6	8D2	2/6	30FL12	11/-
1FD9	3/9	6D6	3/-	8D3	3/-	30L1	5/6
1G6	6/-	6D8	15/-	9BW6	9/6	30L15	10/-
1H5GT	8/-	6E5	9/6	9D2	3/-	30P4	12/3
1L4	2/6	6F1	9/6	9D7	12/3	30P12	7/6
1LA6	16/10	6F5	5/3	10C1	9/6	30P16	6/-
1LD5	4/3	6F6G	4/-	10C2	13/-	30P19	12/3
1LN5	4/6	6F6GT	7/6	10D1	7/-	30PL1	9/-
1N5GT	8/6	6F8	5/-	10D2	10/6	30PL13	9/6
1P1	5/9	6F11	17/9	10F1	10/-	30PL14	12/6
1P10	4/9	6F12	3/-	10F9	10/-	35A5	20/9
1P11	5/6	6F13	5/-	10F18	10/-	35L6GT	7/-
1R5	4/6	6F14	23/3	10LD3	6/6	35W4	5/6
1S4	5/-	6F15	6/9	10LD11	9/-	35Z3	16/4
1S5	3/9	6F16	6/9	10P13	8/6	35Z4GT	4/9
1T2	34/11	6F17	12/6	10P14	11/6	35Z5GT	6/-
1T4	2/6	6F18	13/5	11D3	17/6	40SUA	6/6
1U4	5/-	6F19	4/9	11D5	17/6	41STH	15/-
1U5	5/3	6F23	9/6	11E1	15/-	42	5/-
2A7	10/6	6F24	9/6	11E3	17/-	43	10/-
2C26	3/-	6F26	5/-	12A6	2/3	50A5	21/10
2D13C	7/-	6F32	4/-	12A8	16/6	50B5	7/-
2D21	5/6	6F33	3/6	12AC6	8/6	50C5	6/6
2P	23/3	6G6	2/6	12AD6	9/6	50CD6G	40/9
2X2	3/-	6H6	1/6	12AE6	8/-	50L6GT	6/6
3A4	4/-	6J5G	3/-	12AH7	5/-	52KU	14/6
3A5	6/9	6J5GT	4/3	12AH8	9/-	53KU	14/6
3B7	5/-	6J6	3/-	12AT6	4/9	72	6/6
3D6	4/-	6J7G	4/9	12AT7	3/9	75	5/6
3Q4	5/6	6J7GT	7/-	12AU6	6/6	76	12/6
3Q5	7/3	6J8	12/6	12AU7	4/6	77	6/-
3S4	4/9	6K6GT	6/-	12AV6	6/9	78	5/-
3V4	5/6	6K7G	1/3	12AX7	4/6	80	5/6
4D1	4/-	6K7GT	4/3	12BA6	6/	83	15/-
5R4GY	9/-	6K8G	3/9	12BE6	5/-	83V	8/-
5T4	8/-	6K8GT	7/9	12BH7	7/6	85A1	22/6
5U4G	4/3	6K25	12/6	12E1	17/-	85A2	8/6
5V4G	7/6	6L1	9/6	12H6GT	1/6	90AG	67/6
5Y3GT	4/3	6L6G	6/6	12J5GT	2/6	90AV	67/6
5Y4	9/6	6L6M	9/-	12J7GT	7/6	90CG	42/-
5Z3	8/-	6L7GT	4/6	12K5	10/-	90CV	42/-
5Z4G	7/-	6L17	12/6	12K7GT	3/9	90C1	16/-
6/30L2	8/6	6L18	7/6	12K8GT	9/-	150B2	16/6
6A7	9/-	6L19	9/9	12Q7GT	3/9	150C2	4/6
6A8G	7/-	6LD3	6/9	12SA7	7/-	161	13/-
6AB7	4/-	6LD13	7/-	12SC7	4/-	185BT	34/11
6AC7	3/-	6LD20	5/6	12SG7	3/-	215SG	6/6
6AG5	2/9	6N7GT	5/-	12SH7	3/-	220B	10/6
6AG7	6/-	6P1	16/11	12SJ7	5/-	301	20/-
6AJ5	8/6	6P25	8/-	12SK7	3/6	302	10/6
6AK5	5/-	6P26	9/-	12SQ7	8/-	303	15/-
6AK6	12/6	6P28	11/6	12SR7	5/-	304	15/-
6AK8	5/6	6Q7G	4/6	12U5G	7/-	305	13/-
6AL5	2/3	6Q7GT	7/9	12Y4	2/-	306	13/-
6AM5	2/6	6R7G	6/-	13D1	5/-	866A	12/6
6AM6	3/-	6R7GT	11/-	13D3	5/6	1622	12/6
6AQ5	6/-	6SA7	5/9	14B6	20/9	4033	15/-
6AR6	20/-	6SC7	4/9	14H7	9/6	4687	71/-
6AT6	4/-	6SG7	4/9	14S7	17/6	5763	7/6
6AU6	6/-	6SH7	3/-	15D2	6/-	7193	1/9
6AV6	5/6	6SJ7	4/6	18	12/6	7475	3/-
6B7	5/-	6SK7	4/6	19	10/6	A1834	20/-
6B8G	2/6	6SL7	5/-	19AQ5	7/9	ACO44	9/-
6BA6	4/9	6SN7	4/6	19BG6G	20/5	AC2HL	10/6
6BE6	5/-	6SQ7	5/9	19H1	6/-	AC2PEN	11/6
6BG6G	13/6	6SR7	12/6	20D1	9/-	AC2PEN/DD	12/6
6BH6	5/6	6SS7	2/-	20D2	21/-	AC4PEN	27/2
6BJ6	5/6	6U4GT	9/6	20F2	12/-	AC5PEN/DD	23/3
6BQ5	5/-	6U5G	5/-	20L1	12/6		
6BQ7A	7/6	6U7G	9/6	20P1	12/6		
6BR7	8/6	6V6G	3/9	20P3	12/-		
6BR8	9/3						

AC6PEN	5/-	EB34	1/-	EL81	8/6	LN152	6/-
AC/PEN (5)	17/6	EB41	4/9	EL83	7/-	LN309	8/3
AC/PEN (7)	17/-	EB91	2/3	EL84	5/-	LN319	9/-
AC/SG	22/8	EBC3	20/6	EL85	7/-	LP2	9/6
AC/SG/VM	12/-	EBC33	8/6	EL86	7/6	ME41	15/2
ACTH1	15/-	EBC41	6/9	EL91	2/6	ME91	12/6
AC/TP	19/-	EBC81	6/-	EL95	6/3	MH4	3/6
AC/VP1	12/-	EBC91	5/6	EL360	27/-	MHD4	8/6
ACVP2	20/5	EBF80	6/6	EL820	16/4	MHL4	7/6
ATP4	2/3	EBF83	7/6	EL822	18/6	MHLD6	12/6
AZ1	6/6	EBF89	6/9	ELL80	20/5	ML6	6/-
AZ31	6/6	EBL21	9/-	EM4	17/9	MS4B	20/5
AZ41	6/6	EC52	4/6	EM34	15/2	MSP4	12/-
B36	5/-	EC53	12/6	EM35	12/-	MU12/14	5/-
BL63	10/6	EC54	6/-	EM71	13/6	MX40	9/6
C1	12/6	EC70	12/6	EM80	6/6	N37	23/3
C1C	12/6	EC81	27/6	EM81	7/6	N78	26/2
CCH35	13/-	EC90	2/6	EM84	7/6	N108	26/2
CK506	6/6	EC92	7/6	EM85	9/-	N339	15/-
CL4	23/10	ECC31	7/6	EM87	15/2	P61	2/9
CL33	11/6	ECC32	4/-	EN31	45/-	PABC80	7/-
CV6	2/6	ECC34	21/7	EN91	5/6	PC86	10/6
CV63	10/6	ECC35	5/9	EY51	6/-	PC88	14/7
CV271	12/6	ECC40	7/6	EY81	7/3	PC95	11/8
CY1	18/2	ECC81	3/9	EY83	9/3	PC97	8/3
CY1C	6/6	ECC82	4/6	EY84	10/6	PCC84	5/6
CY31	5/9	ECC83	4/6	EY86	5/9	PCC85	7/-
D1	1/3	ECC84	6/-	EY88	9/3	PCC88	10/6
D15	13/6	ECC85	6/6	EY91	3/-	PCC89	7/6
D42	10/6	ECC88	10/-	EZ35	4/6	PCC189	10/6
D63	5/-	ECC91	3/-	EZ40	5/6	PCF80	5/6
D77	2/3	ECC189	10/6	EZ41	6/-	PCF82	6/6
DAC32	8/-	ECC807	22/6	EZ80	4/6	PCF84	9/6
DAF91	3/9	ECF80	6/3	EZ81	4/3	PCF86	7/9
DAF96	5/9	ECF82	7/6	EZ90	4/-	PCL82	6/6
DCC90	6/9	ECF86	11/6	FC4	9/6	PCL83	8/3
DD4	12/6	ECF804	24/-	FC13	14/6	PCL84	7/-
DD41	12/3	ECH3	21/6	FC13C	17/-	PCL85	8/6
DDT4	8/6	ECH21	10/-	FW4/500	6/6	PCL86	9/-
DET25	7/6	ECH33	22/8	FW4/800	8/6	PCL88	12/6
DF33	8/6	ECH35	6/6	GT1C	10/-	PEN4DD	25/-
DF66	15/-	ECH42	7/9	GU50	41/6	PEN25	3/9
DF72	30/-	ECH81	6/-	GZ30	7/-	PEN40DD	34/-
DF91	2/6	ECH83	7/6	GZ32	7/6	PEN45	7/-
DF96	5/9	ECH84	9/6	GZ33	17/6	PEN45DD	12/-
DF97	10/-	ECL80	6/-	GZ34	10/-	PEN46	4/6
DH30	15/6	ECL82	7/6	GZ37	14/6	PEN383	11/6
DH63	4/6	ECL83	10/-	H30	5/-	PEN453DD	17/6
DH76	3/9	ECL86	9/-	H63	7/-	PENA4	7/6
DH77	4/-	EF6	20/6	HABC80	10/-	PENB4	23/11
DH81	23/3	EF9	20/6	HL2	7/6	PEN/DD/4020	17/6
DH101	25/-	EF22	6/9	HL13C	4/-	PL33	16/11
DH107	16/11	EF36	3/3	HL23	11/6	PL36	8/6
DK32	8/-	EF37A	6/-	HL23DD	5/-	PL38	16/6
DK40	18/8	EF39	3/9	HL41	3/9	PL81	7/-
DK91	4/6	EF40	9/-	HL41DD	8/6	PL82	5/6
DK92	6/9	EF41	6/9	HL42DD	8/6	PL83	5/3
DK96	6/3	EF42	5/9	HL133DD	9/6	PL84	6/-
DL33	7/3	EF50	2/6	HN309	25/-	PL820	8/-
DL35	6/6	EF54	3/-	HVR2	9/-	PM84	9/6
DL63	6/-	EF73	5/-	HVR2A	9/-	PT15	10/-
DL68	15/-	EF80	4/-	1W3	5/6	PX4	9/-
DL72	15/-	EF83	9/9	1W4/350	5/6	PX25	8/6
DL75	30/-	EF85	4/9	1W4/500	6/-	PY31	6/6
DL92	4/9	EF86	6/-	KF35	12/6	PY32	8/9
DL94	5/6	EF89	4/3	KL35	11/6	PY33	10/-
DL95	6/-	EF91	3/-	KLL32	21/7	PY80	5/6
DL96	5/9	EF92	2/6	KT2	7/6	PY81	5/6
DL810	10/6	EF95	5/-	KT8	15/-	PY83	5/-
DM70	5/-	EF97	11/8	KT32	5/6	PY88	8/-
DM71	9/9	EF98	10/-	KT33C	4/-	PY800	7/3
DW4/350	8/6	EF183	8/-	KT36	29/1	PY801	7/6
DW4/500	8/6	EF184	8/-	KT41	7/6	PZ30	15/-
DY86	7/-	EF804	20/5	KT44	5/9	QP21	5/-
E80F	24/-	EH90	15/2	KT61	7/6	QP22B	12/6
E83F	24/-	EK2	25/11	KT63	4/-	QP25	5/-
E88CC	10/-	EK32	6/-	KT66	13/6	Q8150/15	9/6
E180F	19/6	EL2	19/6	KT74	12/6	R12	6/-
E1148	1/9	EL3	21/-	KT88	28/-	R16	34/11
EA50	1/6	EL32	3/6	KTW61	5/-	R17	17/6
EA76	7/-	EL33	7/6	KTW62	6/6		
EABC80	5/6	EL34	10/-	KTW63	5/9		
EAC91	3/6	EL35	10/-	KTZ41	5/6		
EAF42	7/6	EL37	17/6	L63	3/-		
		EL38	12/-				
		EL41	7/3				
		EL42	7/9				

R18	10/6	U78	4/-	AF126	10/-
R19	7/-	U84	47/7	AF127	9/6
R52	9/-	U101	19/6	BYZ13	11/6
RG1/240A	54/-	U107	17/6	GD3	5/6
RK34	7/6	U191	10/-	GD6	5/6
S130	22/6	U251	9/6	GD14	10/-
SP4B	19/6	U281	9/6	GET102	8/6
SP13C	12/6	U282	13/-	GET103	3/6
SP41	2/-	U301	12/-	GET104	10/-
SP42	12/6	U329	9/6	GET106	17/6
SP61	2/-	U339	10/-	GET111	12/-
SU25	27/2	U403	10/-	GET113	8/-
SU61	6/-	U404	6/-	GET114	4/-
T41	9/-	U801	17/6	GET872	10/-
TDD2	12/6	U4020	6/6	GET873	9/3
TDD4	8/6	VMP4G	12/-	GET874	9/6
TH21C	12/6	VMS4B	12/-	GEX35	3/-
TH30C	14/6	VP2	3/6	GEX36	10/-
TH41	13/-	VP2B	9/6	GEX45	6/6
TH233	15/6	VP4	14/6	GEX64	11/6
TP22	5/-	VP4A	14/6	GEX66	15/-
TP25	6/-	VP4B	20/5	MAT100	7/9
TP2620	17/6	VP13C	7/-	MAT101	8/6
TY86F	11/8	VP23	2/6	MAT120	7/9
UABC80	5/6	VP41	5/6	MAT121	8/6
UAF42	7/6	VP133	10/-	OA5	6/-
UB41	10/6	VR75	21/-	OA10	8/-
UBC41	6/6	VR105	5/6	OA70	3/-
UBC81	6/3	VR150	5/-	OA73	3/-
UBF80	6/6	VT61A	7/-	OA79	3/-
UBF89	7/-	VT501	3/-	OA81	3/-
UBL21	11/-	VU111	5/-	OA85	3/-
UC92	7/6	VU120	10/-	OA86	4/-
UCC84	9/-	VU120A	10/-	OA90	3/-
UCC85	6/6	VU133	7/-	OA91	3/-
UCF80	9/6	W21	5/-	OA95	3/6
UCH21	8/6	W42	20/5	OA210	9/6
UCH42	7/-	W61M	24/6	OA211	13/6
UCH81	7/-	W63	10/6	OC16W	35/-
UCL82	8/-	W76	3/9	OC19	25/-
UCL83	9/6	W77	2/6	OC22	23/-
UF41	6/9	W81M	6/-	OC23	57/-
UF42	5/6	W101	26/2	OC25	12/-
UF80	6/6	W107	10/6	OC26	25/-
UF85	7/-	W729	17/6	OC28	12/6
UF86	8/6	X14	8/-	OC29	27/6
UF89	6/-	X18	6/9	OC35	18/-
UL41	7/-	X24	16/6	OC36	21/6
UL44	23/3	X41	15/-	OC41	8/-
UL46	9/-	X61	10/-	OC42	9/6
UL84	6/-	X63	7/-	OC43	12/6
UM4	15/2	X64	4/6	OC44	8/3
UM34	16/10	X65	5/6	OC44PM	9/3
UM80	8/6	X66	7/6	OC45	9/-
UR1C	6/6	X76M	11/-	OC45PM	9/-
UU5	7/-	X78	26/2	OC65	22/6
UU6	9/-	X79	21/-	OC66	25/-
UU7	8/6	X81M	29/1	OC70	6/6
UU8	12/6	X101	23/6	OC71	3/6
UU9	5/6	X109	26/2	OC72	8/-
UU12	4/3	X118	9/6	OC73	16/-
UY1N	10/9	X119	7/-	OC74	8/-
UY21	8/9	X142	7/-	OC75	8/-
UY41	5/-	Y63	5/-	OC76	8/6
UY85	4/3	Y65	5/-	OC77	12/-
U10	9/-	Z63	4/9	OC78	8/-
U12/14	7/6	Z66	8/-	OC81	4/-
U16	10/-	Z77	3/-	OC81D	4/-
U17	5/-	Z729	6/-	OC81M	8/-
U18/20	6/6	Z749	9/6	OC82	10/-
U19	48/6	Z759	36/-	OC83	3/6
U22	6/-			OC84	8/-
U24	15/-			OC139	13/6
U25	8/9	*Transistors and diodes*		OC140	19/-
U26	7/9	AA129	4/6	OC170	8/6
U31	7/-	AC107	14/6	OC171	10/6
U33	26/2	AC127	9/6	OC200	10/6
U35	16/6	AD140	25/-	OC201	29/-
U37	23/3	AF102	27/6	OC203	14/-
U41	19/6	AF114	11/-	OCP71	17/6
U43	6/-	AF115	10/6	ORP12	12/6
U45	15/6	AF116	10/-	SX641	10/-
U47	8/9	AF117	5/6	TS2	12/6
U50	4/6	AF118	20/-	TS3	15/-
U52	4/3	AF124	10/-	V10/15A	12/-
U76	4/9	AF125	10/6	XA102	19/6
				XA103	15/-

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METAL RECTIFIERS DRM1B 13/-. DRM2B and DRM3B 15/6. LW7 21/-. LW15 24/-. RMO 7/11. RM1 5/3. RM2 6/3. RM3 7/9. RM4 12/9. RM5 17/6. 14A86 17/6. 14A97 19/6. 14A100 23/-. 14A124 26/6. 14A163 35/6. 14B130 31/-. 14B261 11/6. FC101 16/9. 16RC.1.1.16.1 8/-. FC31 21/-. 16RD.2.2.8.1 11/-. 16RE.2.1.8.1 8/6. 18RA.1.1.8.1 4/-. 18RA.1.2.8.1 11/-. FC116 6/-. FC124 12/6. SB3 10/6. C2D 9/-. K3/40 9/-. C3D 11/-. C3B 14/8. R3/2D 4/3. Q3/4 3/7. K3/50 10/4.
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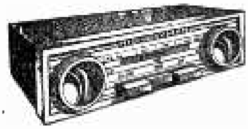

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OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE

Look at these features: ★ Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valves types EBF83 and ECH83. ★ No Fuzz, 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.

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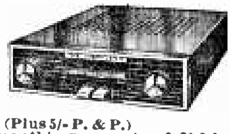

Introducing our new ready-built transistorised car radio for ONLY **9½ Gns.** P. & P. 5/- including 7 x 4" speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions. **H.P. Terms: Dep. £2.19.6** (Plus 5/- P. & P.) **and 7 monthly payments of £1.2.6.**

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.

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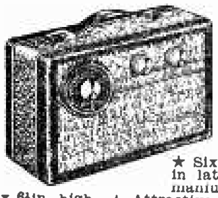
THE "AIR KING"

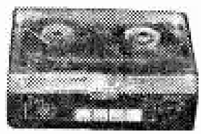


Our highly successful six-transistor luxury portable with the "SLIM LINE" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as Car Radio, with full MEDIUM wave and LONG wave coverage.

Look at these features: ★ 500 milliwatt output to high flux 7 x 3½in. high fidelity loudspeaker. ★ Six selected MULLARD TRANSISTORS in latest supersensitive circuit plus germanium diode. ★ Compact size only 9½ x 3½ x 6½in. high. ★ Attractive three-tone cabinet, black, dark grey and silver grey with gilt control knobs and all gilt fittings. ★ Coax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal Ferrite rod aerial. Special inclusive price for all required components. ONLY **£7.19.6** (Plus P. & P. 4/-).

Alignment service available. Full assembly details and individually priced parts list, all of which are available separately, price 1/6 post free.

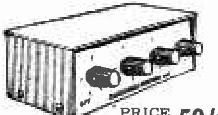
POCKETCORDER TRANSISTORISED RECORDER



Why be bothered with a notepad? Take Pocketcorder with you on those business trips, the mighty Midget is ideal. Simple to operate, a unique 4-way push-button Switch for record/playback, etc., and remote control switch built into microphone ensures complete ease of handling. Fully adjustable speed through the life of Batteries and the volume and tone from the 2½" internal speaker is outstanding. All accessories included such as Leather Case, Accessory Case, Crystal Earpiece, Tape, Batteries and Microphone, no other extras required. Up to 34 mins. recording time, operates on 1-9 volt PP3 and 2-1½ volt U12 Pen Batteries. Size 5½ x 4 x 2in. Weight 24ozs. PRICE **12 Gns.** P. & P. 4/-

Spare 2½" empty spools, 1/-; Spare 2½" 200ft. L.P. Tape, 5/-.

TRANSISTORISED SOUND MIXER



Mixing 4 channels from high impedance source, giving professional results. Inputs for high impedance Microphone, Tuner, Gram and/or Tape Recorder. 9 volt battery operation. Compact and beautifully styled, size 6" x 2½" x 2½". Standard Jack socket inputs.

PRICE **59/6** P.&P. 2/6 Complete with PP3 9v battery circuit, diagram and instructions.

STEREO TAPE DECK WITH BUILT IN PRE-AMPLIFIER

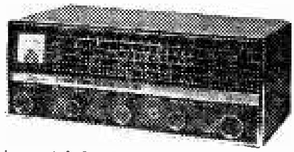
A professional addition to your Hi-Fi Stereo System consisting of two basic Units, the Tape Deck and Pre-amplifier, which employs 4 Transistors and 4 Valves. The Unit with record and playback ½ track stereo or ½ track mono at either 7½ i.p.s. or 3¾ i.p.s. both speeds being fully equalised. **42 GNS.** Carr. & Pkg. 15/-

Features: Track System: ½ track 2 channel stereo or monaural record and playback. Independent single channel recording on either channel while playback on other channel. Head Type: ½ track 2 channel inline stereo and associated erase heads. Low loss laminated pole pieces. Level indicators: 2 Meters, 1 per channel. Digital Counter: 3 digit tape position indicator. Automatic Stop: When tape runs out or breaks. Inputs: Microphone 1mV (50K. ohms impedance) Gram/Tuner 50mV (high impedance). Output: (cathode follower). Monitor Sockets: 2 x 5K. ohms impedance. Audio Output: 500mV. Oscillator: Pushpull 80 Kc/s. S/N Ratio: —45dB or better at 7½" tape speed. Separation: 45dB or more between stereo channels. Frequency Response: 40 to 15,000 cycles per sec. at 7½ i.p.s., 40 to 9,000 cycles per sec. at 3¾ i.p.s. Single Motor: 4 pole heavy duty induction type. Power Supply: 240v A.C. 50 cycles. Size: 6½" x 10½" x 15". Tape Size: Up to 7". Line Up: 4-2SB173 Transistors, 2-12AT7, 1-12AU7, 1-12BH7 Valves.

THE HE30 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 Rectifier superhet circuit. 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.** Carr. & Pkg. 15/-

THE HE-40 4-BAND COMMUNICATION RECEIVER



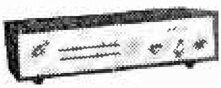
Completely built and ready to go. High sensitivity Superhet receiver covering 550 Kc/s—1,500 Kc/s, 1.6 Mc/s —4.4 Mc/s, 4.4 Mc/s—11 Mc/s 11 Mc/s—30 Mc/s. Electrical Bandspread tuning. Slide rule type tuning dial. Internal ferrite rod aerial formed-ium waveband reception and a 59in. 10 section chromium 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** Carr. & Pkg. 12/6

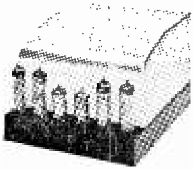
SEND STAMP FOR COPY OF OUR INTERESTING LITTLE BOOKLET **"What is High Fidelity?"** *and Suggestion List of Budget Hi-Fi Systems.*

SEE PRECEDING PAGE FOR OTHER STERN-CLYNE PRODUCTS

INTRODUCTION OFFER ! ! Available Shortly


FOR ONLY **48 gns** Plus 15/- Pkg. & Carr.


THE TUDOR STEREO HI-FI SYSTEM, comprising a Self Powered AM/FM Tuner, Stereo Pre-amplifier, 12 watt per channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal cabinets for shelf mounting, with silver metal dials and matching knobs. Specifications: **Tuner**—Outstanding quality providing full VHF/FM long and medium waveband coverage, frequency range FM 87.5-108.5 Mc/s, AM/MW 522-1630 Kc/s, LW 145-270 Kc/s 100mV output mains supply 105/240 A.C. Valve line-up: ECC85, ECH81, EBF89, EF80, EB91, EM84, ECC83. Multiplex outlet provided. **Pre-amplifier**—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pickups, direct play from Tape-Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion 0.1%, tape outputs 100mV from 90K. ohm source. Inputs—Microphone 5 mV, Tape 5.3 mV, R.I.A.A. 4.3 mV flat 250 mV, Tuner 100 mV. Valve line-up: 2—EF86, 4—ECC83. **Power Amplifier**—14 watts per Channel, sensitivity 1 volt r.m.s. for 14 watts output, frequency response ± 0.5dB 20 c/s.—20 Kc/s. Speaker impedance 4, 8 or 16 ohms, surplus power available for Tape Pre-Amp, mains supply 105/240 v. A.C. Valve line-up, 2—ECC83, 4—EL84, 1—GZ34.



GREAT NEWS!

We have pleasure in giving advance details of the

NEW STERN DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

A new conception in the field of audio engineering by Stern-Clyne development engineers.

The most up-to-date circuitry is used in the Double Feature Pre-amplifier, it has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay.
This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck. *Offers superb reproduction from all sources at low cost. Available shortly.*
Brief Specifications:

J.L.10 POWER AMPLIFIER

Incorporates the latest triode/pentode ECL86 valves in push-pull. PARTRIDGE ultra linear output transformer. PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner output impedance 3—7.5—15 ohms.

PRICE: KIT OF PARTS **11 Gns.** Carriage and Insurance 7/6.
READY BUILT **14 Gns.**

DOUBLE FEATURE PRE-AMPLIFIER

Inputs for microphone, crystal or magnetic pick-ups, tuner unit. Push-button switching for 3 tape speeds equalised. Tape erase Bias Oscillator circuit incorporating ferrox-cube transformer. Function switch, separate base, treble and volume controls, level control and latest EM87 magic eye level indicator. The pre-amplifier is totally enclosed in a steel case, finish in silver hammer and an attractive perspex front panel carefully designed to blend in with modern wood finishes complete the presentation.

PRICE: KIT OF PARTS **£17** Carriage and Insurance 5/-.
READY BUILT **21 Gns.**

PRICES: If both above units purchased together.
KIT OF PARTS **£27.10.0** Carriage and Insurance 10/-.
READY BUILT **32 Gns.**

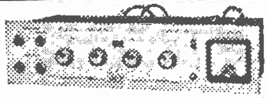
MODEL CR3/S TAPE RECORDER

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 microphone and 1,200ft. tape.

KIT OF PARTS **£33.8.0**
ASSEMBLED AND TESTED **£43.0.0**
(Carr. & Ins. 15/- extra).

Instruction book and detailed price list (free with kit) available separately at 3/- Post Free.

STEREO TAPE PRE-AMPLIFIER



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 Level Meter and separate Gain Control. Includes separate Power Unit. KIT OF PARTS **£22.0.0** (Carr. & Ins. 8/6) ASSEMBLED **£28.0.0**

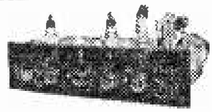
Instruction book and detailed price list (free with kit) available separately at 5/- Post Free.

TAPE PRE-AMPLIFIER MULLARD Type "C"

Suitable for most ½ 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 3/5 Post Free.

MULLARD TAPE AMPLIFIER MODEL HF/TR3/MK.II



Based on Mullard's Type "A" design and suitable for most ½ 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.

COMBINED PRICE OFFERS ! ! !

Includes small charge for special testing and PRECISE MATCHING of the ASSEMBLED PRE-AMPLIFIER (or Amplifier) to TAPE DECK

STP-1 (Kit) and "STUDIO" Deck	£39.0.0	Assembled £46.0.0
STP-1 (Kit) and Brenell Deck ..	£66.0.0	Assembled £75.0.0
STP-1 (Kit) and Truvox Deck ..	£51.0.0	Assembled £59.0.0
TYPE "C" (Kit) and "STUDIO" Deck	£26.10.0	Assembled £33.0.0
TYPE "C" (Kit) and BRENELL Deck	£43.0.0	Assembled £50.0.0
TYPE "C" Assembled and Wearite Deck	£70.0.0	Inc. Head Lift Trans.
HF/TR3 (Kit) and "STUDIO" Deck	£26.0.0	Assembled £33.0.0
HF/TR3 (Kit) and BRENELL Deck	£43.0.0	Assembled £50.0.0
HF/TR3 Assembled and Wearite Deck	£70.0.0	Inc. Head Lift Trans.

VISIT YOUR NEAREST STERN-CLYNE BRANCH

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	23 Tottenham Court Road, W.1.	MUSeum 3451/2	Half-day Thurs
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NORTH LONDON:	162 Holloway Road, N.7.	NORth 8161/5	Half-day Thurs
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MANCHESTER:	10 Withy Grove, Manchester 4.	BLAck Friars 5379	Now open 6 days a week

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162 Holloway Road, London, N.7. NORth 8161/5

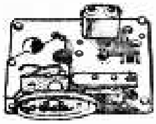
Great Britain's Greatest Electronic Hobbies Organisation

SPECIAL PURCHASE! TURRET TUNERS

by famous maker

Brand new and unused. Complete with PCC84 and PCF80 valves, 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P.P. 2/6.

F.M. TUNER HEAD



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) and drum and spindle, 13/6, plus 1/9 P. & P. Valve 8/6 extra. Drum and spindle 3/6 extra.

GÖRLER F.M. TUNER HEADS

10.7 Mc/s I.F. 15/-, plus 1/9 P. & P. (ECC85 valve, 8/6 extra.)

E.M.I. 4-speed Player and P.U.

FURTHER HUGE PURCHASE enables us to offer these at **67/6** P. & P. 4/6.

Heavy 8½in. metal turntable. Low flutter performance 200/250v. shaded motor with tap at 45v. for amplifier valve filament if required. Turnover LP/78 head.

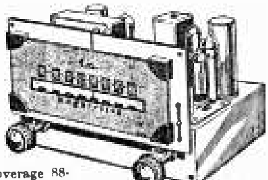
RECORD PLAYER AMPLIFIER

2 valve (EZ80 ECL82), A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7in. w. x 2½in. d. x 5½in. h. 55/-. P. & P. 3/-. Suitable speakers: 6in. 15/-. P. & P. 1/6. 10 x 6in., 25/-, P. & P 1/6.

SPEAKER & CABINET FABRICS

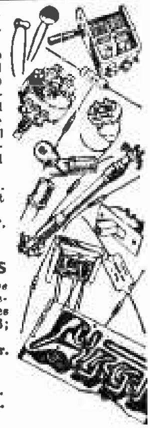
Oatmeal, Red and Gold fabrics and various patterns in Vynair and Tygan for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard.
OUR PRICE **13/6** per yard length, plus P. & P. 1/6. (Minimum order 1 yard). Send S.A.E. for samples.

HARVERSON'S F.M. TUNER Mk.I



● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier ● Valves used ECC85, two EF80's, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. Set of parts if purchased at one time £5.19.6, plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye, front panel and brackets, £6.12.6. P. & P. 8/6. **Mark III Version** as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6. **Handsome Metal Cabinets.** Choice of Grey, Black or Green. To fit Mark I, 25/-, P. & P. 2/6. To fit Mark II, 17/6. P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET



A first-class 2 wavebands transistor superhet. ● Printed circuit panel (size 8¼ x 2¾in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.
All parts sold separately. Set of parts if purchased at one time.
ONLY **£4.5.0** P. & P. 2/6

35 OHM SPEAKERS

Suitable for use with above 2in. Goodmans. Ideal replacement for most pocket portables 8/6; 2½in. 10/6; 3½in. 12/6; 5in. 17/6; 7 x 4in. 21/-. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6¾ x 3¼in. Suitable for above using 3½in. speaker, 25/-, P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling), 28/6 complete, post 1/-. 6 transistor printed circuit board to match, 8/6, post 9d. Circuit diagram 1/6 extra.

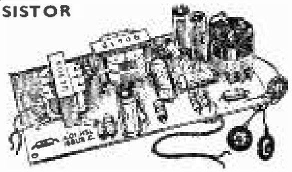
QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker.
PRICE 69/6 P. & P. 3/6
DITTO. Mounted on board with output transformer and 6in. speaker.
Complete at 89/6 P. & P. 4/6.

QUALITY PORTABLE RECORD PLAYER CABINET

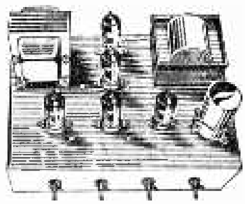
Uncut motor board. Will take above amplifier and B.S.R. or GARRARD. Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.
PRICE £3.9.6 Carr. 5/-

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips solder etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/- P. & P. 2/6.
Also ready built and tested, 52/6. P. & P. 2/6. A pair of TA1's are ideal for stereo.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.)
All parts sold separately. ONLY £6.19.6 P. & P. 8/6.
Also available ready built and tested complete with input jack plugs. £8.15.0 P. & P. 8/6.

BRAND NEW 3 OHM LOUDSPEAKERS

2½in. 12/6; 5in. 12/6; 6½in. 15/-; 8in. 21/-; 10in. 25/-; 12in. 27/6
E.M.I. 2½in. tweeter .. 10/6
8in. x 5in. By famous maker 10/6
E.M.I. Ceramic Magnet 13¼in. x 8¼in. high flux .. 36/-
Rola Celestion approx. 9in. x 6in. middle register speaker 10/6
10in. x 6in. 26/-
Also 15 ohm 12 inch, 30/-.
P. & P. up to 6in. 1/6; over 6in. 2/6 per speaker.

AMPLIFIER CARRYING CASES

BRAND NEW

Strongly made wooden construction, tough vynide covered, complete with carrying handle. Overall size 13¼in. wide x 9in. deep x 8in. high with sloping front panel. Weight only 4½ lbs. Ideal for our 10/14 watt amplifier and many others.
BARGAIN PRICE **28/6** P. & P. 4/-.

AMPLIFIER ON PRINTED CIRCUIT BOARD

Two valve. UY85, UL84 O.P. trans. use with 80 volt tap off motor, 39/6. P.P. 2/6 on above. Dropper res. for filaments if required 2/6.

B.S.R. AUTO UNITS

160 v. Suitable for use with above.(Slightly soiled.) £4.4.0

Superior CABINET To take 8 x 5in. speaker, with motor board will accommodate BSR UA14 or UA16. £3.9.6. Carr. 5/6. Speaker 15/- extra. P. & P. 1/6 extra.

LARGE CABINET Similar to above with 3 ohm speaker. £3.9.6. Carr. 5/-.

BARGAIN CORNER!!

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, 18/6. P. & P. 1/6.

TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price 18/6. P. & P. 1/6.

CARBON MIKE INSERTS. Brand new, 2¼in. dia., 3/6. P. & P. 9d.

MIDGET 2-GANG CONDENSERS. Capacity 195 and 100 pF Polystyrene case with built-in trimmers. Size ⅞ x ⅞ x ⅜in. Not used but removed from P/C boards. Two for 9/-, plus 1/- P. & P.

TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output), plus 4 suitable Transistors giving approx. 1 watt output. 30/-. P.P. 2/-

3 PUSHBUTTON TRANSISTOR SWITCH. D.P. —D.T. Each switch 5/6 and 1/- P. & P.

MAINS TRANSFORMER

Drop thru' type. Tapped primary 110v., 200v., 220v., 240v. 320-0-320v. at 80mA and 6.3v. at 3 amps. Generous core. Stack size 3¾ x 2¾ x 1¾in. Weight 4lbs. ONLY 15/-. P. & P. 3/6.

4-WAY NON-TANGLE TELEPHONE CABLE

Latest spring back coil type, extends 12in. to 5ft. Complete with rubber bushes. 3/6 each. P. & P. 1/-.

COLLARO HI-FI STEREO T/O CARTRIDGE

Type "C", Complete with universal bracket and styli for Stereo LP and 78. Original list price 59/8. OUR PRICE 25/-. P. & P. 1/-.

ACOS GP65/1 T/O MONO CRYSTAL CARTRIDGE. Comp. with sapphire styli and mounting bracket. Limited n'ber only at 12/6.P.&P.1/-

TAPE DECKS

COLLARO STUDIO DECK £10.10.0 plus 5/6 carr. and ins.

B.S.R. MONARDECK (Single speed) 3¾in. per sec., simple control, use 5¾in. spools, £8.15.0 plus 5/6 carr. and ins. (Tapes extra on both).

◀ LOOK OPPOSITE FOR MORE BARGAINS

HARVERSON SURPLUS CO. LTD.

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Open all day Saturday *Early closing Wed., 1 p.m.*

A few minutes from South Wimbledon Tube Station. *(Please write clearly)*

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SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

R.S.C. (Manchester) Ltd.

MAIL ORDERS to 5 County Arcade, Leeds 1. Terms: C.W.O. or C.O.D. No C.O.D. under £1 Postage 2/9 extra under £2. 4/6 extra under £5. Trade Supplied. S.A.E. with all enquiries please.

LEICESTER 32 High St. Half-day Thursday | BIRMINGHAM 6 Gt. Western Arcade (Opp Snow Hill Sta) No half-day | SHEFFIELD 13 Exchange St. Castle Market Bldgs. Sheffield Half-day Thursday | HULL 51 Savile St., Hull | LIVERPOOL 73 Dale St. Liverpool 2 | BRADFORD 56 Morley St. (above Alhambra Theatre) Bradford Half-day Wednesday | MANCHESTER 8-10 Brown St. (Market St.) Manchester 2 No half-day | LEEDS 5-7 County (Mecca) Arcade Briggate, Leeds Half-day Wed.

FANE HEAVY DUTY HI-FI SPEAKERS

12in. 15 ohms. Cast chassis. Exceptionally robust 2in. diam. Voice Coil Assemblies.
122/10 20w., 5 gns. 122/10A 20w., 6 gns.
122/12 20w., 6 gns. 122/12A 20w., £7.19.6
122/14 22w., 9 gns. 122/14A 22w., 10 gns.
122/17 25w., 11 gns. 122/17A 25w., 12 gns.
15in. 15 ohms. Cast chassis. Exceptionally robust 2in. diam. Voice Coil Assemblies.
152/12 20w., 12 gns. 152/12A 20w., 13 gns.
152/14 27w., 14 gns. 152/14A 27w., 15 gns.
152/17 35w., 16 gns. 152/17A 35w., 17 gns.
"A" indicates dual cone type, 30-17,000 c.p.s. Send S.A.E. for leaflets. Terms available.

R.S.C. 30-WATT ULTRA LINEAR HIGH FIDELITY AMPLIFIER A10

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db down. Frequency response ±3 db. 30-30,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE.** The unit is designed for **CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUT-DOOR FUNCTIONS,** etc. For use with Electronic **ORGAN, GUITAR, STRING BASS,** etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for a **RADIO FEEDER UNIT.** An extra input with associated vol. control is provided so that two separate inputs such as Gram and "Mike" can be mixed. Amplifier operates on 200-250 v. 50 c/s. A.C. Mains and has output for 3 and 15 ohm speakers. Complete Kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required perforated cover with carrying handles can be supplied for 19/9. The amplifier can be supplied, factory built with EL34 output valves and 12 months guarantee, for **14 gns.** Send S.A.E. for leaflet.

11 Gns. Carr. 10/-

TERMS: DEPOSIT 33/9 and 9 monthly payments of 33/9.
Suitable microphones and speakers available at competitive prices.

WE STOCK ARMSTRONG, DULCI, LINEAR, ROGERS, LEAK and JASON EQUIPMENT. GOODMANS, W.B. AND FANE SPEAKERS. GARRARD AND GOLDRING T/TABLES CASH or H.P

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner (specially suitable for use with our Amplifiers). Delayed A.V./C. Controls are Tuning, W/Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size approx. 9 x 6 x 7in. high. Simple alignment procedure. Point-to-Point wiring diagrams, instructions and priced parts list with illustrations, 2/6. Total building cost **£4.15.0.** S.A.E. for leaflet.

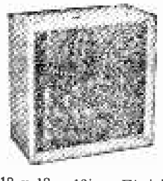
P.M. SPEAKERS. 10in. W.B. "Stentorian" 3 or 15 ohms type HF 1012 10 watts, hi-fidelity type. Recommended for use with our All Amplifier, £4.7.6. 12in. R.A. 3 ohms 10 watts (12,000 lines), 59/6.

TWEETERS. R.A. 3 ohm, 19/9; 15 ohm, 25/9

R.A. 12in. DUAL CONE 3 ohm 8 watt Speakers. Ideal for Stereo. Only **39/9** ea.

Jason FMT1 V.H.F./F M. Radio Tuner design. Total cost of parts including valves, Tuning dial, Escutcheon, etc., **£7.19.6.**

LINEAR L45 MINIATURE 4/5 WATT QUALITY AMPLIFIER. Suitable for any record playing unit, and most microphones. Negative feed-back 12 db. Separate Bass and Treble Controls. For mains 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Mullard valves EZ80, ECC83, EL81. Size only 7 x 5 x 5½in. high. Guaranteed 12 months. Only **£5.19.6.** Send S.A.E. for leaflet. Terms: Deposit **22/6** and 5 monthly payments of **22/6.**

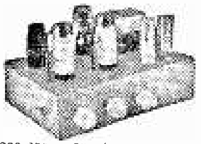


12in. 10 WATT HIGH QUALITY LOUDSPEAKER in walnut veneered cabinet. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only **£4.19.6** Carr. 5/-. Terms: Deposit **11/3** and 9 monthly payments of **11/3.**

12in. 20 WATT HI-FI LOUD-SPEAKERS IN CABINETS. Size 18 x 18 x 10in. Finish as above. Terms: Deposit **17/9** and 9 monthly payments of **17/9.** Only **£7.19.6.** Carr. 8/6.
For larger types see preceding page.

LINEAR LG34 GRAM. AMPLIFIER. High quality. Separate Bass and Treble controls. Handsome appearance. Completely enclosed. Black/Gold Frontplate **5 gns.**

R.S.C. 4-5 WATT A5 HIGH-GAIN AMPLIFIER



A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads, in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 db. down, 15 db. of Negative feedback is used. H.T. of 300 v. 25 mA and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape-Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue Hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4.15.0. or assembled ready for use 25/- extra. Plus 3/6 carr., or deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

NOW OPEN AT 26 Osmaston Road THE SPOT DERBY

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.

THE SKYFOUR T.R.F. RECEIVER. A design for a 3 valve long and medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion detector. Valve line-up 6K7, SP61, 6V6G. Selectivity and quality excellent. Simple to construct. Point-to-Point wiring diagrams, instructions and parts list 1/9. maximum building costs **£4.19.6.** inc. attractive walnut veneered wood cabinet 12 x 6½ x 5½in.

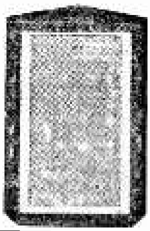
MULTI-METERS. CABY M1. Sensitivity 2,000 ohms per volt. A.C. and D.C., **54/-.** **A.10.** Basic Meter sensitivity 155 micro-amps A.C. and D.C. ranges **£4.17.6.** **B.20.** Sensitivity up to 10,000 ohms per volt A.C. and D.C., **£6.10.0.** 30,000 ohms per volt, with overload buzzer, **£8.19.6.**

R.S.C. JUNIOR HI-FI REPRODUCER. The very latest Goodman Axiette 8 High Fidelity loudspeaker (retailing at approx. 5 gns.) fitted in a specially designed Bass Reflex cabinet size 12 x 18 x 10in. Acoustically lined and ported and finished in polished walnut veneer. Matching impedance 15 ohms. Frequency range 40-15,000 c.p.s. Power handling 6 watts nominal. Ideal for Stereo. Limited number. **8 Gns.** Carr. 4/6.

R.S.C. BASS REFLEX CABINETS. JUNIOR MODEL. Specially designed for W.B. HF1012 Speaker, but suitable for any good quality 10in. speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18 x 12 x 10in. Handsome appearance. Ensure superb reproduction for only **£3.19.6.**

STANDARD MODEL. As above but for 12in. speakers. Size 20 x 15 x 13in. For vertical or horizontal use, **£5.19.6.** Suitable legs with brass ferrules, **19/6** per set of 4.

R.S.C. CORNER CONSOLE CABINETS

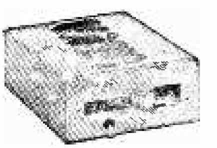


Polished walnut veneer finish. Pleasing design. **JUNIOR MODEL.** Size 20 x 11 x 8in. for 8 x 5in. or 10 x 6in. speakers, **£2.9.9.** **STANDARD MODEL.** Size 27 x 18 x 12in. for 8 or 10in. speakers, **£4.11.9.** **SENIOR MODEL.** Size 30 x 20 x 15in. for 12in. Speaker. Suitable Speaker systems below. Only **7 gns.**

AUDIOTRINE HI-FI SPEAKER SYSTEMS. Consisting of matched 12in. 12,000 line, 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. The smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating **£4.19.9.** Carr. 5/-. Or Senior 15 watt, **£6.19.9.** Carr. 7/6.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces battery supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 and 90 v.** This includes low consumption types. Complete kit with diagrams, 39/9, or ready to use, **46/6.**



Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v. 90 v. and 60 v. 40 mA and 2 v. 0.4 a. to 1 amp. fully smoothed. **Thereby completely replacing both H.T. batteries and L.T. 2. v. accumulators when connected to A.C. mains supply** 200/250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulators. Complete kit of parts with diagrams and instructions, **49/9**, or ready for use, **59/6.**

AUDIOTRINE EQUIPMENT CABINETS. Size 36 x 15 x 18in. Beautiful walnut veneered finish. Elegant contemporary design. Robust construction. Uncut, removable baseboard. Depth above baseboard 5½".

Only **12½ gns.** Carr. 15/-.
Terms: Dep. **29/9,** and 9 mthly. pymts. **29/9.**

AUDIOTRON HI-FI TAPE RECORDER KIT 25½ GNS. Carr. 17/6.

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR
Incorporating the latest Collaro Studio Tape Transcriptor. The Audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 14½ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS.** Deposit £2.13.9 and 12 monthly payments of 44/-. Cash price if settled in 3 months.

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

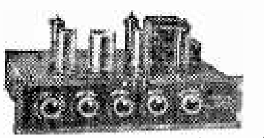
HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES

Two input sockets with associated controls allow mixing of "mike" and gram., as in 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. 30-30,000 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 ready to use for 59/6 extra.

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 **39/9.** 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 **35/9.**

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. **£7.19.6.** 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 11½ x 2½ x 2½in. Controls: Vol. and Tone with Switch. Only **59/6.**

B.S.R. MONARDECK TAPEDECKS. Speed 3¾in. per sec. With high quality recording heads. **£6.19.6.** Carr. 5/-. Cabinets to take Deck and amplifier **39/6.**

SENSATIONAL STEREO OFFER

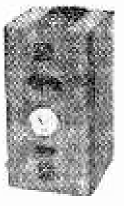
A complete set of parts to construct of a good **(4 Gns.)** quality Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. Stereo Pick-up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

HEAVY DUTY CHARGER KIT. F/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 200-250 v., 50 c/s.



ASSEMBLED 4-5 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 blue hammer finish. Fused and ready for use with mains and output leads. Carr. 5/-. **69/9** Terms: Deposit **13/3** and 5 monthly payments **13/3**. 6/12 v. 3a., all facilities as above. Only **59/9**, carr. 3/9.

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. **49/9** 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 and Circuit. Only **6 gns.** 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.	**45/9**
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
425-0-425v. 200mA. 6.3v. 4a. 5v. 3a	49/9

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/-
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 8watts, 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 2¾ x 2¾ x 2¼in.

FILAMENT TRANSFORMERS
All with 200-250v. 50 c/s primaries 6.3v. 1.5a., **5/9**; 6.3v. 2a, **7/6**; 0-4-6.3v. 2a, **7/9**; 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. 10 H. 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.
0-110/120-230/250v. 50-80 watts. **13/9**; 250 watts. **39/9**; 150 watts. **27/9.**

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

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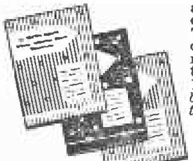
Here are three books to keep you in step with the latest development in transistor design and practice. Each is crammed with invaluable information, tested circuits and layout diagrams. All are expertly prepared and based on Sinclair Transistors.



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Give extremely high power gains at all levels of collector current and voltages and from A.F. to 100 Mc/s. Greatly improve performance of any circuit.

MAT 100	High gain low level........	7/9
MAT 101	Extra high gain, low level..	8/6
MAT 120	High gain, medium and high level	7/9
MAT 121	Extra high gain, medium and high level..............	8/6

ADT.140 FOR V.H.F. and U.H.F.

Only 1/5in. high x 1/5in. dia. Made by the unique alloy-diffused process, and specially suitable for F.M., T.V., V.H.F. and U.H.F. frequencies. Has typical alpha cut-off of 400 Mc/s with power gains of 15dB at 100 Mc/s and 9dB at 200 Mc/s. **15/-**

TWO OUTSTANDING AF AMPLIFIERS

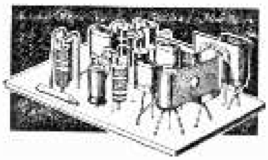
SINCLAIR TR5

COMBINED PRE-AMP AND HALF-WATT POWER AMPLIFIER

Will produce a perfectly clean half watt of audio power even from very low output sources such as low-impedance tape heads, pick-ups and microphones. Ready built with instructions and unconditionally guaranteed.

CIRCUIT—5 matched transistors and temperature compensating diode in a transformerless complementary-symmetry configuration.
POWER OUTPUT—500 mW undistorted into 15 ohms.
SENSITIVITY—0.5 mV.
POWER GAIN—80 dB (100 million times).
FREQUENCY RESPONSE—50 c/s to 20 kc/s ±3dB.
SIZE—2¼ x 1¼ x ⅜in.
POWER REQUIREMENTS—9V. battery or power supply.

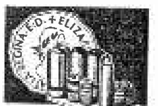
59/6



READY BUILT AND TESTED

"I have tried the TR.5 amplifier with a gram P.U. feed and find it a remarkable 'mighty atom' with astonishing volume and quality."
-.D.A.B., *Welwyn Garden City.*

SINCLAIR MICRO AMPLIFIER



40dB GAIN at 1Mc-s

OUTPERFORMS AMPLIFIERS 20 TIMES LARGER

This fantastically powerful amplifier is smaller than a 3d. piece. With a frequency response from 30 to 50,000 c/s. ± 1 dB, and power gain of 60dB (1,000,000 times) it can be used as a sub-miniature hi-fi amplifier with an output suitable for any earpiece or even a loudspeaker.

"The micro-amplifier kit was received yesterday. The assembly time was about 15 minutes, and it is doing the job so well that I felt I must let you know how pleased I am with it. Please forward as soon as possible another micro-amplifier. If this letter is of any use to you in advertising, please feel free to use it.
D.H., *nr. Calne, Wilts.*

With MAT Transistors, brand new micro-miniature quality components and micro-printed circuit. Inc. instructions for building and many uses. **28/6**

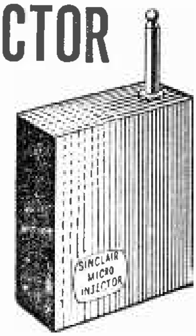
THE SMALLEST AND MOST EFFICIENT YET

SINCLAIR MICRO-INJECTOR

FOR FAULT FINDING AND SERVICING

Using two MICRO-ALLOY TRANSISTORS, the Sinclair Micro-Injector is a precision sub-miniature instrument which generates and injects a test signal into any part of a receiver or amplifier at any frequency from 1 Kc/s to 30 Mc/s. By this means, the position of any fault can be rapidly found.

This Micro-Injector is powered by a standard 6d. battery which will last for about 6 months. Size is 1⁴/₅" x 1³/₁₀" x ⅜", excluding the ³/₅" probe. Assembly is extremely simple and will take even a beginner only half an hour With illustrated building and operating instructions.



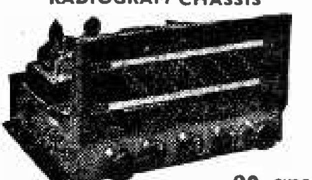
Total cost including all parts, MAT Transistors, printed circuit board, plated probe, and case in royal blue with gold trim. **27/6**

READY BUILT AND TESTED **32/6**

ALL EQUIPMENT UNCONDITIONALLY GUARANTEED

SINCLAIR radionics LTD. 69 HISTON RD. CAMBRIDGE

ARMSTRONG AF208AM/FM RADIOGRAM CHASSIS



20 gns. (carriage free)

- FULL VHF BAND (87-108 Mc/s). MEDIUM BAND 187-570 m.
- 5 WATTS OUTPUT.
- 15 dB NEGATIVE FEEDBACK. 7 VALVES.
- SEPARATE WIDE-RANGE BASS AND TREBLE CONTROLS.
- 2 COMPENSATED PICK-UP INPUTS.
- FREQUENCY RESPONSE 30-22,000 c.p.s. ±2 dB.
- TAPE RECORD AND PLAYBACK FACILITIES.
- CONTINENTAL RECEPTION OF GOOD PROGRAMME VALUE.

FOR 3, 7½ and 15 ohm SPEAKERS.
Write for free literature.

New Boxed VALVES 90-day Guarantee

OZ4	5/-	6K7G	5/-	EB91	4/-	PCL82	10/-
1R5	6/-	6K8G	5/-	EBC41	8/-	PCL84	10/-
1S5	6/-	6L6G	8/-	EBC81	8/-	PL81	10/-
1T4	3/-	6N7M	5/-	EBF80	9/-	PL83	8/-
2X2	2/-	6Q7G	6/-	ECH42	9/-	PY33	15/-
3S4	7/-	6SN7	5/-	ECH81	9/-	PY80	7/-
3V4	7/-	6V6G	5/-	ECL80	9/-	PY81	8/-
3Q4	7/-	6X4	5/-	ECL82	10/-	PY82	7/-
5U4	6/-	6X5	6/-	EF85	6/-	PQ25	7/-
5Y3	6/-	12AT7	6/-	EF89	8/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EL32	5/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EL84	7/-	U22	7/-
6AM6	4/-	12BH7	7/-	EY51	9/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EY86	9/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EZ40	7/-	UBF89	9/-
6BE6	5/-	12Q7	5/-	EZ80	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	EZ81	7/-	UCL82	10/-
6C4	5/-	35L6	9/-	HABC80	10/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HVR2A	5/-	UF89	9/-
6G6	4/-	954	2/-	KT33C	8/-	UL41	9/-
6H6	3/-	DAF96	8/-	KT76	8/-	UY41	7/-
6J5	5/-	DF96	8/-	MU14	7/-	UY85	7/-
6J6	5/-	DK96	8/-	PCC84	8/-	UU9	7/-
6J7G	6/-	DL96	8/-	PCF80	8/-	VR150	7/-
6K6	5/-	EABC80	8/-	PCF82	8/-	W81	6/-

NEW ELECTROLYTICS — FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350V	2/-	50/350V	5/6	8/600V	9/-
2/350V	2/3	100/25V	3/-	16/450V	5/-
4/450V	2/3	250/25V	3/-	16/600V	12/-
8/450V	2/3	500/12V	3/-	16+16/500V	7/6
16/450V	3/-	1,000/12V	3/-	50/450V	6/6
32/450V	3/9	5,000/6V	5/-	32+32/350V	5/-
25/25V	1/9	8+8/450V	3/6	32+32/450V	6/-
25/50V	2/-	8+16/450V	3/9	32+32+32/350V	7/-
50/25V	2/-	16+16/450V	4/3	50+50/350V	7/-
50/50V	2/-	32+32/350V	4/6	64+120/350V	11/6
				100+200/275V	12/6

TELESCOPIC CHROME AERIALS, 13in. extending to 43in., 8/6 ea. 5in. to 32in., 7/6 ea.
TRIPLEXERS Bands I, II, III, 12/6. **COAX PLUG**, 1/-
LEAD SOCKET, 2/-. **PANEL SOCKETS**, 1/-.
OUTLET BOXES (Surface or flush), 4/- ea.
BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
Wirewound Ext. Speaker Control, 10Ω 3/-, 25Ω 6/6.
WIRE-WOUND POTS. 3 WATT. Pre-set Min. TV Types. All values to 10 ohms to 25 K., 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K. to 2 meg., 3/-).
WIRE-WOUND 4 WATTS Pots. Long spindle. Value, 50 ohms to 50 K., 6/6; 100 K., 7/6.
PHILIPS TRIMMERS. 0-10 pF., 3-30 pF., 1/-.
TRIMMERS, Ceramic. 30, 50, 70 pF., 9d.; 100 pF., 150 pF., 1/3; 250 pF., 1/6; 500 pF., 750 pF., 1/9.
TV etc. **TRIMMER**, 1000 pF., with knob, 2/-.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. High Stability. ½ w., 1%, 2/-. Preferred values 10Ω to 10 meg. Ditto 5% 10Ω to 22 meg., 9d.
BRIMISTORS. CZ1, 3/6; CZ2, 2/6; CZ3, 1/6.

WIRE-WOUND RESISTORS 10 ohms—10,000 ohms

5 watt	1/3
10 watt	2/-
15 watt	2/-
12.5K to 47K 10 w.	3/-

Volume Controls

Linear of Log Tracks Long spindles. Midget 5 K ohms to 2 Meg. L.S. 3/-; D.P., 4/6; Stereo L/S 10/6; D.P. 14/6

80 ohm CABLE COAX

Semi-air spaced ¼in. Stranded core **6d. yd.**
40 yds. 17/6
60 yds. 25/-
Fringe Quality **1/- yd.**
Air spaced
Ideal 625 lines.

MAINS TRANSFORMERS 200/250 v. A.C.

Postage 2/- each transformer.

STANDARD, 250-0-250, 80 mA, 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier, 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350 .. 29/6
MINIATURE 200 v. 20 mA, 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA, 6.3 v. 2 a. .. 15/6
SMALL, 250-0-250, 45 mA, 6.3 v. 2 a. .. 17/6
STD. 250-0-250, 65 mA, 6.3 v. 3.5 a. .. 17/6
HEATER TRANS. 6.3 v. 1½ amp. .. 7/6
Ditto, tapped 1.4, 2, 3, 4, 5, 6.3 v. .. 8/6
Ditto, sec. 6.3 v. 4 amp. 10/6
GENERAL PURPOSE LOW VOLTAGE, 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v. 22/6
AUTO TRANSFORMER, 150 w. .. 22/6
0, 115, 200, 230, 250 v., 500 w. .. 82/6
MULLARD "510" Mains Transformer .. 38/6
PARMEKO MAINS TRANSFORMER. Made for special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA, L.T. 6.3 v. 1.8 amp. Size 4 x 3½ x 3 in. .. 17/6

INTERVALVE TRANSFORMERS. 3:1 or 5:1, 9/-
O.P. TRANSFORMERS. Heavy Duty 50 mA 4/6. Multiratio, 7/6. Multiratio heavy duty push-pull, 10 w., 15/6. Miniature, 384, etc., 5/9.
10 w. O.P. matching trans. 3, 7, 15Ω, 12/6.
L.F. CHOKES 15/10H., 60/65 mA, 5/-; 10H., 85 mA, 10/6; 10 H., 150 mA, 14/-.
TINNED COPPER WIRE 16 to 22 swg., ½lb., 3/-.
ENAMEL COPPER WIRE 16-22, 2/9; 24-30, 3/6; 32-40, 4/6; **D.C.C.** 28, 34, 36 swg. 2oz. 3/6.

I.F. TRANSFORMERS 7/6 pair

465 K/s Slug Tuning Miniature Can, 2 x 1 x 1in High Q and good bandwidth. Data sheets. Standard size Weyrad, 10/6 pair.

FULL WAVE BRIDGE SELENIUM RECTIFIER: 2, 6 or 12 v. 1½ amp., 8/9; 2 a.. 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6; 2 amps., 17/6; 4 amps., 22/6. Circuit included.
4 AMP CAR BATTERY CHARGER with amp. meter Leads, Fuse Case, etc., for 6 v. or 12 v., 69/9.
AMMETER 0 to 5 amp., 9/6.

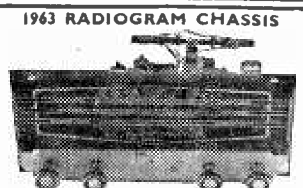
BOOKS list S.A.E.

Boys' Book of Crystal Sets 2/6
"W.W." Radio Valve Data.. .. 6/-
High Fidelity Speaker Enclosure 5/-
Valve and TV Tube Equivalents .. 9/6
TV Fault Finding 5/-
Mullard Amplifier Manual.. .. 8/6
Radio Valve Guide, Books 1, 2, 3, 4 or 5 .. .. .. 5/- each
Transistor Superhet Receivers .. 7/6
Practical Radio Inside Out .. 3/6
Master Colour Code Chart 1/6
Transistor Controlled Models .. 7/6
Principles of Colour TV 16/-
International Radio Stations 2/6

4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

Size 3 x 1½ x ¾.
A ready built miniature push-pull amplifier with Driver and output transformers. 4 transistors. Ideal for use with record players, intercoms, BABY ALARMS, etc. Complete with full instructions and circuit.
Price **47/6** 9v. Batt. 2/3 2½in. Speaker 15/-.

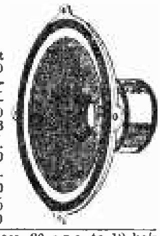
1963 RADIOGRAM CHASSIS



THREE WAVEBANDS	FIVE VALVES
S.W. 16 m.—50 m.	LATEST MULLARD
M.W. 200 m.—550 m.	ECH81, EF89, EBC81,
L.W. 800 m.—2,000 m.	EL84, EZ80

12-month guarantee.
A.C. 200/250 v. 4-way Switch: Short-Medium, Long/Gram. Ferrite Aerial A.V.C. and Negative feedback, 3 ohm output, 5 watts. Glass dial, horizontal wording, size 13in. x 4in. Aligned and calibrated. Isolated Chassis, size 13½in. x 9in. high x 5½in. deep.
£8.19.6 Carr. & Ins. 4/6.

BAKER SELHURST LOUDSPEAKERS



12in. Baker 15w. Stalwart 3 or 15 ohms, 45-13,000 c.p.s. 90/-
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. £6.17.6
12in. Standard H.D. 20w. 40-14,500 c.p.s. .. £8.0.0
12in. De Luxe 15w. 25-17,000 c.p.s. .. £9.10.0
12in. Bass 25w. 20-18,000 c.p.s. .. £12.12.0
15in. Auditorium, 35w., Bass, 20 c.p.s. to 12 kc/s. Ideal Bass Guitar. £18.
Portable enclosures for 12in. "Stalwart", £3 each.

LOUDSPEAKERS P.M. 3 OHM. 2½, 3, 4, 5in; 7 x 4in., 15/6; 6½in. Rola, 16/6; 8in. Plessey, 17/6. 10 x 6in., 22/6; 10in. Rola, 30/-; 12in. R.A., 30/-; 13½ x 8in. Double Cone E.M.I., 35/-.
STENTORIAN HF1012. 10in. 3 to 15 ohms, 10w. 87/6; 8in. HF812, 72/-; Tweeter T359, 30/-; Cross-over CX3000, 30/-.

EXTENSION SPEAKER CABINETS. 5in. 15/6, 6½in. 18/6, 8in. 19/6, 10in. 29/6.

C.R.T. BOOSTER TRANSFORMERS

for heater cathode short circuit, or tubes with failing emission. Full instructions supplied, mains input. Type A optional 25% and 50% boost 2v. or 4v. or 6.3v. or 10.8v. or 12.6v. State voltage required. PRICE 10/6.

TWIN GANG TUNING CONDENSERS. 365 pF, miniature 1in. x 1½in. x 1½in., 10/-; 500 pF standard with trimmers, 9/-; midget, 7/6; with trimmers, 9/-. 500 pF slow motion tuning, standard or midget, 9/-. Transistor gang 208 + 176 pF with trimmers, 10/6. **SMALL** 3 gang 500 pF, 17/-. **SINGLE** 365 pF, 7/6. **SINGLE** 10 pF, 25 pF, 50 pF, 75 pF. 100 pF, 160 pF 5/6. Solid dielectric 100, 300. 500 pF. 3/6.
CONDENSERS. New stock. 0.001 mfd. 7 kV, T.C.C., 5/6; Ditto, 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-. 0.25, 1/6; 0.5/350 v., 1/9; 0.1/350 v., 9d.; 0.1/2,000 v; 0.1/1,000 v., 1/9; 0.1 mfd, 2,000 volts, 3/6.
CERAMIC CONDS. 500 v. 0.3 pF to 0.01 mfd., 9p. **SILVER MICA CONDENSERS**, 10% 5 pF to 500 pF. 9d.; 600 pF to 3,000 pF, 1/-. Close tolerance (+1 pF) 2.2 pF to 47 pF, 1/-. Ditto 1% to 50pF, to 815 pF, 1/-; 1,000 pF to 5,000 pF. 1/9.

465 kc/s SIGNAL GENERATOR

Price 15/-. Uses B.F.O. Unit, ZA 30038 ready made with valve 1S5. POCKET SIZE 2½ x 4½ x 1in. One resistor to change, full instructions supplied. Battery 3/6 extra. 69V1½V. Details S.A.E.

WAVECHANGE SWITCHES
8 p. 4-way 2 wafer long spindle 6/6
2 p. 2-way or 2 p. 6-way long spindle .. 3/6
4 p. 2-way or 4 p. 3-way long spindle .. 3/6
3 p. 4-way or 1 p. 12-way long spindle .. 3/6
Wavechange "MAKITS". Wafers available: 1 p. 12 way, 2 p. 6 way, 3 p. 4 way, 4 p. 3 way, 6 p. 2 way, 1 wafer switch, 8/6. 2 wafer switch. 12/6; 3 wafer switch, 16/-; additional wafers up to 12. 3/6 each extra; Toggle Switches, s.p.. 2/-; d.p., 3/6. d.p.d.t., 4/-. Min. Slide d.p.d.t.. 3/6.

CRYSTAL MIKE INSERTS, 6/6 High output. Size 1½in. dia. x ⅜in.
ACOS MIC. 14, insert 1½in. dia. x ⅜in. 8/6

ACOS 39-1 DE LUXE STICK MIKE 35/-
TSL QUALITY STICK MIKE......25/-

Valveholders. EA50, 6d. B12A, CRT. 1/3. Engl. and Amer. 4, 5, and 7 pin, 1/-. MOULDED Mazda and Int. oct., 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 1/9. Ceramic EF50. B7G, B9A. Int. oct., 1/-. B7G, B9A cans. 1/- each. Valve plugs B7G, B9A, 2/3.

HIGH GAIN TV PRE-AMPLIFIERS

BAND I B.B.C.
Tunable channels 1 to 5. Gain 18dB. ECC84 valve. Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred.) Coils only 9/6.
BAND III I.T.A.—Same prices. Tunable channels 8 to 13. Gain 17dB. Circuit and coils only. 9/6.

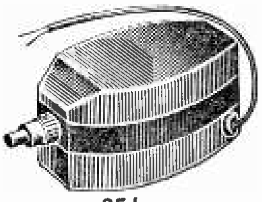
A HAPPY CHRISTMAS TO ALL READERS OF

RADIO COMPONENT

Our written guarantee with every purchase.
NEW COMPONENT LIST 1/-.

Bus 133 or 68 pass door
S.R. Station Selhurst

THE "INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETIZER



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

PLASTIC RECORDING TAPE

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

"EASISPLICE" Tape Splicer 5/-.

CRYSTAL SET BOOKLET, 1/-.
CRYSTAL DIODE G.E.C., 2/-. GEX34, 4/-. OA81, 3/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 15/- pr.
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, 8¼in. x 2¾in., but EXCLUDING Speaker and cabinet.
Speakers, 35 ohms, 7 x 4in. 21/- 5in., 17/6, 3¼in., 15/6. **£4.5.0**

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 6/6. "DOMINA" plugs, 2/6; sockets, 2/6.
JACKS. English open circuit, 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, ¾in. sq. x 2¼in., or ⅝in. sq. x 1½ in., 2/- with cores.
SLOW MOTION DRIVES, 6:1, 4/3.
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.
1/16in. **Paxolin Panels**, 10 x 8in., 2/-.
Miniature Contact Cooled Rectifiers, 250V 50mA, 7/6; 250V 60mA, 8/6; 250V 85mA, 9/6; **Selenium Rect.**, 300V 85mA, 5/-. **TV etc., Silicon Sub. Min. Rectifier**, 250V 450mA, 10/-, K3/25, 600V, 5mA, 5/-. RM4, RM5, 14A100, 14A116 10/- each. FC31, 20/-
Coils Wearite "P" Type, 3/- each.
Osmor Midget "Q" type, adj. dust core, from 4/- each. All ranges. List S.A.E.
Teletron D.W.R. L. and Med. T.R.F. with reaction, 4/-. 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 5/16 in. 3/-.
H.F. Chokes, 2/6. **Osmor QC1**, 6/9.
T.R.F. Coils, A/HF, 7/- pair; HAX, 3/-, Repanco DRR2, 4/6. DRX1, 2/6.
Radio Screwdriver, 5in., 6d. **Test Prods**, 2/9. **Neosid 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., 4/6; 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/-.

JASON FM TUNER COIL SET 29/-. H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s. detector transformer, heater choke. Circuit book using four 6AM6, 2/6.
Complete Jason FMT1 Kit. Jason chassis with calibrated dial, components and 4 valves. £6.5.0.
Model FMT2 with new shelf cabinet, 5 valves, components and powerpack, £10.

MAINS DROPPERS. Midget adjustable sliders 0.3A, 1,000 ohms, 5/-; 0.2A, 1,200 ohms, 5/-; 0.15A, 1,500 ohms, 5/-; 0.1A, 2,000 ohms, 5/-.
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 S.A.E. Expanded Metal, Gold, 12 x 12in., 6/-. Panel mounting fuse holders, 2/-. Fuses 1¼in. 60mA –5A. 6d. Insulated side cutters, 8/6. 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 TRANSISTOR SUPERHETS WITH PRINTED CIRCUIT AND FERRITE ROD AERIAL.

Long and Medium Wave Aerial—RA2W On 6in. rod, 208pF tuning, with car aerial coupling coil	12/6
Osc. Coil P50/1AC. 176 pF tuning	5/4
1st and 2nd I.F. Trans.—P50/2CC. 470kc/s 11/16in. dia. by ⅞in.	5/7 each
3rd I.F. Trans.—P50/3CC.	6/-
Spare Cores	6/- each
Driver Transformer—LFDT4	9/6
Wavechange Slide Switch d.p.d.t.	3/6
Printed Circuit—PCA1. Size 2¾ x 8¼in. Ready drilled, and printed	9/6
Volume Control, 5K-DP	4/6
35 ohm Speakers, 3¼in., 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 8/9, OC45 8/6, 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.

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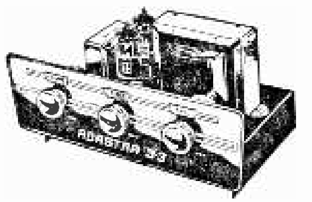
ADASTRA 3-3 AMPLIFIER 3 WATTS HIGH FIDELITY AT LOW COST



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

BUILD YOUR OWN RECORD PLAYER

AND SAVE POUNDS!!

4 Speed Autochange or Single Player units supplied with Brand New 2-tone Portable Cabinets 17 x 15 x 8½in. de luxe Strong carrying handle, gilt finish clips and hinges. As used by Famous Make for 20gns. models. Ready cut-out motor board 14 x 13in. 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
Collaro	£11.15.0	P.P. 5/6
Garrard	£12.15.0	P.P. 5/6
SINGLE PLAYER KITS Complete (as above)		
E.M.I. Junior	£9.19.6	P.P. 5/6
E.M.I. auto stop/start ..	£11.5.0	P.P. 5/6
OR SEPARATELY		
Cabinet with cut out board 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. UA16	£6.17.6	P.P. 4/6
SINGLE PLAYERS		
E.M.I. auto stop/start ..	£5.10.0	P.P. 4/6
E.M.I. Junior	£3.7.6	P.P. 3/6
TRANSCRIPTION UNITS		
Garrard 4HF	£16.10.0	P.P. 5/-
Philips AG1016	£12.5.0	P.P. 5/-
Garrard AT6	£11.0.0	P.P. 5/-
BARGAIN		
B.S.R. Autochange UA12 Stereo/Mono	£7.10.0	P.P. 4/6

Replacement sapphire styli available from 5/3.
Replacement Xtals from 15/-; Stereo from 31/6.

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 board 12¾ x 9¾in.

ARDENTE TRANSISTOR TRANSFORMERS

D3035, 7.3 CT:1 Push-Pull to 3 ohms for OC72,	11/-
D3034, 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 ⅞in. x ⅞in.,	11/6
D240, 8.5:1 Driver, ⅞in. x ⅞in. x ⅞in.,	11/6
ARDENTE TRANSISTOR VOLUME CONTROLS VC1545, 5K or 1 meg. with switch dia., .9 in.,	5/3
DEAF AIR EARPIECE, Xtal or magnetic,	7/6
SUB-MIN. JACK and **PLUG**,	3/6 pair

MINIATURE PANEL METERS

Size 1½in. 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
0-300 V ..	27/6	"S" Meter ..	35/-

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P.P. charge 1/-. C.O.D. 2/- extra.

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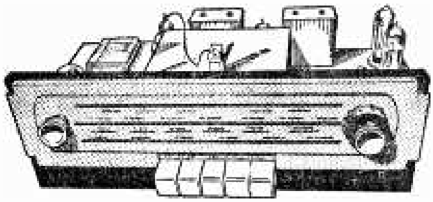
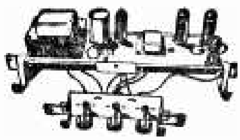
BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £13.13.0 (Carriage Paid)



Chassis size 15 x 6¾ x 5¼in. high. New manufacture. Dial 14½ x 4in. in 2 colours, predominantly gold. 200-250 v. A.C. only.
Pick-up, Ext. Speaker, Ae., E., and Dipole Sockets. Five push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested. O.P. Transformer. Tone Control. 1000-1900 M.: 200-550 M.: 88-98 Mc/s. Valves EZ80 rect.; ECH81, EF89, EABC80, EL84, ECC85. Speaker 8 x 5in. and Cabinet to fit chassis (table model), 47/6 (post 5/-).
10 x 6in. ELLIPTICAL SPEAKER 25/- to purchasers of this chassis.
TERMS: (Chassis) £3.10.0 down and 5 monthly payments of £2.4.0. Cheap Room Dipole for V.H.F., 12/6. Feeder 6d. per yard. Circuit diagram 2/6.
ALTERNATIVE DESIGN. L.W. 1000-2000 M.: S.W. 17-50 M. (6-17 Mc/s): M.W. 200-550 M.: V.H.F. 87-100 Mc/s: Gram. position. Otherwise similar to above chassis. Price £15.15.0 (carr. paid). **TERMS:** £3.10.0 down and 6 monthly payments of £2.4.0.



PUSH-PULL AMPLIFIER £5.5.0

(6/- Carr.)

Brand new 200/240 A.C. mains. Bass, treble and vol. controls, with valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 x 3½ x 3½in. With o.p. trans. for 2-3 ohm speaker. Front panel (normally screwed to chassis) may be removed and used as "flying panel". Stereo version 2 x 4 w., same price. Fixed panel. Tone & Vol. Controls.

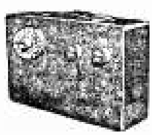
TAPE RECORDER AMPLIFIER

Type TR3. Fully built, high gain, low noise, printed circuit. Attractive grey and gold front panel 13 x 1½in. Height 5¼in. overall. Front to back 5¼in. Vol. and on/off tone. Mike, radio and ext. speaker jacks. Valves, magic eye, ECC83, ECL82, EZ80. Mains trans. Ready to bolt to B.S.R. Deck. Complete with switch wafer wired. Our Price ONLY £6.15.0 (6/- Packing and Carr.). Also available for Collaro Deck at 5/- extra.

THE "REGENT" 6-TRANSISTOR AND DIODE PORTABLE

COMPLETE KIT FOR ONLY

£5.17.6 (post 5/-)



500mW push-pull output. Ferrite rod aerial. Car aerial socket and coil. M.W. and L.W. full coverage. Operates on two 4.5v. cells. Printed circuit board 8½ x 2¾in. All holes drilled and component positions marked. Instructions 2/6 for 16p. (refunded on purchase of kit). Size 9 x 3½ x 7in. 8 x 2¾in. P.M. high quality speaker. Attractive Vynair covered cabinet. two-tone. Two batteries 5/6 the pair (Ever Ready 126). Mullard transistors OC44, 2 x OC45, OC81D and 2 x OC81. Top grade Weymouth Radio coils and transformers. Alignment service if required 17/6 (inc. post). Write for list of prices. All parts supplied separately. Built in two hours.

6-TRANSISTOR PORTABLE—Fully Built

The "SCALA" for only £7.10.6, carr. paid. 8½ x 2 x 5¼in. high. Choice of colours. Rexine. M.W. and L.W. Ferrite aerial. Battery 2/6 extra. Printed circuit. Nicely styled. A professional job. 3¼in. speaker. Fully tunable M.W. and L.W. Superhet circuit.

100 mF. + 200 mF. ELECTROLYTIC. New 275 v. (350 v. surge). 4in. x 1¾in. dia., 5/- each. (Post 1/-).

ALL ITEMS ARE NEW AND FULLY BUILT UNLESS OTHERWISE STATED. TESTED BEFORE DESPATCH.
Terms Available on Items over £5. Send 6d. (stamps will do) for 20 page illustrated catalogue. Delivery by return. C.O.D. 2/- extra.
ALL ITEMS GUARANTEED 12 MONTHS VALVES 3 MONTHS

GLADSTONE RADIO

"SCALA", CAMP RD., FARNBOROUGH, Hants.
Farnborough 3871 CLOSED SATS.

"REALISTIC" 'SEVEN'

7 Transistor Superhet. 350 Milliwatt output. 4-inch speaker. All components mounted on a single printed circuit board size 5½ x 5½in. in one complete assembly. Plastic cabinet, with carrying handle, size 7 x 10 x 3½in. External Socket for car aerial. Ferrite rod aerial. Price for the complete parcel including Transistors, Cabinet, Speaker, etc., and Full Construction Data: **£5.19.6** P. & P. 4/6.

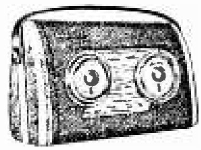
PP9 Battery 3/9. Data and instructions separately 2/6. Refunded if you purchase the parcel.

Any parts supplied separately.

4 TRANSISTOR MINIATURE PUSH-PULL AUDIO AMPLIFIER

PRINTED CIRCUIT. 5in. x 2in. x 1½in. over transformers. Output for 3-ohm speaker. Suitable for microphone, record player, guitar and radio input. 9-12 volt battery required. Frequency range 100 cps. to 25 Kcps. Push/pull output single ended. Instruction sheet provided. Fully wired ready for use. Two types available. ¾ watt output, 35/-, 1½ watts 41/-. P. & P. 2/6.

THIS SUPERB SET for £9 (Carr. pd.)



6-transistor radio covered in sponge clean Duracour fabric, in latest two tone shades. M.W. and L.W. ferrite rod, provision for car aerial, 2-colour scale. With PP9 battery giving 300 hours use. Weighs under 4 lbs. With carrying handle. 12 x 7in. high x 4½in. at base tapering to 2in. at top. Brand new fully guaranteed. 3 push buttons. Superhet circuit. 5in. L.S.

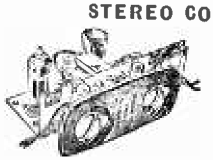
5 WATT AMPLIFIER

Our price ONLY 56/-, (post 5/-); a few hundred only: valves EF91 and EL84 with metal rectifier; 6 x 4 x 1¾in. high (5in. over EL84). Mains trans. and o.p. with vol. and tone controls; on-off; co-ax input.

SPECIAL REDUCTIONS ON GRAMOPHONE AMPLIFIERS

1½ watt type. Save 4/6. With 5in. speaker. Baffle 12½ x 6in. 200-240 v. A.C. EL84 and Rectifier. Tone and Volume. On/off switch. Two knobs. Ready to play. Useful for Stereo. 45/-, post 5/-.
4 watt type. Save 20/-. Valves UY85, UF80 and UL84. 200-240 v. A.C. Covered baffle 13½ x 7½in. (6½in. speaker), 3 front controls: bass, treble, on-off/vol. 54/-, post 5/-. Double wound mains transformer.
2½ watt type. Save 20/-. 2½ watts. ECC83, ECL82 and EZ80. Controls volume, bass and treble. On/off switch. 200-240 v. A.C. O.P. trans. Size 12 x 3½ x 5in. over valves. Suitable for microphone input and for Guitar. 55/-, post 5/-.

STEREO CONVERTER UNIT



Converts existing Radiogram to play stereo records. Chassis 6½ x 2½ x 4in. overall height. Mains and O.P. trans., Metal Rect., ECL82 valve and all screws, panels, etc. Moulded front escutcheon, fully built, brand new only extras needed, speaker and stereo cartridge. Full instruction leaflet. Limited quantity at 39/6. (5/6 P. & P.). Ronette Stereo Cartridge, 25/-.

TOP QUALITY RECORDING TAPE (Guaranteed)

(1/- per tape, six or more post free).

4in.	600ft.	12/6	5¾in	1200ft.	17/6
5in.	600ft.	11/3	5¾in.	1800ft.	35/-
5in.	900ft.	17/-	7in.	1200ft.	15/-
5in.	1200ft.	30/-	7in.	1800ft.	19/6
5¾in.	850ft.	11/6	7in.	2400ft.	32/6

BATTERY ELIMINATOR

For 4 Low Consumption Valves (96 range) 90v. 15mA and 1.4v. 125mA. 45/- (4/- post). 200-250v. A.C. Also for 250mA, 1.4v. and 90v. 15mA at same price. Two separate units to replace existing batteries. 4 x 2¼ x 2¼in. and 3 x 2½ x 1¾in.

AMPLION "Activette" for charging dry batteries. Mains operated 200-250v. A.C. Size 4¼ x 2¾ x 1¾in. with output socket and plug for 45v., 69v. and 90v. H.T. with 1.5v. L.T. Price ONLY 27/6.

HEATER TRANSFORMER

Mains input giving 6.3v. 2 amp. Size 2¾ x 2¾ x 1in. (2¼in. over winding) 5/6 ea. Less 10% for 12, or 20% for 50. P. & P. 2/- for 1 to 6, post free more than six.

Practical Wireless

Vol. XXXIX No. 683 JANUARY, 1964

Editorial and Advertisement Offices:
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Contents

Measure of Success

ONE sometimes hears of enthusiasts who consistently build equipment without the aid of test gear. This *is* possible, of course, but what happens when a completed job fails to function satisfactorily or does not work at all? One can only poke about haphazardly hoping to stumble on a mechanical fault or abandon the project.

At all events, time and energy are wasted, often fruitlessly. Not only that, but this approach is to say the least a very untechnical one in a technical hobby!

Test gear is not only helpful in tracing breakdowns. Even assuming that all home-built equipment works, how much of it functions at optimum? How many receivers and amplifiers are there at this moment working at less than full efficiency?

All components, whether from the spares box or new from dealers, are subject to tolerances and variations in quality. The permutations possible in even simple equipment are considerable. Again, a "4·7k" resistor, for example, may be actually 47k or 470Ω due to wrong colour coding and components may be o/c or s/c or changed in value. These things *do* happen and if there is no means of checking when in doubt, the constructor may spend many frustrating hours looking for a constructional fault that does not exist. Without test gear he is working blind.

The acquisition of test gear need not be prohibitive, because for the average enthusiast a few basic items should suffice. And of these, an accurate multirange test meter is the obvious starting point. For those regularly building equipment it is an indispensable item and will provide facilities for overcoming many everyday snags and for solving mysteries of sub-standard performance.

It is, however, inadvisable to buy an inferior meter, for this type of false economy may only aggravate certain problems. Bearing in mind the need for an inexpensive yet accurate and sensitive test meter we felt it would be a popular conclusion to our present series of blueprints to present an instrument of the calibre of the P.W. "Sixteen".

It will stand comparison with a good quality commercial product. A special plastics case is available, with the switch ranges and other lettering already printed on the front panel. The scale arcs are specially calibrated and printed ready for use. All the special components are available through usual sources.

We have thus overcome all the snags in building your own test meter—no tricky work in making up special shunts and multipliers, no calibration to work out and mark up on the scale. In other words we are making available to the home constructor a multirange test meter which not only performs to commercial standards but looks professional, too!

With its sixteen a.c. and d.c., voltage, current, and resistance ranges, the P.W. "Sixteen" is a fine opportunity for those not having a test meter or wishing to replace an old one.

Our next issue dated February will be published on January 7th

HI-FI IN THE ARABIAN GULF

EQUIPMENT made and tested by the British manufacturers prior to its delivery, has been installed in the club recently built for the staff of the Bahrain Petroleum Company Limited in the Arabian Gulf. The equipment, which has been supplied by A.E.I. Limited, provides a high-fidelity amplification system covering every part of the several acres of ground which the club occupies.

Six A.E.I. 30W power amplifiers provide amplification for microphone, tape recorder, radio broadcast or record player inputs.

Laboratory Extension

THE Research and Development department of Garrard Engineering Limited at Swindon, has recently undergone a major extension programme which has resulted in an enlarged laboratory with the number of engineers and scientists employed there increased to 70. By the end of the year at least 80 technicians will be engaged on the research, development and testing of Garrard-made products.

Power Amplifiers Clear Birds from Runways

A COMMON hazard faced by pilots of aircraft is the presence of large numbers of birds on and around runways. At several of the major airports in Britain steps have been taken by the authorities to remove this hazard and thus make take-offs and landings safer.

The device which is used in dispersing the birds consists of loudspeakers and amplifying equipment installed in a van. These mobile units operate close to the airport runways and broadcast bird cries which are effective in removing certain species from the area.

The Sappho audio equipment employed in these vehicles, is made by Trix Electronics Limited. The latest order for such equipment received by Trix is for a unit for Speke airport, Liverpool.

A mobile bird-dispersal unit, fitted with Sappho audio equipment, in position near an airport runway.

British Simulator Trains Canadian Mariners

A FULLY transistorised marine radar simulator manufactured in England by the Solartron Electronic Group, Limited, has been installed in the Navigation Department of the College for Trade and Technical Training, St. John's, Newfoundland, Canada. Here it will be used to train some of Canada's future mariners in the methods of handling all kinds of ships in congested coastal seas.

The simulator confronts the student mariner with situations typically met with in the more crowded shipping areas as displayed on a radar screen. He has all the controls and navigation aids that would be found on the bridge of a ship and his handling of the "ship" under varied simulated conditions is reproduced on the screen. Other simulated ships can be brought into the field of his radar and the movements of these are constantly fed to a computer where they are compared with the movement of the student's "ship".

The instructor who decides how to deploy these simulated ships can also simulate coastlines and typical radar effects which are often present with sea-borne equipment.

Laser Drills Holes in wire

IN a technical paper presented at the National Electronics Conference held recently in Chicago, U.S.A., Dr. Danilo V. Missio of the Raytheon Company of Massachusetts, revealed that he and his fellow research workers had successfully used accurately controlled flashes of laser light to bore holes through tin wire only two-thousandths of an inch in diameter. The holes themselves were less than five microns (two ten-thousandths of an inch) in diameter, and this was the first report of holes of such small magnitude being drilled using a beam of laser light, although previous work had indicated that it was possible.

RADIO EQUIPMENT FOR AIRLINERS

EVER since 1949, Central African Airways have specified Marconi aeronautical radio equipment for their aircraft. Now the Marconi Company Limited have received an order from C.A.A. to equip their new B.A.C. One-Eleven aircraft with the Sixty Series of airborne radio units.

Under this order, each aircraft will have dual v.h.f. communications systems, a single v.h.f. navigation system and dual automatic direction finding systems.

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

ULTRASONIC CLEANING FOR GEARS

ULTRASONIC cleaning equipment made by Mullard Equipment Limited, has replaced conventional methods of cleaning gearheads made at the Egham factory of O.T.M. Servo Mechanisms Limited. To ensure the efficient operation of these gearheads—which are used in servo systems of aircraft and guided missiles—it is essential for the gears and pinions to be thoroughly cleaned before they are assembled into the head.

Originally hand-washing in a solution of carbon tetrachloride was the cleaning process used, but this was found to take too long and the standard of cleanness achieved was not satisfactory. The Mullard Ultrasonic equipment, however, successfully removed all particles of dirt bigger than two microns in diameter after a two minute cleaning period. This not only saves time but also increases considerably the life-expectancy of the gearheads because of the large percentage of dirt that can be removed by this process.

The Mullard equipment consists of an ultrasonic generator and a 1½ gallon stainless-steel tank, which holds the cleaning solution (a chlorinated hydrocarbon) into which the gears are placed for the cleaning operation.

Commonwealth Telephone Link Complete

ON October 10th, the final part of the Commonwealth Telephone cable was layed off Hawaii and for the first time the Pacific Ocean was spanned by telephone cable. This occasion also marked the completion of the 14,000 mile Commonwealth link between Britain and Australia. With the trans-Atlantic cable between Britain and Canada—which has been in service since December 1961—and the new 3,000 mile microwave network which crosses Canada, London and Sydney operators will be able to dial right through to subscribers at each end of the link.

For telephone users in Australia and Britain, this link means a reliable method of communication over more than half the world's circumference. A total of 80 two-way speech channels thus become available which, unlike previous radio links, will be free from fading and atmospheric conditions. As well as telephone conversations, the new cable will be used for teleprinter traffic: each speech channel being capable of carrying 22 such circuits. Circuits will also be made available to commercial concerns, such as airlines and shipping companies.

In itself, the Pacific section of the link is the longest submarine telephone cable in the world; as a whole, the Commonwealth link is by far the biggest project of its kind ever attempted.

All of the cable used in the project—and there were 11,000 miles of it—was manufactured in Britain by Submarine Cables Limited, and Standard Telephone and Cables Limited. This cable, which at one point in the Pacific section of the lay reaches a depth of over three miles, is little more than an inch in diameter.

The Atlantic and Pacific cable-laying operations have taken two and a half years to complete by the three British ships which had the task of making the lays. Terminal points of the Atlantic link are Oban in Scotland and Hampden, Newfoundland. The Pacific cable joins Sydney, Australia with Vancouver, Canada, via Auckland (New Zealand) and Suva (Fiji).

New Communication Equipment for Police

POLICE forces throughout the U.K. are to be supplied with new radio communication equipment manufactured by Ultra Electronics Limited under a contract from the Home Office Communications Branch. Three separate types of equipments come under the contract and these are, a hand-held transceiver, a mobile transmitter/receiver for motor-cycles and a similar unit for other motor vehicles used by the police.

In the design of the motorcycle and car units, the manufacturers have employed circuit techniques which have resulted in economies in space and weight. The new pocket-sized transceiver is fully transistorised and takes its power from a nickel cadmium rechargeable battery which gives it an operating life of several hours.

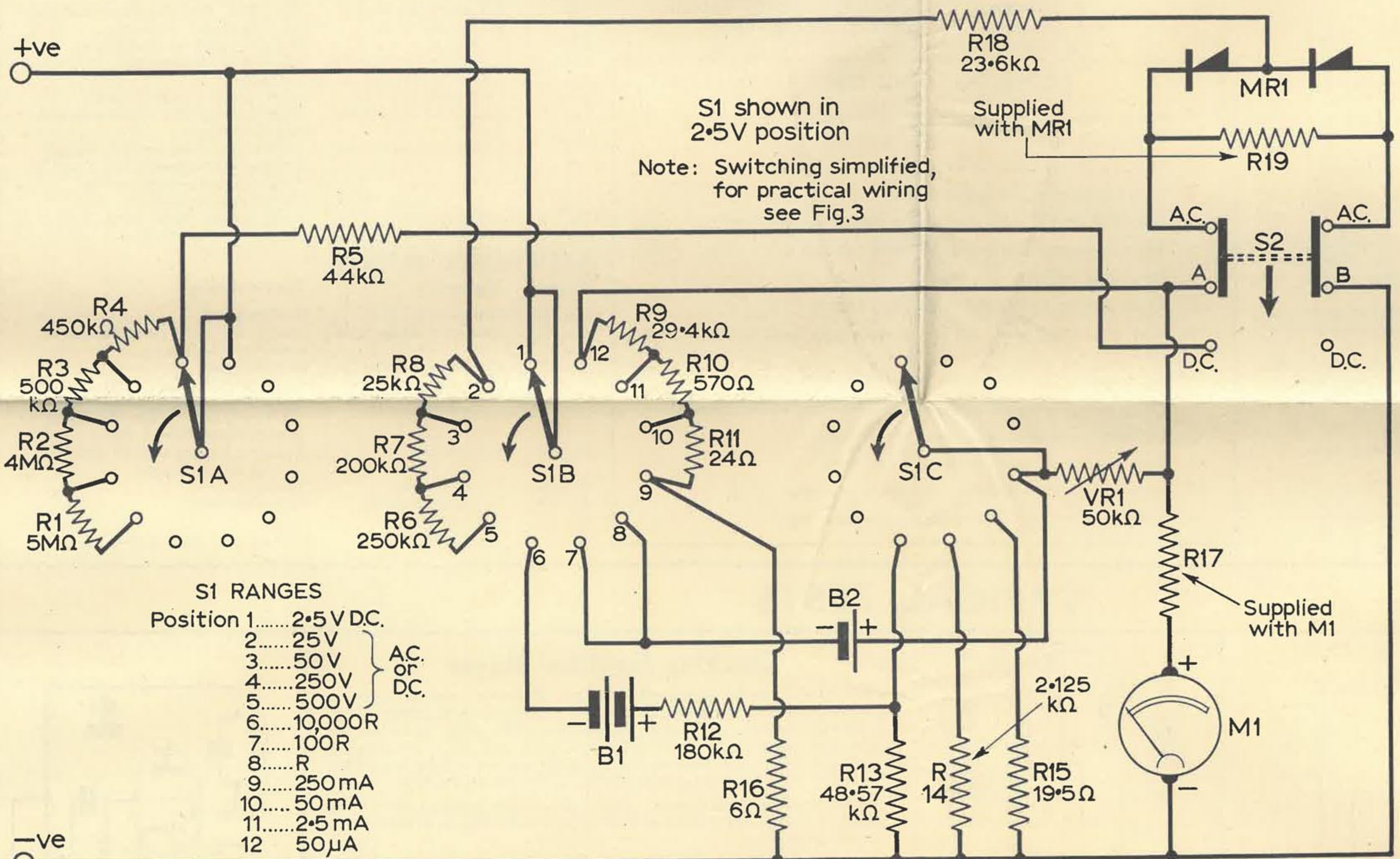
PRESENTED FREE
WITH
"PRACTICAL WIRELESS"
JANUARY 1964

Practical Wireless

"Sixteen" Multirange METER

PRICE 5/-

PUBLISHED BY GEO. NEWNES LTD., TOWER HOUSE, SOUTHAMPTON STREET, LONDON W.C.2.



S1 RANGES

Position 1	2•5 V D.C.	
2	25 V	A.C. or D.C.
3	50 V	A.C. or D.C.
4	250 V	A.C. or D.C.
5	500 V	A.C. or D.C.
6	10,000R	
7	100R	
8	R	
9	250 mA	
10	50 mA	
11	2•5 mA	
12	50 μA	

Fig.1 Theoretical circuit diagram (for reference only)

LIST OF COMPONENTS

Resistors
- R1...5 MΩ ½ Watt
- R2...4 MΩ ½ Watt
- R3...500kΩ
- R4...450kΩ
- R5...44kΩ
- R6...250kΩ ½ Watt
- R7...200kΩ
- R8...25kΩ
- R9...29•4kΩ 0•5%
- R10...570 Ω
- R11...24 Ω
- R12...180kΩ
- R13...48•57kΩ
- R14...2•125kΩ
- R15...19•5 Ω
- R16...6 Ω ½ Watt
- R17...Supplied with meter
- R18...23•6kΩ
- R19...Supplied with rectifier

All resistors are high stability ± 1% ¼ Watt unless otherwise stated

VR1...50kΩ carbon pot'meter with knob (East Grinstead Electronic Components, P16T)

M1...Moving coil meter 40μA f.s.d. (Taylor Electrical Inst. Ltd.)

MR1...Meter rectifier D8-1-1Y (Taylor Electrical Inst. Ltd.)

S1...3-pole, 12-way, 2 wafer rotary switch, type PW16

S2...2-pole change-over slide switch (Arcolectric T225)

B1...1•5 Volts cell
B2...15 Volts battery
{Ever Ready} type U10 and B121 respectively or equivalents

Instrument case and knob for S1 (Taylor Electrical Inst. Ltd)
4...6BA round-head screws 3/32" long; 2..6BA solder tags (one double ended); 6mm. dia. plastic sleeving 3" long; pair of test prod leads with 4mm. wander plugs

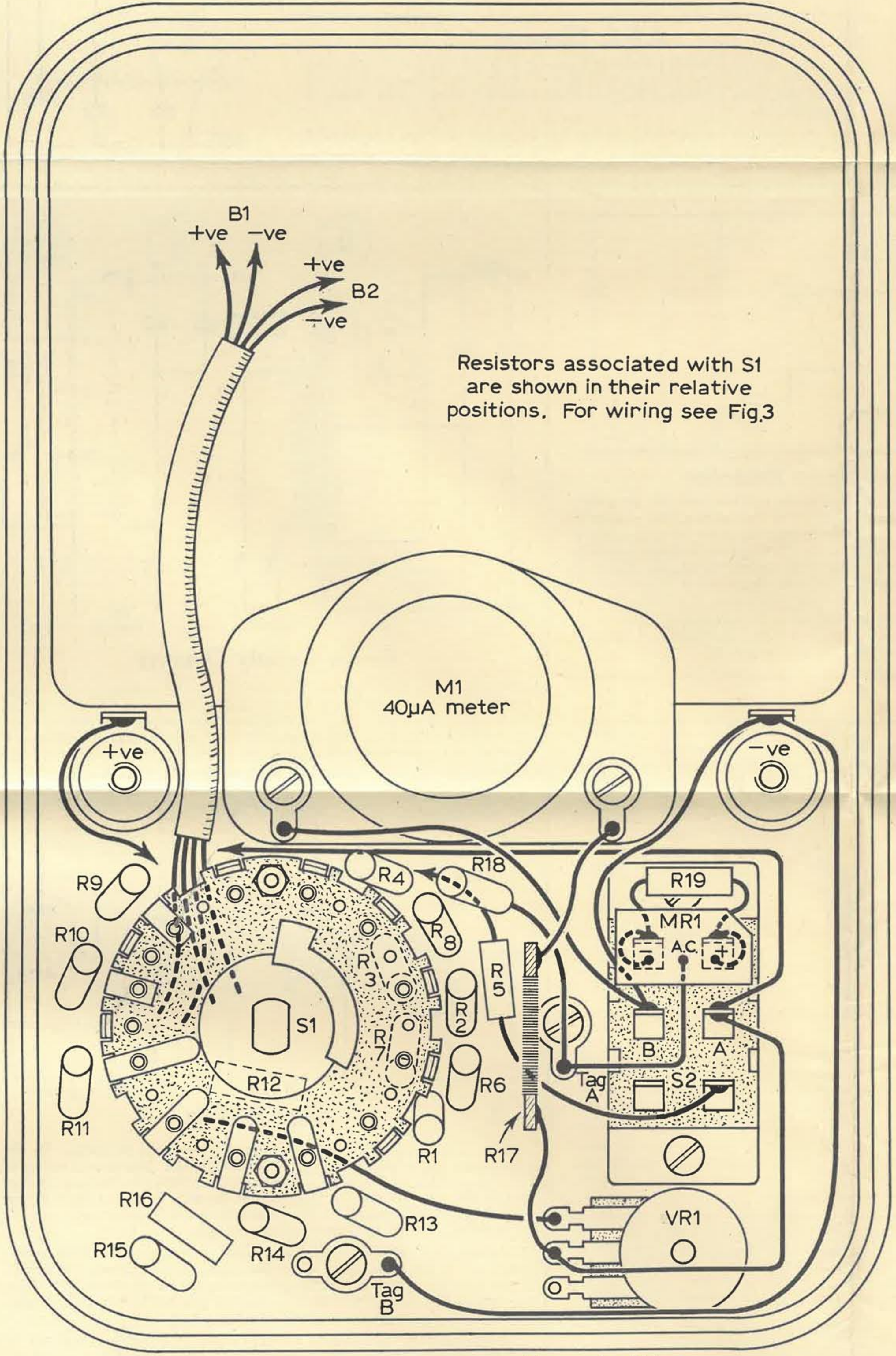


Fig.2 Instrument assembly and wiring

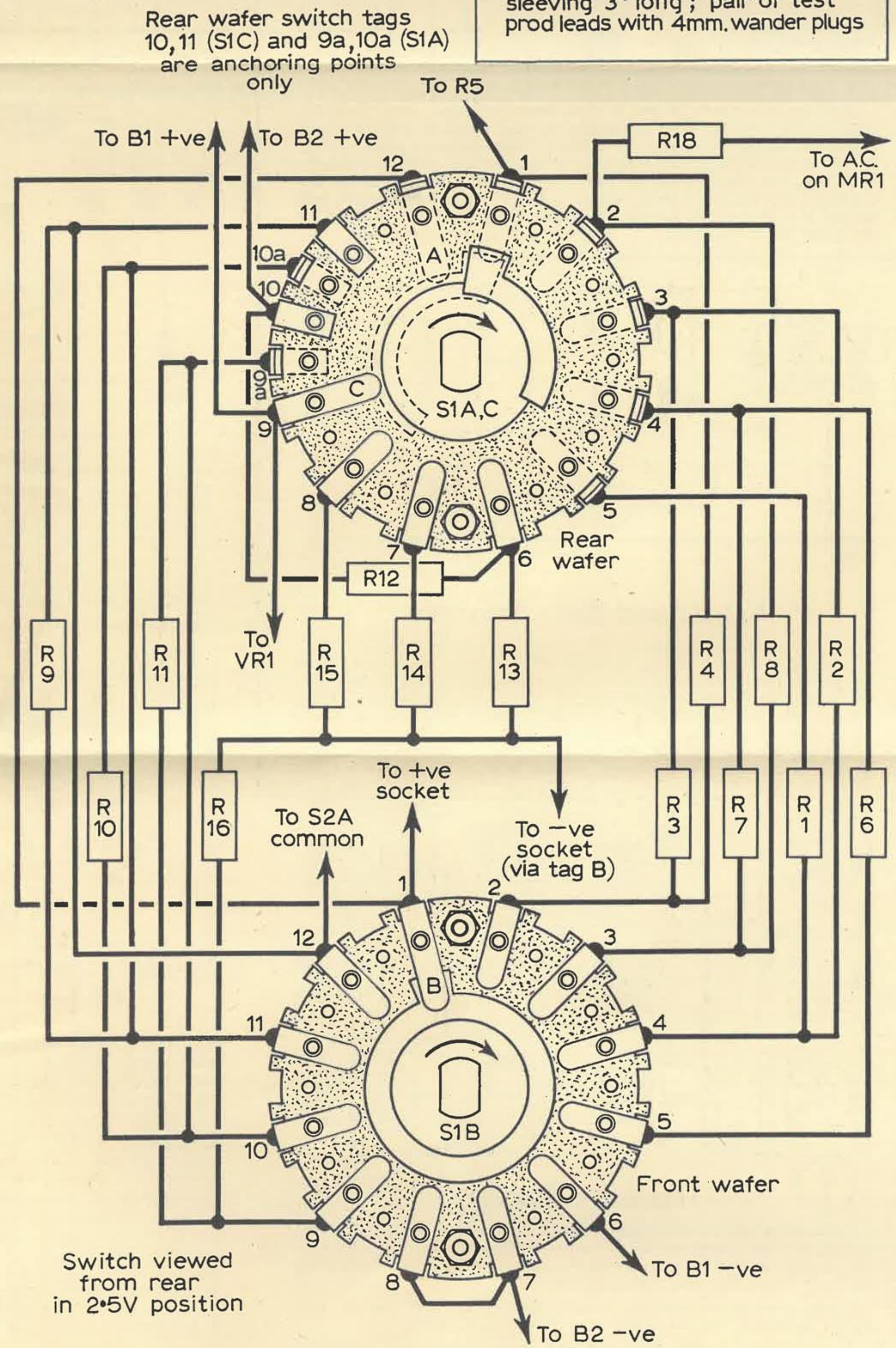


Fig.3 Practical wiring of Range switch

MULTIMETER APPLICATIONS

D.C. VOLTAGE CHECKS

Range	Application	Typical reading
500V	H.T., cathode of rectifier.	200–300V Full-wave. 190–220V Half-wave.
500V	H.T., a/c smoothing capacitor	200–250V Choke-capacitance smoothing. 170–210V Res-cap'y smoothing.
250V	Anode, output stage, at transformer primary.	Full H.T.
250V	Screen grid, output stage.	150–200V.
250V	Anode, driver stage, audio.	50–100V High impedance circuit; meter damps and affects reading.
250V	Anode, i.f. amplifier, mixer and r.f. stages.	150–250V Meter acts as r.f. bypass. Check between 'hot' side of r.f. load and decoupling.
250V	Anode, oscillator.	70–120V Meter damps oscillator circuit. See Fig. 1.
250V	Screen grid, i.f., mixer, r.f. amplifiers. See Fig. 2.	50–120V. Vari-mu valve will have lower voltage on screen than straight amplifier.
50V	Detector, f.m. receiver. See Fig. 3 and Fig. 4.	30–50V varying to zero null point.
50V	A.G.C. See Fig. 5.	0–10V depending on signal strength.
25V	Cathode bias, audio and r.f. stages.	0–10V. Where bias is low, anode and screen volts near normal, suspect low-emission valve.
25V	Battery supply	As appropriate. Check readings on and off load. Wide variation indicates high internal resistance.
25V	Single-ended push-pull transistor output stage.	4·5V at base of upper transistor and at junction of collector of lower with emitter of upper.
25V	Collector of grounded-emitter stages.	5–9V.
25V	Base to emitter of grounded-emitter stage.	3–5V in some audio driver circuits.
2·5V	Across collector load of grounded emitter stage.	0·75–1·5V.
2·5V	Base with respect to chassis	0·75–1·5V Polarity dependent on circuit.

D.C. CURRENT CHECKS

Range	Application	Typical reading
250mA	H.T. line.	100–200mA, depending on number of valves. Examples: EZ40, 90mA; EZ80, 90mA; EZ81, 150mA.
50mA	Anode and screen currents. (Cathode current=sum). Note decoupling, Fig. 2.	Output valves, 30–60mA, screen current, 5–10mA. I.F. and r.f. valves, anode 5–10mA, screen 1–5mA.
50mA	Total consumption, battery operated, transistorised portable.	25–50mA, increasing from quiescent condition to maximum signal output.
50mA	Oscillator anode. See Fig. 1	3–7mA. Damping the oscillator causes change.
2·5mA	Collector current, transistor amplifier stage.	0·5–2·5mA.
50μA	Detector, F.M. radio. See Figs. 3 and 4.	0–30μA.

METER DO'S AND DON'TS

1. Always begin at the highest range when in doubt of the voltage or current.
2. Never insert the meter in a live circuit to read current.
3. Do not apply ohms test to live circuit.
4. Beware of charged electrolytics when making resistance tests.
5. Avoid connecting to a d.c. circuit when testing a.c.
6. Zero ohms before making tests.
7. Check pointer zeroing before each test session.
8. Look after leads, prods and clips—even a poor joint can affect small readings.
9. Keep leads as short as possible when testing r.f. circuits.
10. When testing in high-voltage chain, use meter at low potential end.
11. Do not allow leads to dangle over edge of bench.
12. Keep meter away from strong magnetic fields.
13. View pointer from directly above to avoid 'parallax' effect.
14. When making comparative tests, use the same range.

A.C. VOLTAGE CHECKS

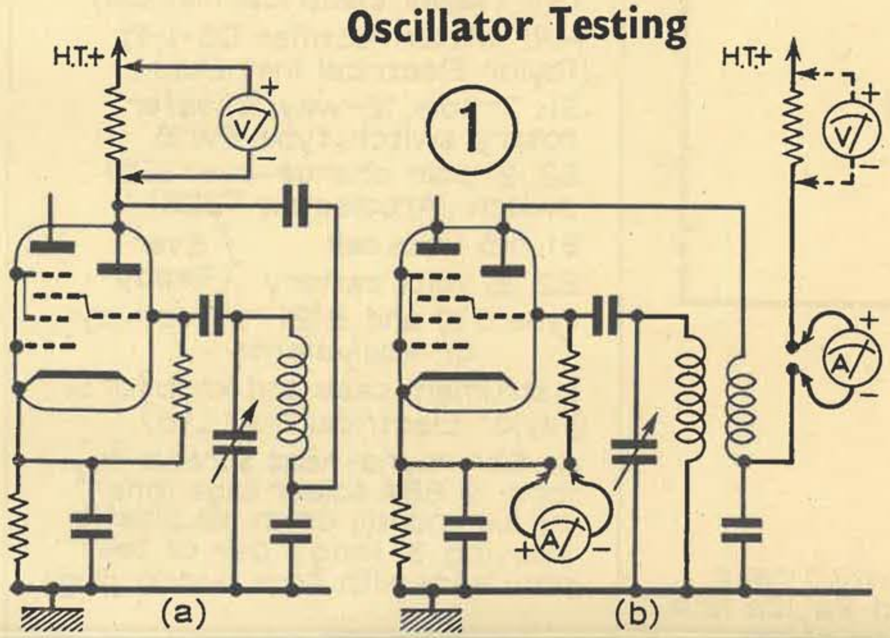
Range	Application	Typical reading
500V	H.T. secondary of c.t. mains transformer.	250–0–250, 350–0–350. Measure at each end with respect to chassis.
250V	Mains input.	200–250V, 110V, as appropriate.
250V	Mains dropper and surge limiter, a.c./d.c.	250–90V, as appropriate. See Fig. 6.
50V	Valve heaters, a.c./d.c.	6–35V, check across valve base.
50V	A.C. bias, tape recorder.	10–40V. At R/P and erase heads with respect to chassis.
25V	A.C. bias, tape recorder.	1–10V across series resistor to avoid damping high impedance head. Also for checking signal voltage, with h.f. oscillator inoperative.
25V	Audio output.	1–10V varying. Meter across output transformer secondary.

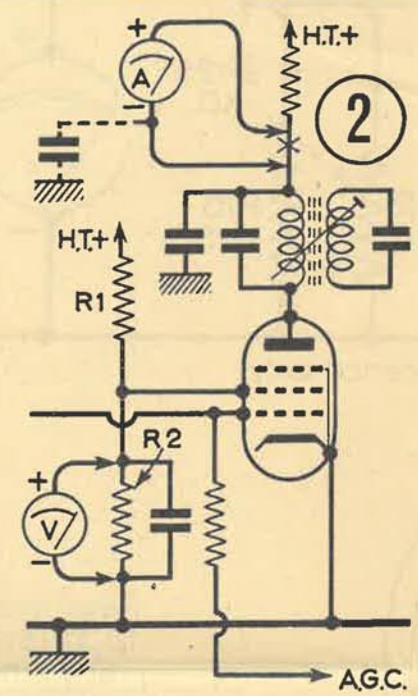
RESISTANCE CHECKS

Range	Application	Typical reading
R x 10,000	Component testing.	As appropriate.
R x 10,000	Low-volts leakage testing.	Infinity. Slight kick on connection to higher value capacitors.
R x 100	Component testing.	As appropriate.
R x 100	Electrolytic capacitor testing.	Apply correct polarity, note 'kick' and slow increase. Example: 25μF, kick to 10k, slowly raise to 50k. 100μF, kick to zero, slowly raise to 100k.
R x 100	H.T. line check.	As above, limiting at point depending on total line resistance.
R x 100	Transistor tests.	See Fig. 7.
R	Component testing.	As appropriate.
R	Continuity check.	Zero.
R	Coil d.c. resistance.	0–50 ohms, as appropriate.

TYPICAL TESTS

Oscillator Testing





Checking Amplifier Stages

To check anode or screen grid voltages, allowance must be made for current drawn by the meter. For example, if the screen grid potentiometer of V1 was effectively modified by the presence of the meter across R2, the screen grid voltage would tend to drop. This in turn would alter the operating conditions of the valve, reducing the screen current and tending to stabilise. The higher the voltage range used, the more accurate the readings.

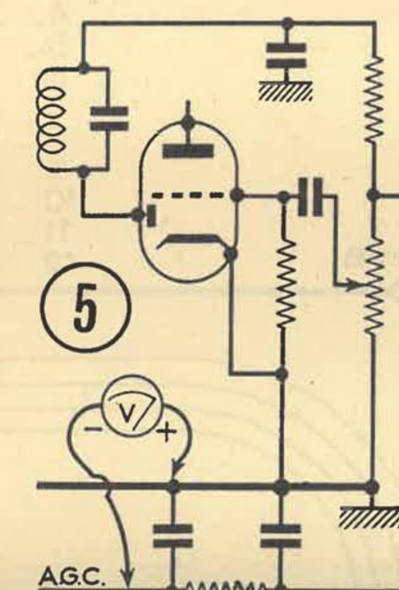
When checking anode current, measure at low signal potential side of tuned circuit, as shown, and provide decoupling to avoid feedback, as indicated by dotted capacitor.

A quick check for a.g.c. operation is to measure the screen grid voltage of a controlled stage (i.f. amplifier), under 'no-signal' conditions, then tune in a strong carrier. An increase from 5 to 15 volts should be noted.

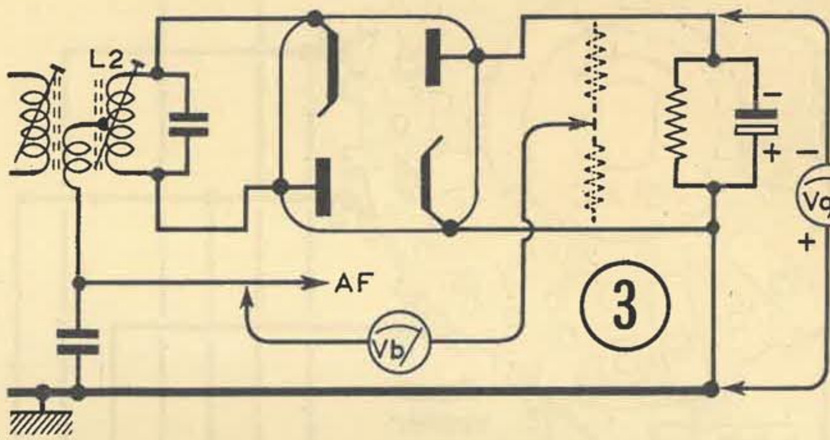
A.G.C. Circuits

The high impedances present in a.g.c. circuits, and the precise time constants of components, makes measurement misleading in certain cases. Apply the meter to a junction between filter resistors, never across diode or grid circuits.

A method of testing which imposes no load on the a.g.c. line is to measure the screen grid voltage of a controlled stage (see also Fig. 2).

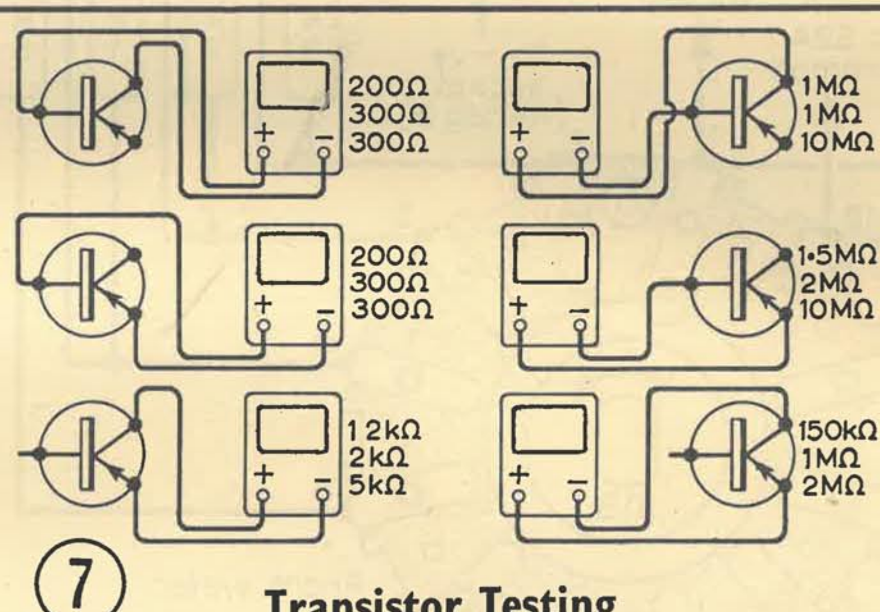


Meter applied directly to anode will prevent oscillation. With shunt-fed types, measure voltage drop across load resistor, or anode current, short-circuit grid by application of 0·1μF capacitor, note change in anode current or volts drop, indicating that oscillation was taking place. With tuned-anode types (Fig. 1b), insert meter on 'hot' side of tuned circuit, or across de-coupling filter resistor, if fitted. Check as before. Where convenient, grid current may be checked directly. Valve not oscillating, about 10μA, rising when oscillations take place.



Unbalanced Ratio Detector

Alignment procedure requires first the detuning of the secondary of the discriminator transformer L2, by unscrewing the core, then tuning other circuits for resonance, measuring the output across the R-C load. The meter, Va, is connected with positive to chassis. Next, the secondary is tuned for correct balance, which can be measured by connecting a matched pair of resistors across the output circuit of the detector (47k each, suggested), and connecting the meter Vb from the centre-tap to the a.f. take-off point. Adjust secondary tuning for null point, zero reading.

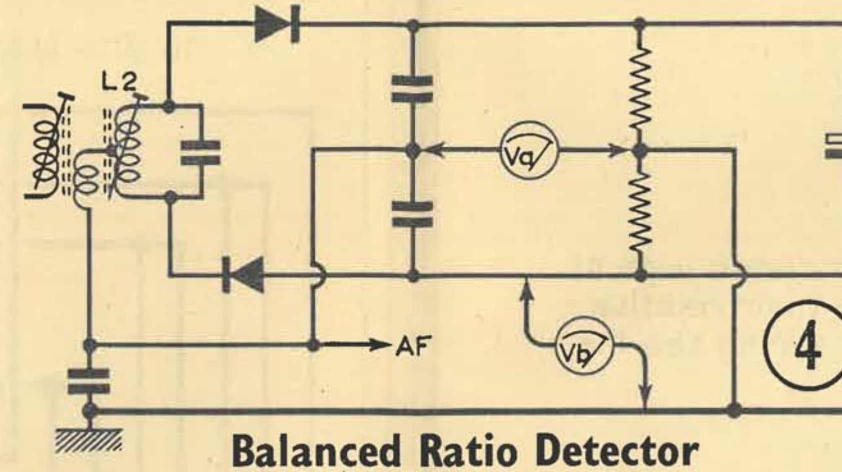


Transistor Testing

Semiconductors can be checked for back and forward resistance by the application of the ohmmeter in the correct sense (polarity). Remember that the positive terminal presents a negative voltage to the external circuit on the ohms ranges, from the internal battery.

Typical readings for specimen p-n-p transistors are given beside each meter illustration. The specimens were OC81, OC71, OC44.

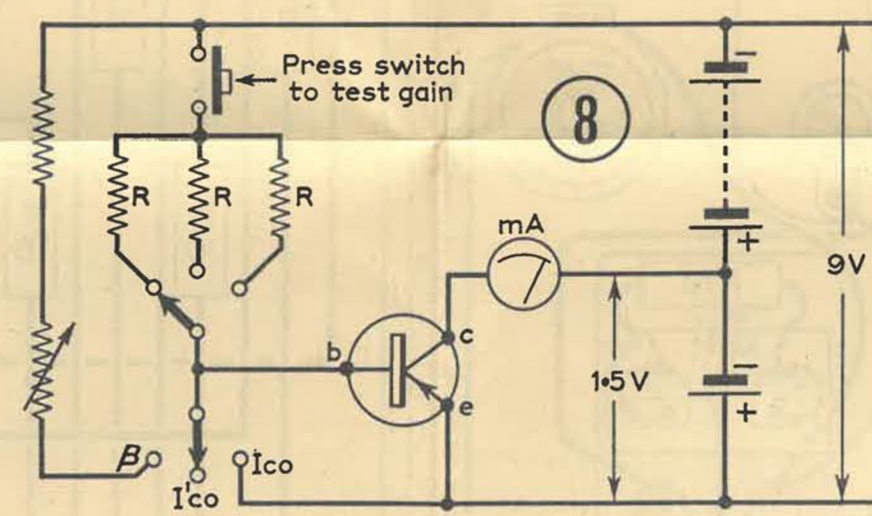
A simple circuit can be set up, using the meter switched to the 2·5mA range, and a few components from the spares box. In the circuit, the transistor



Balanced Ratio Detector

Meter Va is connected across one-half of the resistive load, the secondary L2 detuned and the tuned circuits previous to this adjusted for maximum output. L2 is finally adjusted for balance by applying meter Vb to the centre tap of the load and the centre tap of L2. As the former is at chassis potential and the latter is the a.f. take-off point with respect to d.c., the meter is connected between the a.f. take-off point and chassis. L2 is tuned for null point, zero reading.

An alternative method, stipulated by some manufacturers, is to use a μA-meter with 47k resistor in series, in place of Vb. The high o.p.v. rating of this meter makes it quite suitable for this test, however.

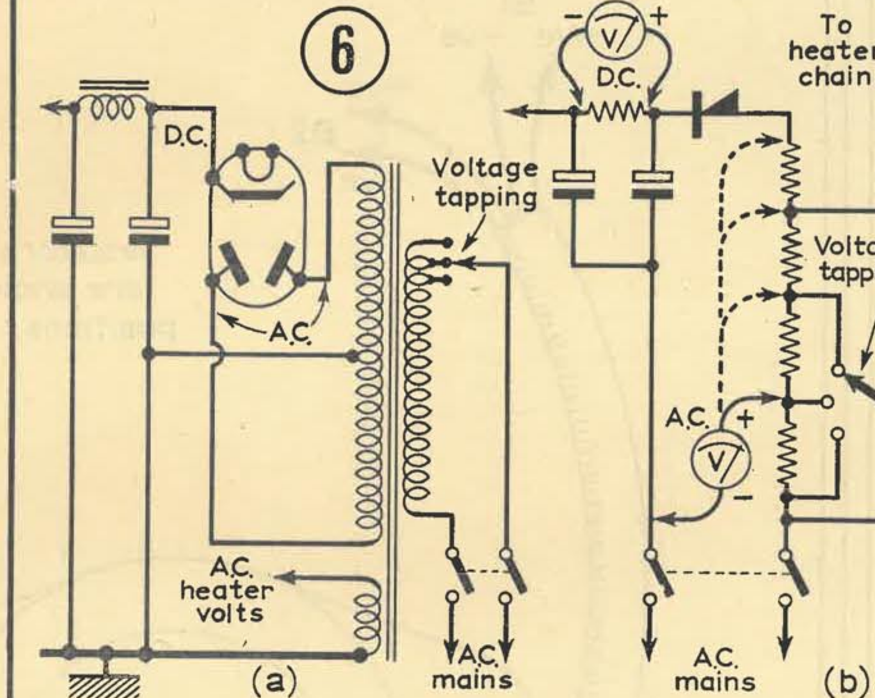


under test is a p-n-p type, connected in the grounded-emitter mode. N-P-N types require potentials of opposite polarity. The three switch positions select collector leakage current (I'co) with base open-circuited, collector current (I'co) at cut-off, with base connected to emitter, and β, current gain.

Note that the milliameter is fed from a tapping on the supply. Current gain measures the test current (collector) caused by change in base current. First, adjust the base current for normal bias conditions by varying the potentiometer. Set for a 1mA reading. The press-switch S2 allows the base current to be increased by an amount governed by R.

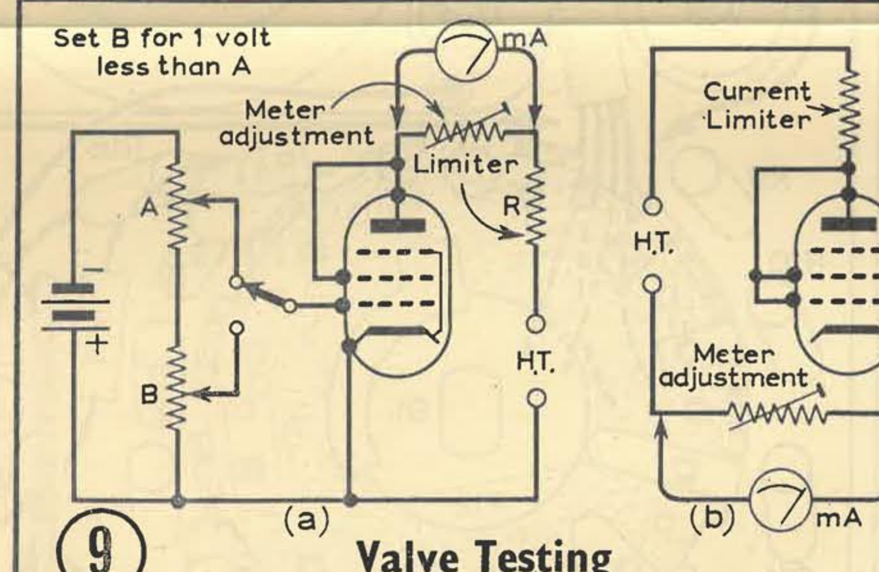
This resistor must be calculated for the appropriate transistor. If a transistor with, for example, a current gain of 100 is chosen, R is calculated to provide a 2mA deflection. Thus a change of 1mA results from an increase in base current of $\frac{1}{100}$mA. So R must feed an extra 0·01mA to the base when S2 is pressed, which works out to be 900k. Gains of other values can be calculated by the same method and several preset resistors fitted in the R positions.

$$\text{Current gain } \beta = \frac{\text{change in collector current}}{\text{change in base current}}$$



Power Supply Circuits

Always ensure that the meter is switched to the correct range. Avoid application of meter to circuit carrying d.c. when switched to a.c. ranges. Never connect or disconnect current-measuring ranges with the receiver switched on. When testing a.c./d.c. circuits, ensure that the chassis is connected to the neutral pole of the mains input.



Valve Testing

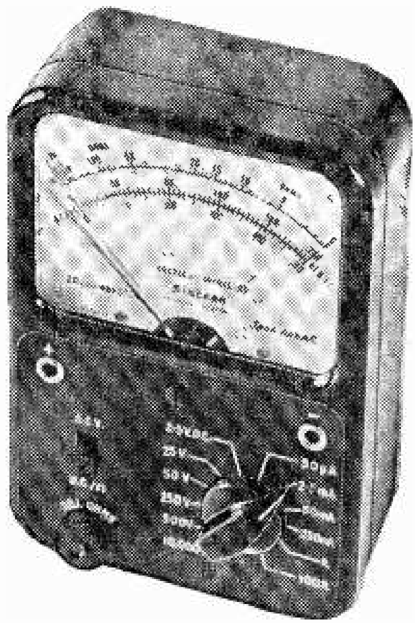
With the aid of the meter, the quality of a valve may be tested. Fig. 9a shows the arrangement for testing mutual conductance. The meter is switched to a suitable current range and indicates anode current. A voltage is applied to the grid, and varied by 1 volt (this can be done by first measuring the applied voltage, resetting the potentiometer for a 1-volt change, and re-connecting the meter to measure anode current).

The mutual conductance $g_m = \mu/r_a$, where μ is the amplification factor and r_a the anode impedance. As a valve ages, its r_a increases, and consequently the gm decreases. Mutual conductance can be calculated by dividing the change in anode current by the change in grid voltage, in units of amps and volts. The g_m is generally stated in mA/V.

Another test of 'goodness' is a measurement of emission. As shown in Fig. 9b, the total valve current is measured by the milliameter.

THE PRACTICAL WIRELESS "Sixteen" Multirange METER

The Blueprint given away free with this issue provides all the circuit and wiring diagrams for this instrument



16 switched ranges; nine for voltage measurements, four current ranges, and three resistance ranges.

Voltage		Current	Resistance
0–2·5V d.c.		0–50µA	0–2,000Ω
0–25V	a.c. and d.c.	0–2·5mA	0–200kΩ
0–50V	a.c. and d.c.	0–50mA	0–20MΩ
0–250V	a.c. and d.c.	0–250mA	
0–500V	a.c. and d.c.		

Meter sensitivity: 20,000Ω/V on d.c. ranges; 1,000Ω/V on a.c. ranges.

Basic movement: 40µA f.s.d. moving coil. With universal shunt full scale deflection current is 50µA.

Physical details: Black plastic case, 3¾in. x 5¾in. x 1¾in. 3in. scale window; two scales printed black on white.

Controls: 12-position range switch; slide action a.c. volts—d.c./ohm switch; ohms zero adjustment potentiometer; meter zero.

External Connections: Two sockets to suit 4mm test lead plugs.

WHEN properly assembled, with the specified components used throughout, the P.W. Sixteen will meet most of the requirements of the average radio constructor for voltage, current and resistance measurement. The special arrangements that have been made with various manufacturers ensure that not only will the finished multimeter have an excellent electrical performance but that it will also have a neat, professional external appearance.

The multimeter is built around a highly accurate and sensitive moving coil movement. The universal shunt used in conjunction with this movement brings the overall d.c. sensitivity to 20,000 ohms per volt. Two clearly printed scales are provided on the meter face. Uppermost is the ohms scale which is calibrated (right to left) from zero to 2kΩ. The second scale is used for the d.c. and a.c. ranges and is in fact a double scale.

This scale is divided linearly into 50 small divisions, with main calibration points at every tenth division. These points are marked 50, 100, 150, 200 and 250 on the upper edge, and 100, 200, 300, 400 and 500 on the lower edge of the scale. A quick glance at the setting of the range switch is all that is necessary to establish which particular calibration is to be read.

THE COMPONENTS

It is emphasised straight away that with an instrument of this nature, no liberties can be taken as far as the components are concerned. Close adherence to the details given in the components list on the blueprint is essential if the calibration accuracy and general performance of the final instrument is to be up to standard.

The following notes amplify the information in the components list and should be read with particular care before arranging to purchase the various parts. In this connection it should also be made clear that all components are obtainable through usual retail sources and that the manufacturers named here do not, as a general rule, supply direct to individuals.

The instrument case is supplied with the meter movement built in. With the meter case is supplied a specially selected swamp resistor (R17); note that meter movements and swamp resistors are not interchangeable. This point also applies to the meter rectifier (MR1), which comes complete with its own associated shunt resistor (R19). All these components are supplied as a kit by Taylor Electrical Instruments Ltd.

The slide type changeover switch (S2) has been listed as an Arco-electric type T225: however, mention should also be made of an alternative Aerial pressings type RA 2133/PVC. This particular switch has p.v.c. insulation which is impervious to moisture.

The range switch (S1) is an N.S.F. type, and can be obtained by quoting its reference "PW16".

The various multiplier and shunt resistors are generally of non-standard values and it will certainly prove convenient to obtain these as a complete kit; as manufactured and supplied by The Radio Resistor Co.

BUILDING THE METER

Having obtained all necessary parts and materials, it is good policy to examine carefully Fig. 2 and Fig. 3 on the blueprint and so familiarise oneself with the arrangement to be adopted. The task of construction is not unduly complicated but the restricted space necessitates a methodical approach. The wiring-up should not be rushed, but a high standard of workmanship aimed at as befits a piece of test equipment.

A small instrument type iron is essential. Good soldered connections are vital. A badly-made, high-resistance joint may have a serious effect upon the accuracy of the meter. Overheating of components must be guarded against.

Remove the two 4BA screws from back of instrument case and lift off the top panel. Inside will be found the meter rectifier, two resistors (R17, R19) and two sockets, with solder tags, locking nuts and plastic pillars.

Do not remove the protective cap fitted to the rear of the meter movement, as particles of dirt or dust could easily fall into the movement while assembly work is in progress.

Fit the two input sockets to the front panel; place a solder tag beneath each locking nut and then screw on the plastic pillar.

Mount the a.c./d.c. switch (S2) and secure to the front panel by means of two screws.

Remove the knob from the potentiometer (VR1) and place this component in position securing with the ring nut supplied (a pair of fine nosed pliers can be used for this purpose). Fit the knob by pressing lightly into the hole, rotate until the slot engages and then press right down to lock it.

Screw the solder tags " A " and " B " in position (Fig. 2). If a double tag is not available, use two single tags for tag " B ".

Solder R19 across uppermost pair of tags on S2, then solder the meter rectifier to these same tags. The centre lead on the rectifier is soldered to tag " A ".

Special care is required during this soldering operation, because excessive heat will (1) affect the calibration of the rectifier and (2) melt the p.v.c. switch plate and cause intermittent contact.

The range switch S1 should next be dealt with. All the wiring shown in Fig. 3 must be performed before the switch is installed. It is suggested that each switch tag be dealt with in turn, proceeding in a clockwise direction and starting with tag 1. See Fig. 3. The high stability resistors must be handled with care. If the thin protective coating suffers damage, the resistance value can be seriously affected. Grip by the wire leads only.

Ensure that all resistors have at least ¼in. of wire at each end, this is to avoid overheating when soldering—which might result in damage or change of value. Space all resistors at least ¼in. away from each other, and also from any other switch tags. Careful positioning of R1 and R6 is particularly important as these resistors carry 500V.

It may be an advantage to fit a plastic protective sleeve to the following resistors in order to prevent them coming into contact with other components of a different potential: R3, R7 and R18.

See that all flying leads are of adequate length, check by referring to Fig 2. Use 7/36 p.v.c. covered wire for the battery leads; these should be suitably colour coded, and should extend 6in. from the edge of the switch wafer.

All other wiring can be in 22 or 24s.w.g. tinned copper, p.v.c. covered.

Carefully check over the wiring of S1, then fit this switch in position, ensuring that the orientation and the rotor setting agrees with that shown in Fig. 2 and Fig 3. Secure the switch with the nut, then fit knob, aligning the pointer with the 2·5V position engraved on the front panel.

The remaining wiring should now be completed as per Fig. 2. Handle the wirewound meter swamp resistor R17 with care to avoid open-circuiting the winding. R5 and R16 should preferably be sleeved.

Thread a 2½in. length of 6mm plastic sleeving over the four battery leads and push this down as far as possible into the centre of the switch. This sleeving will prevent chaffing of the leads by the switch spindle or rotors.

Place the instrument case body close against the left hand side of the panel, and solder the four battery leads to the connection points on the back of the battery compartment. The uppermost pair of connection points are for B2 (15V), the lower pair for B1 (1·5V). The right hand connection points are positive (+).

Close the two sections of the case, carefully dressing the battery leads so that they do not foul anywhere, and secure by replacing the two 4BA screws.

To install the batteries, remove the small panel at the rear of the instrument case. Looking into the battery compartment, the positive contacts are those to the left hand side. ■

Christmas 1963

The editor, staff and contributors join in wishing all readers a Happy Xmas and a successful New Year

a wide range l.f. OSCILLATOR

by P. CAIRNS

A good-quality instrument for the amateur experimente[r]

THIS article describes a simple and cheaply made sine wave oscillator covering audio and ultrasonic frequencies. This unit, when correctly built and calibrated, can be extremely useful, having many practical and experimental applications, and should prove of use to both the amateur and professional engineer. The frequency stability is extremely good, being better than ±2% for changes in h.t. of ±20%, and changes in heater voltage of ±5%. The wave shape is also of good sine waveform, though very slight distortion was noticeable at the extreme h.f. end of the tuning ranges.

Circuit Description

The complete oscillator circuit is shown in Fig. 1. This covers the frequency range 35c/s to 70kc/s in six overlapping ranges. The oscillator is the double triode V1 with the necessary resistance-capacitance phase shift network required to maintain oscillation. The output stage, V2, gives both high and low impedance outputs.

The frequency of oscillation is determined by the resistance-capacitance network R1-R6, R7-R12, and VC1. Feedback is fed from V1b anode to V1a via C6, the amount of feedback being controlled by VR1. This pre-set control also has a marked effect on waveform. The frequency range with the variable capacitor shown and a given set of resistors is less than 4 : 1. Thus six resistor ranges were necessary to cover the required band of frequencies, S1 being the range selector switch.

The oscillator output is taken from the cathode of V1b via C8 and VR2 to the triode amplifier V2. This has two outputs which are selected by S2, position 1 being the high impedance output, V2 working as an amplifier. Position 2 gives the low impedance output with V2 working as a cathode follower. In either position the output not in use is bypassed to earth via C10 or C11, these being the output coupling capacitors in the alternative position. Position 3 is "off", with the output point earthed. The amplitude of the output waveform is controlled in both cases by VR2. With VR2 at maximum, the output voltage in the high impedance position is approximately 25 peak, and in the low impedance position, approximately 2·5 peak.

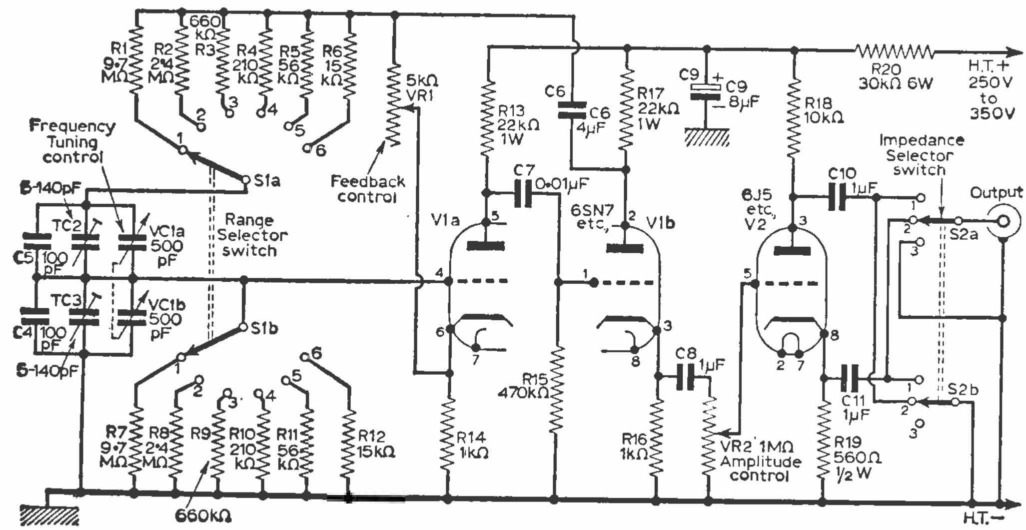


Fig. 1: The circuit of the oscillator.

Construction

The layout of the majority of the circuit components is not critical, and a suggested scheme is shown in Fig. 2. Care should be taken with the resistors R1 to R12 on S1, these being mounted directly on to S1, the resistor end wires being cut as short as is practicable. S1 should also

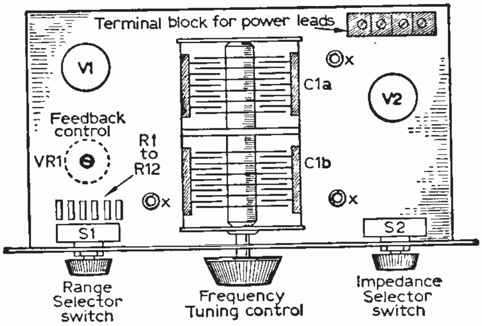


Fig. 2. An above-chassis view of the instrument.

be a good quality switch, ceramic if possible. This is to avoid leakage on the l.f. ranges as the 10M resistors (range 1) may approach the insulation value of a poor quality switch.

Good insulation is also preferable on the twin gang capacitor VC1 for similar reasons, this being mounted away from, and insulated from, the chassis. The V1a section of the circuit should be kept to its own part of the chassis and wired with reasonably heavy gauge wire.

To reduce any possibility of mains hum, the heaters can be wired with screened wire. Screened wire may also be used on the VR2 output lead. An important point regarding the resistors R1 to R12 should be made. As these resistors are of non-standard values, the correct values may be obtained by measuring the nearest preferred value for a high or low component as suggested in the components list. These resistors should be within 5% and preferably 2% of the stated values and of each other. This latter point is most important as any great discrepancy between resistor pairs on the same range can result in poor tracking, variations in amplitude, and possibly dead spots in the tuning range.

Values

Should difficulty be met with in obtaining the correct value, two resistors may be used in series; e.g., R2, R8, are 2·42M each, and these could be made up from a 2·2M and a 220k in series. The resistor pairs, R1-R7, R2-R8, etc., should be matched on an ohmmeter if possible before connecting them into circuit.

No power unit has been incorporated as the oscillator will work from any 250-350V power pack without affecting the frequency calibration, the h.t. current drain being only 6mA.

For those wishing to keep the size of the unit to a minimum, miniature all-glass type valves may be used without any change in circuit values.

COMPONENTS LIST

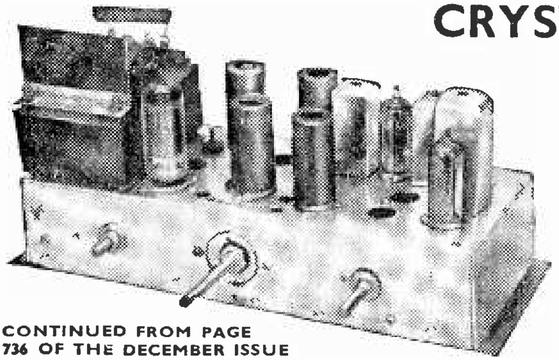
Resistors		
R1, R7	9·7M ½W (low 10M)	see text
R2, R8	2·4 ½W (high 22M)	see text
R3, R9	660k ½W (low 680k)	see text
R4, R10	210k ½W (low 220k)	see text
R5. R11	56k ½W	see text
R6 R12	15k ½W	see text
R13, R17	22k 1W	
R14, R16	1k ½W	
R15	470k ½W	
R18	10k 1W	
R19	560Ω ½W	
R20	30k 6W (two 15k in series)	
VR1	5k w.w.	
VR2	1M	
Switches:		
S1	2-pole, 6-way	
S2	2-pole, 3-way	
Valves		
V1	6SN7 or ECC82, 12AU7	
V2	6J5, B65 or EC90, L77	
Capacitors:		
VC1	Twin gang capacitor, 500pF per section	
TC2, TC3	5 to 140pF trimmers	
C4, C5	100pF (silver mica)	
C6	4μF 350V (electrolytic)	
C7	0·01μF 350V	
C8, C11	1μF 25V	
C9	8μF 350V (electrolytic)	
C10	1μF 350V	

Alignment and Use

Switch on and allow the unit to warm up, set both trimming condensers TC2, TC3 to maximum, S1 to position 3, S2 to position 1, and VR2 to minimum. A pair of headphones are connected to the output. An audio note should then be heard when VR2 is increased; if not, adjust the feedback control VR1 until the circuit just goes into oscillation. If the circuit is already oscillating, adjust VR1 in the opposite direction until oscillation is just occurring, as at this point the best waveform is obtained. Too much feedback gives a distorted waveform. With the circuit just oscillating, swing VC1 through its entire tuning range. Should oscillation stop at this point, adjust the trimmers TC2, TC3, for better capacitance balance. With correct adjustment of TC2, TC3, the oscillator should work correctly over the entire range of VC1.

The other frequency ranges are then checked in a similar manner. Should any range not oscillate over the complete sweep of VC1, the resistor pairs on that particular range are not closely enough matched. This should not occur, however, if the tolerances quoted are used. Should difficulty be met with in maintaining oscillation over all ranges, the feedback may be increased by a very slight adjustment of VR1. It should be stressed, however, that the purest sine wave is obtained with VR1 at the lowest setting which maintains oscillation over the entire frequency range.

—continued on page 870



CRYSTAL CONTROLLED V.H.F. - F.M. TUNER

CONTINUED FROM PAGE 736 OF THE DECEMBER ISSUE

By E. M. BERNEY

IN last month's article the author referred to the coils and crystals used in this tuner. There are several other components which warrant special attention.

OTHER COMPONENTS

Resistors generally should be of 10% tolerance, and R16 and R17 should be matched as accurately as possible. If the ratio detector is used, R22 and R23 should be similarly matched, and R20 and R21 should be 5% or better. Wattage ratings are given in the list of components.

The i.f. transformer should ideally have an acceptance band width of 250-300k/cs. This is usually achieved by over-coupling, and if critically coupled transformers are used it may be necessary to fit damping resistors across their primaries. The manufacturer's instructions should be followed here.

The choke, L4, is made by close winding 50 or 60 turns of 30 gauge enamelled copper wire onto a 100kΩ resistor of about 5/32in. diameter. The value of the resistor is not critical.

WIRING

It is essential to observe v.h.f. technique here, reducing all connections to minimum length. Do not make any attempt at orderly layout; the short direct connection is the primary requirement and must take precedence.

If the specified types of components are used, it will be found possible to reduce connections to decoupling components to less than ⅛in. in length and this should be the aim.

A small iron of the instrument type is essential. Tinned copper wire of 20s.w.g. covered with sleeving can be used for the heaters, but 22 gauge is a more suitable size for the remainder of the wiring.

Decoupling resistors are conveniently fitted in a vertical position so that the h.t. line can be taken around to each stage in turn in the final stages of construction, well away from other components. it will not then be liable to carry r.f. currents from one stage to another.

The main smoothing resistor, R24, must be mounted in a position where its heat is easily dissipated. The top of the mains transformer is a good place but the choice is one of convenience provided it is above the chassis.

Complete wiring diagrams, showing all the connections, are given in Figs. 7 and 8. It should be noted that as the wiring has been opened out for clarity the positions of the components are only approximate, and many of the connections appear much longer than is permissible in construction.

The circuit diagram (Fig. 1) shows the grid of V2 connected to the cathode, this is, of course, incorrect and pins 1 and 6 should be taken directly to chassis, as indicated in Fig. 7.

It should also be mentioned here that V2 is an EC91—not an EF91 as stated in the components lists.

TESTING

When the wiring has been completed and checked against the circuit diagram, test with a meter between C30 and chassis to see that there are no shorts in the h.t. circuits. Power can then be applied and a further check made with the meter that the proper voltages are present at the valve electrodes. The h.t. line voltage should be between 220 and 250, and if it is not the value of R24 must be altered as necessary.

ALIGNMENT OF I.F. AMPLIFIER

If a signal generator is available, it is advisable first to align the i.f. amplifier to 10·2Mc/s. as follows.

Remove V2 and connect a high resistance d.c. voltmeter positive to chassis and negative to test point A. Inject an unmodulated 10·7Mc/s. signal at the grid of V5 and adjust both cores of IFT2 for maximum reading on the meter, reducing the output from the generator as the circuits come into line.

Transfer the generator to the grid of V4 and adjust IFT1 in the same way.

To align the discriminator, connect the voltmeter between test point B and chassis and detune the transformer secondary by withdrawing the bottom core so that it projects about 1/16in. from the can. Inject an amplitude modulated signal at the grid of V5 and adjust the primary core for maximium response; then adjust the bottom core for extinction of the response. Finally, set the secondary core to produce a very small negative reading and peak this reading by adjusting the primary core. Return the secondary core to zero.

RATIO DETECTOR

If the ratio detector has been used, connect the meter to test points D and E, observing polarity, and inject an unmodulated signal at the grid of V5. Adjust the top core of the transformer for maximum response. Connect the meter next between chassis and test point C and adjust the bottom core for zero output. This will affect the

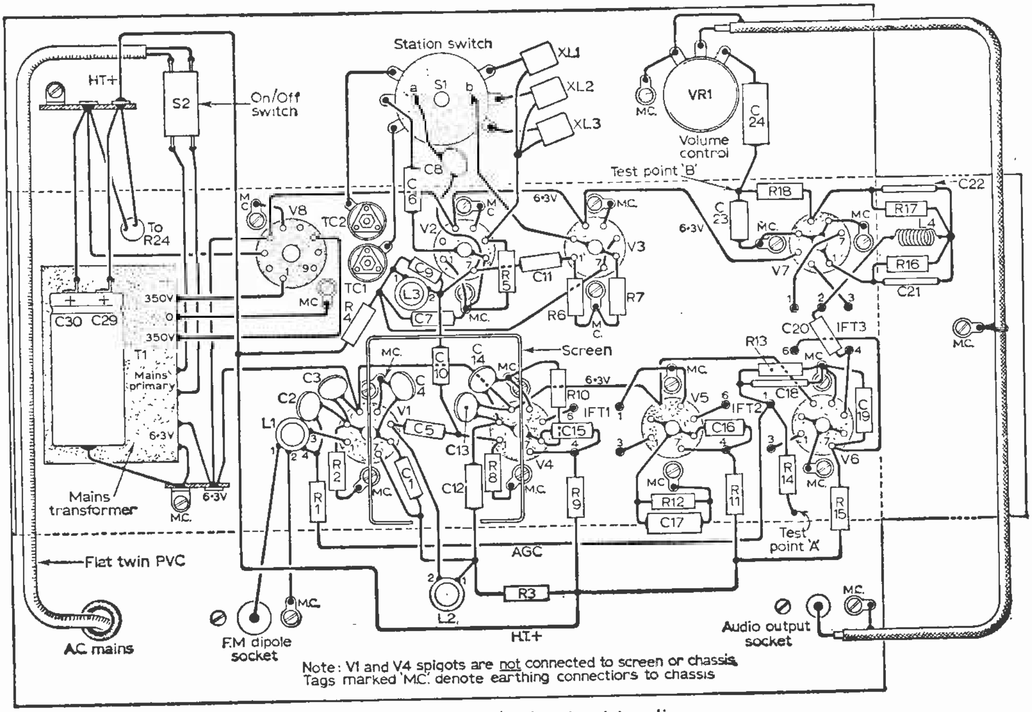


Fig. 7: The main underchassis wiring diagram.

top core which should be re-adjusted for maximum as already described.

The foregoing adjustments need not be made with the greatest accuracy since the final alignment must be done on a BBC transmission. With both types of detector transformer, it will be found that as the bottom core is traversed through the former, the meter reading will rise to a maximum, fall through zero to a reverse maximum, and then return to zero, after which further movement has no effect. The correct position for the core is at the zero between the two maxima.

OSCILLATOR CIRCUIT

To align the oscillator, replace V2 and connect an audio amplifier. Set the tuning switch to the highest frequency to be received. Commencing with the core of L3 almost fully withdrawn, enter it slowly into the former until the programme is heard. It will be found that as the inductance of L3 is increased, the programme strength will rise slowly and then fall suddenly to zero as the crystal relinquishes control. The proper position for the core is just before the point at which control is lost.

If the programme cannot be found, reduce the inductance of L2 and try again. If there is still difficutly it should be checked that the oscillator circuit is in order and covers the required range. Remove the highest frequency crystal and fit in its place a mica or ceramic capacitor of about 47pF. With the switch in the appropriate position it will then be possible, if the circuit is in order, to tune all three transmissions by manipulating the core of L3.

The i.f. amplifier and the detector transformer must now be aligned accurately to the crystal controlled signal in the manner described for alignment with a signal generator.

The tuning switch can next be set to each of the other two positions in turn and the programmes tuned in with the trimmers TC1 and TC2. Commence at minimum capacity and set the trimmers to a position just before that at which control is lost.

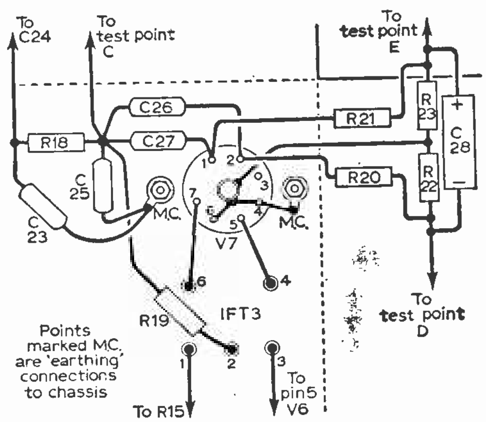


Fig. 8: The ratio detector wiring diagram.

H.F. PROBE

A more accurate method of adjustment, and one that may be found essential in poor reception areas, is to use a high frequency probe connected to a high resistance voltmeter, or a low range milliameter to detect resonance of the crystals.

A suitable circuit for such a probe is given in Fig. 9, while Fig. 10 shows how it may be constructed on a strip of paxolin or other similar material. It may be applied to the grid of the mixer valve or to the cathode of V2. As the inductance or capacitance of the oscillator circuit is increased, the meter reading will rise slowly, falling abruptly to zero as control is lost. The diode used in the probe is not critical; a GEX34 or similar will serve.

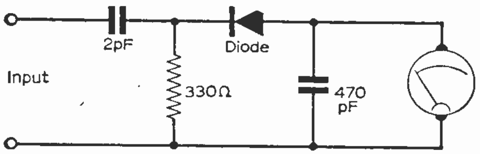


Fig. 9: A suitable circuit for an h.f. probe.

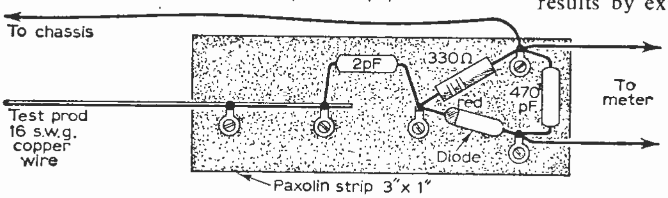


Fig. 10: A suggested form of construction of the probe.

OPERATION

The aerial required will depend on local reception conditions.

A loft-mounted or outside dipole with reflector and low loss 75Ω coaxial down lead is recommended for fringe conditions; while in areas of good field strength satisfactory results may be had from an internal cabinet aerial. This may be made from a length of flat twin p.v.c. covered flex by parting the conductors at one end over a length of 30in. and extending them along the top of the cabinet to form a rudimentary dipole. The arms can be turned downwards 90 deg. if their whole length cannot be accommodated horizontally.

If something smaller is required, the arms of the dipole can be shortened and the deficiency made up with loading coils as shown in Fig. 11. No large scale experiments have been done on this by the author but promising results were obtained with metal foil glued to the inside of the cabinet, each arm being 1½in. wide and 15in. long. The loading coils can be self supporting, consisting of 18 gauge tinned copper wire, four or five turns each and about half an inch in diameter. The inductance can be adjusted for optimum results by extending or compressing the coils.

In all cases, the aerial should be mounted perpendicular to the direction of transmission, and it is worth remembering that with a normal dipole the strength of the received signal varies almost directly with the height of the dipole above the ground. If the Foster-Seeley discriminator has been used, do not forget that a fairly large signal is required at V5 grid for efficient limiting.

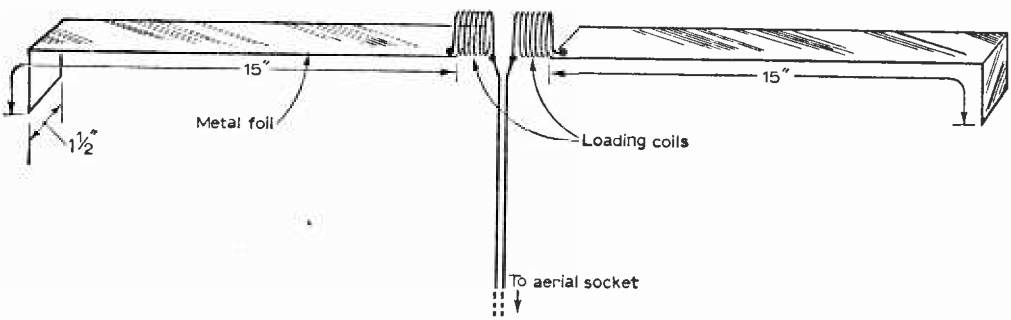


Fig. 11: Internal aerial for high field strength areas.

R.F. CIRCUITS

Connect the meter negative to test point A and positive to chassis. Adjust L1 for maximum on the lowest frequency transmission and the L2 similarly on the highest.

ALIGNMENT WITHOUT A GENERATOR

If the signal generator is not available, it is best to use pre-tuned i.f. and detector transformers. If this is not done, then one of the crystals must first be brought to resonance by the probe method when, provided a reasonable signal is available, it should be possible to align the i.f. and r.f. circuits as described.

VENTILATION

The cabinet in which the tuner is housed should permit free ventilation above and below the chassis. ■

A. GLOVER discusses

Variable Capacitance Diodes

Theory and applications of this new semiconductor device

VARIABLE capacitance diodes have a wide variety of uses both industrially and commercially, one of the more popular uses being that of remotely controlling the tuning of radio receivers. These devices are now becoming more readily available to the home constructor and experimenter, and this article provides a brief summary of their operation and shows the practical aspects of their use.

P-N JUNCTIONS

The normal junction diode consists of two pieces of germanium (or silicon) sandwiched together, one of which is 'n' type, the other 'p' type, Fig. 1(a) shows this diagrammatically. It will be noticed that the electrons in one side and the "holes", or absence of electrons, in the other side collect near the junction. This region, known as the "depletion layer", has a relatively high resistance compared with the rest of the diode, and in fact forms the dielectric of our capacitor; the two outer pieces forming the plates.

Fig. 1(b) shows the same diode with a reverse voltage applied across it. The "depletion layer" (the dielectric of our capacitor) has now increased in width, so the capacitance has been reduced.

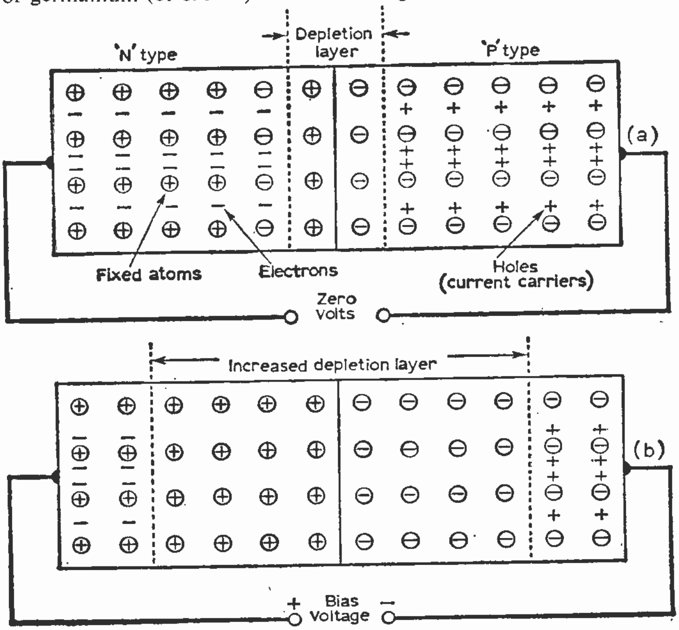


Fig. 1a: A p-n junction, without bias.

Fig. 1b: A p-n junction, with reverse bias.

The fact that capacitance decreases with an increase in voltage should be born in mind when using these devices, and a typical curve showing capacitance/voltage relationships is given in Fig. 2. The lower part of this curve is definitely not straight and is due to what is termed the "built in voltage". This can be overcome, if required, by biasing the diode on to a straighter part of its characteristic.

CHANGE OF CAPACITANCE

This change of capacitance with applied voltage is common to all types of germanium silicon diodes, and this, of course, includes point contact diodes and transistors. Before attempting to use these devices, it is wise to check the capacitance to ensure they have the capacitance range for the particular application. The test circuit shown in Fig. 3 is useful here. Two similar devices should be used to ensure that the bridge voltage does not produce

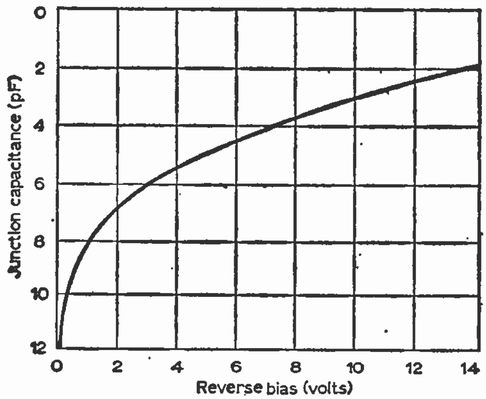


Fig. 2: A typical curve for a low capacitance variable capacitance diode.

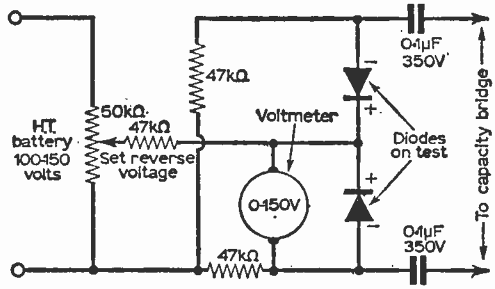
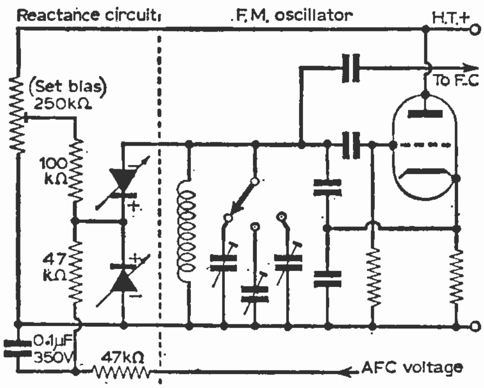


Fig. 3 (above): Suggested test circuit for checking the capacitance of diodes.

an error, the bridge voltage should be kept as low as possible, and the peak inverse voltage of the diodes, obtainable from manufacturers data, should never be exceeded. The capacity reading on the bridge should be doubled for a single diode, as here we have two capacities in series.

In practice it will usually be found that the larger the junction the greater the capacitance, point contact diodes normally do not exceed about 10pF, on the other hand there are variable capacitance diodes which change from approximately 50pF to 250pF for a 25V change in applied voltage.

Fig. 5 (below): Replacing a reactance valve by a v.c.d.



REMOTE CONTROL OF RECEIVERS

The circuit shown in Fig. 4 is for the remote operation of a radio receiver, with both the oscillator and r.f. stages remotely tuned. In the case of f.m. receivers it is usually unnecessary to tune the r.f. circuit, so one pair of diodes may be replaced by a trimming capacitor.

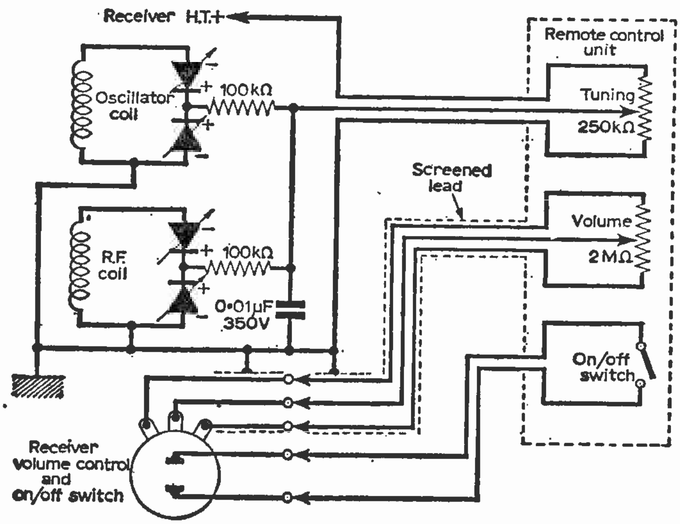


Fig. 4: Circuit for remote control of a radio set, using a variable capacitance diode.

The volume control may be used remotely as shown together with the receiver on/off switch. All these interconnecting leads, and the control unit itself, should be adequately insulated, particularly so in the case of a.c./d.c. equipment.

In Fig. 5 we have a circuit which shows how the reactance valve in a switched tuned receiver may be replaced by capacitance diodes. The preset resistor which is used to bias the diode to the centre portion of its characteristic could at a later stage be replaced by two fixed resistors.

A similar circuit may be used for frequency modulating an oscillator, in this case, however, we replace the a.f.c. voltage input by a modulating signal; this method is shown in Fig 6. The audio oscillator is in most instances already built into the signal generator. The maximum frequency deviation will depend

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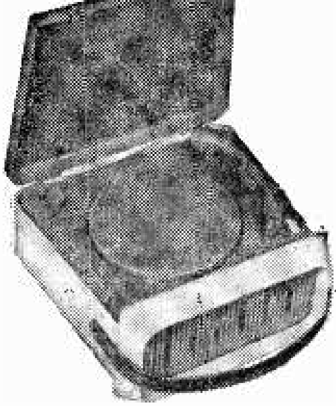

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5 × 3	9000	25	11/-
5 × 3	9000	35	11/-
6 × 4	6000	3	8/6
6 × 4	7000	3	9/-
6 × 4	8500	3	9/6
6 × 4	9500	3	10/-
7 × 3½	9500	3	10/6
7 × 4	7000	3	10/-
7 × 4	8500	3	10/6
7 × 4	9500	3	11/-
7 × 4	9500	30	11/6
8 × 2½	6000	3	8/6
8 × 2½	7000	5	9/-
8 × 2½	6000	30	9/6
8 × 2½	8500	5	9/6
8 × 2½	9500	3	10/-
8 × 2½	9500	4	10/-
8 × 2½	9500	5	10/-
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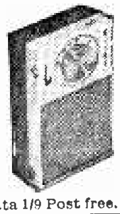

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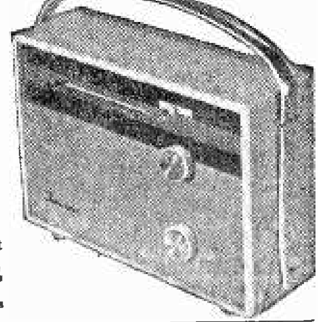

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on the type of diode used and the modulation voltage available. The resistor R1 is used to limit the peak inverse voltage, and the preset resistor to bias the diode to the centre of the operating characteristic.

PARAMETRIC AMPLIFIER

Another device which uses the variable capacitance effect of diodes is the "parametric amplifier". This is a very low noise type of amplifier and is now used fairly extensively for increasing the range of sensitive radio receivers, such as those used in radio telescopes.

Fig. 7 shows a simplified circuit and the device functions as follows. If we charge up a capacitor then pull the plates apart, the voltage across the capacitor will increase as shown by the familiar expression $Q=C\times V$, i.e. "Q" is the quantity of electricity stored by the capacitor. So when we halve C (the capacity) the voltage across the capacitor must double. What we do in this circuit is to arrange that the capacity is reduced when the input signal reaches its positive or negative peak, and we do this by increasing the voltage across the diode at the right moment. This driving voltage is supplied by an oscillator running at twice the signal frequency in order that the peaks of the signal are "pumped" every half cycle.

There are many other applications for these diodes, such as voltage controlled oscillators, and filters, pocket-sized transistors, f.m. transmitters and d.c. to a.c. converters, in fact more and more uses are being continually found for them. In the future we can expect to see more sensitive devices with a greater capacitance range, and it is also to be hoped that the home constructor and experimenter will have a wider range from which to choose. ■

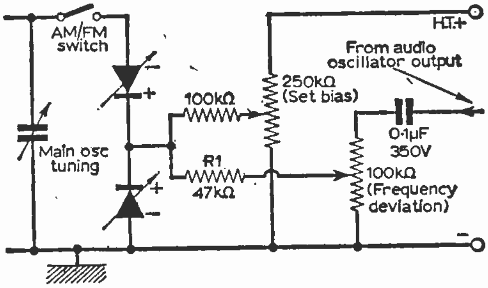

Fig. 6: Circuit for frequency modulating an oscillator.

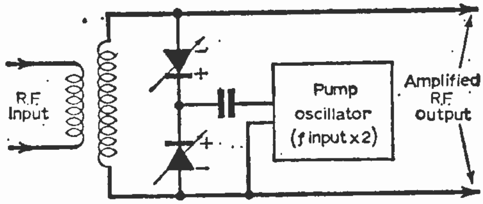

Fig. 7: Simplified circuit of a parametric amplifier.

THE "PRACTICAL WIRELESS" FILM SHOW

The "Practical Wireless" Film Show which is held annually and to which readers of P.W. are invited, is to be held, as before, at Caxton Hall, Westminster. The date of the Show, which is arranged in collaboration with Mullard Limited, is the 31st January, 1964.

The programme will appeal to all readers of "Practical Wireless" and of especial interest will be the illustrated talk on colour, 625-line and u.h.f. television, which will form the first part of the programme. After a break for refreshments, the programme will continue with a film entitled "Ultrasonics".

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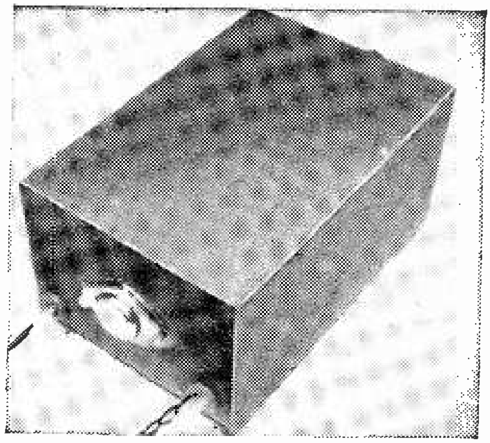

THIS little amplifier is suitable for use with domestic tape recording equipment or with hi-fi record playing equipment. It is preferable to conventional class B transistor amplifiers as it is so simple to make and gives a higher quality of sound reproduction.

Another feature of this amplifier is the extremely wide audio-frequency response, limited only by the characteristics of the output transformer. By using transistors having good high-frequency characteristics the response of the amplifier itself is virtually linear right up to the lower part of the radio-frequency spectrum. This results not only in absence of frequency distortion but also in extremely good transient response. The lack of coupling capacitors eliminates phase distortion. The automatic mismatching between stages resulting from the direct coupling gives a high degree of linearity of transistor characteristic.

Technical Description

This unusual circuit employs three directly-coupled transistors in the grounded emitter configuration. To achieve satisfactory d.c. levels the first and third transistors are of the usual pnp type, while the middle one is an npn transistor.

Suitable working currents for the first and second transistors in the amplifier are determined by the judicious choice of collector resistors. The overall working currents in the amplifiers are set by adjustments of the base-bias resistor VR2 of the first stage, which is then stabilised from the average collector voltage of the output (or third) transistor.

Overall negative feedback compensates for the characteristics of the output transformer T1.

A thermistor in the base circuit of the first transistor overcompensates for temperature variations and, although this effect is partially offset by the d.c. feedback loop, the overall effect is to prevent use of the amplifier at unsuitable temperatures.

The Circuit Stage by Stage

The first stage is a high-gain, directly-coupled, grounded emitter a.f. amplifier. The base circuit of this stage is provided with separate a.c. and d.c. negative feedback circuits. The a.c. feedback consists of a fraction of the amplifier output signal developed across R2, via R3, from the loudspeaker speech coil. This voltage is then fed, via the volume control VR1 and C1, to the base of the first transistor Tr1. It will be seen that the feedback voltage appears effectively in series with the input signal, thereby increasing the impedance of the input circuit and reducing the effect of the curvature of the voltage/current characteristic of the first transistor. This, in turn, permits use of a lower value of R1 when the amplifier is used with "voltage" sources such as crystal pick-ups, allowing some reclamation of the loss of gain inherent with negative feedback.

The d.c. feedback circuit R6, C2, VR2 is a supplementary stabilising circuit to the overall temperature control of the thermistor R4. Having a relatively short time constant, about 2sec., it exerts prompt partial control of standing-current variations. The d.c. feedback voltage is developed due to the voltage drop produced by the output stage collector current through the resistance of the primary winding of the output transformer and the a.c. component is removed by the filter circuit R6, C2. The resultant voltage is used to provide the base bias of the first transistor. Increased output stage collector current, causing increased voltage drop across the transformer primary therefore reduces the bias to the first stage, resulting in amplified bias reduction to the output stage and overall stabilisation. Long-term overall amplifier dissipation is controlled by the thermistor R4, which takes into account not only local heating due to amplifier dissipation but also the effect of ambient temperature.

The second stage, directly coupled to the first, employs an npn transistor. Its bias is provided by the voltage drop in R7, due to the collector current of the first transistor, and its input impedance forms the collector load of the first stage. Signal currents in this stage are in phase with those of the first stage. This stage operates also in the grounded emitter configuration to obtain maximum gain.

The output stage employs a small power transistor Tr3 with extended high-frequency charac-

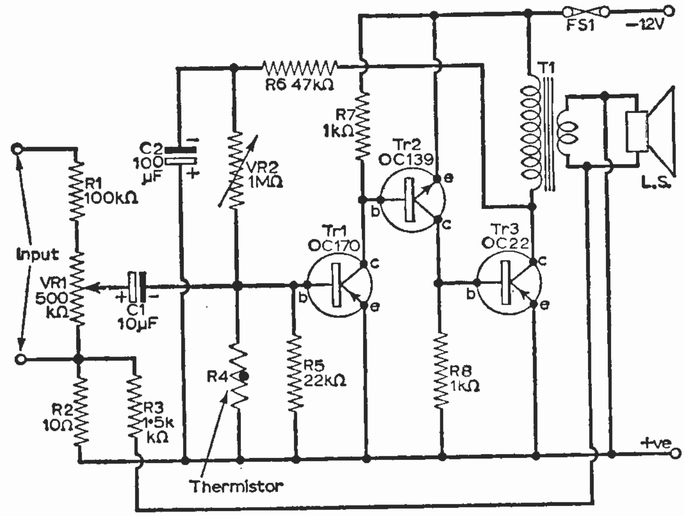

Fig. 1: The circuit of the amplifier.

teristics. By employing this transistor in class "A", directly coupled to the previous stage, a "hi-fi" output is obtained. The quality of reproduction is now limited only by the characteristics of the output transformer T1 and the loudspeaker. The characteristics of the output transformer are improved even further by the use of the negative feedback loop around the amplifier.

With a 12V supply and the amplifier set up so that the output stage is drawing 350mA, well over a watt of high-quality audio is obtained, more than adequate for domestic use in a normal size room.

Construction

The amplifier is best constructed in a small steel instrument case of the type specified, as one wall of the box can then be used to support the output transistor and at the same time act as a heat sink. The remainder of the circuit may then be assembled on a paxolin board mounted inside the case. Either tagboard or printed circuit construction may be employed as desired.

A simple printed circuit may be constructed by drawing the circuit on a piece of copper laminated board, obtainable from advertisers. The outline of the circuit is then carefully but firmly scored through with the point of a sharp penknife and then with the edge of the blade the unwanted portions of copper are carefully prised off. The printed circuit shown in the illustration was constructed in this way.

If tagboard construction is preferred, a sheet of paxolin should be drilled in the positions indicated on the printed circuit diagram and 6B.A. nuts and bolts, with soldering tags, inserted in these positions. The tags should then be wired as in the printed circuit diagram, after which the components may be inserted in position.

The customary protection should be provided for transistors during soldering to prevent damage by heat. In particular the emitter and base wires of the power transistor should be firmly gripped

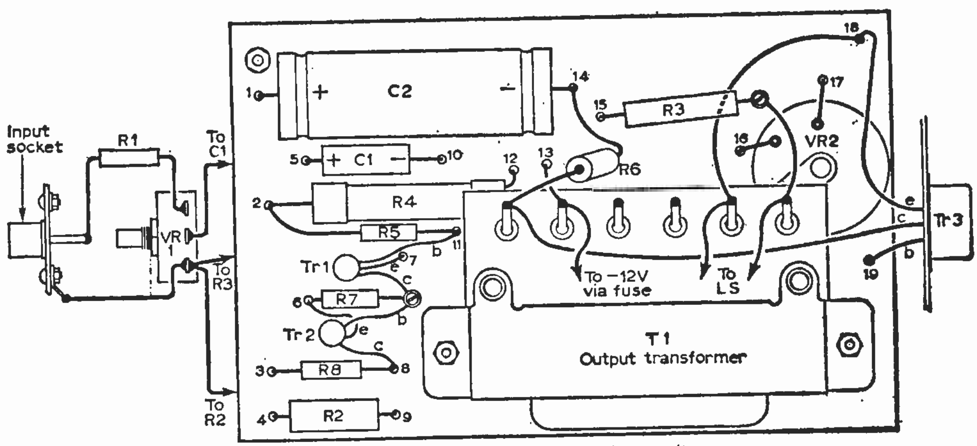

Fig. 2: The main wiring and component layout diagram.

by long-nosed pliers while flying leads are quickly soldered to their ends.

Setting-up

When construction is complete and all wiring checked the amplifier is ready for setting-up for use. For this purpose a 0-500mA meter will be required, together with a 12V low-consumption lamp.

Before connecting to the power supply ensure that the variable resistor VR2 is set to maximum resistance. If this is not done, damage to the transistors may result when the power supply is connected.

Check the polarity of the power supply and connect the amplifier to the power supply via a

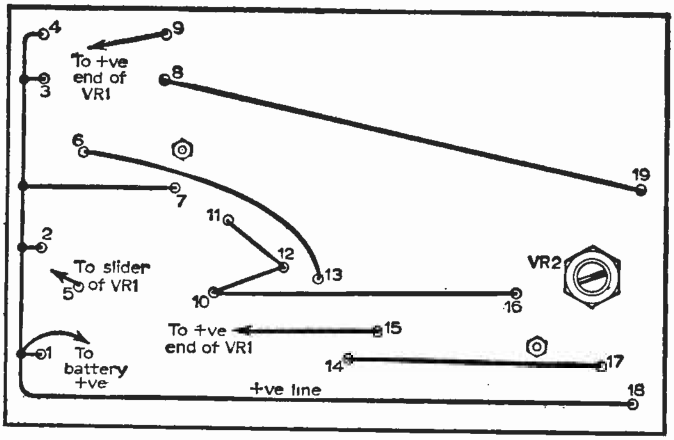

Fig. 3: The wiring on the reverse of the mounting panel.

COMPONENTS LIST

Resistors:

R1	100kΩ (or to suit pick-up)	R5	22kΩ
R2	10Ω	R6	47kΩ
R3	1·5kΩ	R7	1kΩ
R4	Thermistor CZ1 (Brimar)	R8	1kΩ

All ¼W carbon, except where otherwise stated
VR1 500kΩ carbon potentiometer, log
VR2 1MΩ carbon preset potentiometer, linear

Capacitors:
C1 10μF electrolytic 6V
C2 100μF electrolytic 12V

Miscellaneous:
Tr1 OC170, XA123, GET692, MAT121
Tr2 OC139, OC140, 2N647, 2N649
Tr3 OC22
T1 Output transformer (Repanco TT12)
LS Loudspeaker 3Ω
FS1 Fuse 500mA
Steel instrument case 6in. x 4in. x 3in. (Tele-Radio Ltd.)

12V low-consumption bicycle headlamp bulb and the milliammeter. The bulb will protect the meter and the amplifier should a mistake have been made in wiring the amplifier. When connected and switched on, at this stage, the bulb should not light. If it does light there has been either a mistake in construction or the variable resistor VR2 has not been turned to maximum resistance. If the lamp does not light, short-circuit it or remove it completely from the circuit, reconnecting the supply, and commence *gradually* to decrease the resistance of VR2. Up to this point the amplifier has not been drawing any appreciable current from the supply and the milliammeter will have been reading "O". As VR2 is gradually decreased in value, however, a point will be reached where the amplifier suddenly begins to draw current. The transition will be quite abrupt and must be watched for. Carefully adjust VR2 until the milliammeter reads 350mA, allowing time after each adjustment for the d.c. stabilising circuit to settle down and take effect.

A signal may now be applied to the amplifier and a trial run made, checking the current drawn from time to time and adjusting VR2 if necessary. It will be necessary to adjust VR2 further only if a change of supply voltage occurs or the amplifier is operated at a greatly different ambient temperature. As the amplifier is intended for domestic use, however, this is not likely to arise. Should it be desired to operate the amplifier over a wide ambient temperature range a permanent 0-500mA meter should be fitted. Should the amplifier be unstable when switched on it will be found to be due to the feedback connections to the loudspeaker speech coil being the wrong way round. Reversal of these connections should clear the fault.

Note that if the output transistor is bolted directly to the steel case the metal of the case will be "live" to the power supply negative. If this should not be desired the power transistor should be insulated from the steel case by use of the mica and plastic washers provided. A small dab of silicone grease between washers, case and transistor will improve thermal conductivity. ■

A Variable POWER SUPPLY for Transistors

This unit provides a d.c. output adjustable from 0 to 26·7V in steps of 0·15V. Its maximum continuous current rating is 1·2A.

By R. Leyland

WHEN powered from self-contained batteries, transistorised apparatus is fully portable but, on the other hand, a supply derived from the mains has very low running costs despite the higher initial expenditure on the power unit.

Dry batteries cannot supply large currents for long periods and are therefore inadequate when power output stages are to be worked, especially the class A type required for quality reproduction. For these it is necessary to employ either a car battery or a directly derived mains supply. The mains voltage is usually dependable and does not fall with the passage of time as in the case of batteries.

The power unit to be described (the circuit is shown in Fig. 1) provides up to 24V, which is probably as high a voltage as could be required with transistors—at least with types so far available. It has a maximum continuous current rating of 1·2A (at 14V). The rectifiers can deliver up to 1·5A but cannot do so for more than half an hour without reaching ambient temperatures too high for such a current rating, whereas at 1·2A the power unit can work continuously, reaching a maximum temperature of about 50 deg. C in three hours.

Silicon Rectifiers

The silicon rectifiers, Ediswan type XU612, have ratings similar to S.T.C. type RS210AF and to G.E.C. type SX631. However, type SX631 have provision for 6B.A. stud mounting, while the XU612 and the RS210AF are wire-ended only and cannot be fitted to heat sinks.

In a compact power unit the proximity of the transformer and choke raises the ambient temperature and this limits the current that can be drawn continuously without exceeding the rating of the rectifiers. Although silicon rectifiers can be used at 100 deg. C their current rating is reduced considerably as compared with that at lower temperatures and, of course, the temperature has to be kept much lower if an electrolytic capacitor is to be included.

The time lag of three hours in warming up to the maximum temperature is accounted for by the large thermal capacity of the transformer and choke.

The Transformer

A less elaborate transformer than the one here proposed would usually suffice but a series of secondary tappings offers a more convenient and efficient method of controlling the output voltage than dropper resistors and raises the temperature less.

The provision of both coarse and fine tappings enables close adjustment of the output voltage to be made. The tappings are brought out to connector strips which extend along both sides of the power unit: 12-way for the principal tappings and 15-way for the fine tappings. This allows the r.m.s. input to the rectifiers to be adjusted from zero up to 26·7V in steps of 0·15V.

The use of switches for selecting the tappings was not considered advisable. These would require to be of a break-before-make type to avoid short-circuiting sections of the winding but, even so, sparking would probably cause rapid deterioration of the contacts. As the output voltages are low there is no objection to the use of connector strips along the sides of the box with flying leads for voltage selection. The connector strips are adequately insulated for much higher voltages than those encountered here.

Laminations with a window large enough to ensure ample winding space are required because a large number of tappings causes the windings to take up more room than straightforward calculation would suggest (see Fig. 2). The size of stack is chosen to give a cross-section large enough to keep the turns per volt to a reasonable number.

Primary Turns

The primary was wound with 1,560 turns of 35s.w.g. double silk covered wire for a nominal

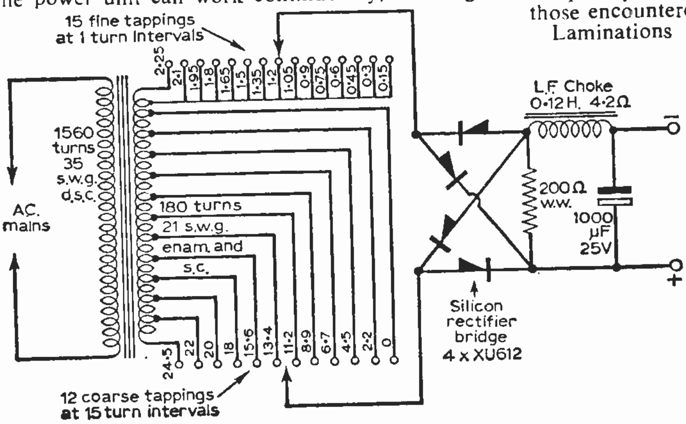

Fig. 1: The circuit of the unit.

mains voltage of 240.

At first the actual mains voltage appeared less, but this was because allowance had not been made for the current (about 0·3A) taken by a large a.c. voltmeter used in measuring the secondary voltages. The unloaded a.c. voltages of the secondary tappings are therefore about 3% higher than the values that have been marked on them. This is not a large difference but it brings a close agreement between the voltage ratios and turns ratios.

As the maximum open-circuit output voltage (measured by a d.c. voltmeter) has been adjusted in this circuit by means of a resistance to be approximately the maximum working voltage of the electrolytic capacitor, to obtain the same results on a different mains voltage would simply require proportionate change in the number of primary turns. The number of turns per volt is 6·5. Thus to obtain the same results on 250V would require 1,625 turns.

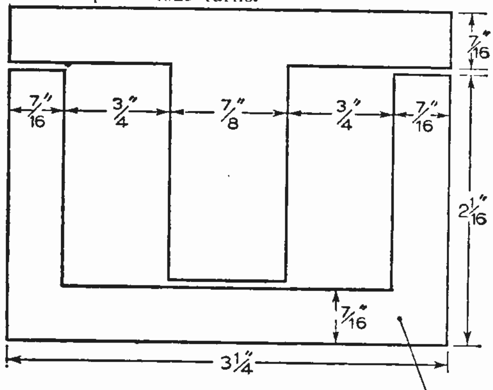

Fig. 2: Details of the laminations of the mains transformer.

It is necessary to check that the highest direct voltage obtained across the electrolytic capacitor does not exceed 25V with the 200Ω resistor in circuit. Should higher voltages be obtained, the secondary tappings giving these voltages would have to be disconnected, insulated and left unused.

Winding the Transformer

The transformer bobbin, made of $\frac{1}{16}$in. insulating material and provided with rows of holes in the cheeks to bring out the 2·2V tappings, was wound by fitting into it a wooden block drilled in the centre for a $\frac{1}{4}$in. shaft. This was retained between collars on the shaft. A screw inserted in the block and tied to a screw on one of the collars prevented the bobbin from slipping on the shaft.

The $\frac{1}{4}$in. shaft was fitted into bearings mounted on two supports on a base-board. A handle was fixed on one end and a short flexible drive at the other connected to a turns counter through a universal joint to give the maximum freedom from alignment difficulties.

With this arrangement the transformer bobbin could be wound quite rapidly. Flexible plastic-covered wire leads were used to the mains primary winding with the soldered joins well insulated by a double thickness of Empire cloth. Plastic insulating tape should not be used for such applications as it is easily pierced by any irregularity in the solder.

Three thicknesses of Empire cloth separated the primary and the secondary. The secondary consisted of 180 turns of 21s.w.g. enamelled and single cotton covered wire, wax-dipped before winding to prevent fraying of the cotton. Double cotton covered wire takes up less than 10% more space and could possibly have been used instead. Double silk covered wire of the same gauge could certainly have been used as it takes up less room than E. and S.C. It, too, would preferably be waxed before winding to ensure undamaged insulation at bends in the wire. Enamelled wire without additional protection would require interleaving and special care in insulating the tappings. The 180-turn secondary has a resistance of 1·4Ω.

Secondary Tappings

Tappings extending 6in. outside the transformer were made at half-layer intervals (15 turns) by doubling the wire. The second and third tappings were taken out at the opposite side from the start of the winding, then the next two at the other (first) side and so on. Pieces of Empire cloth were applied as insulation above and below each loop where it traversed the winding and at the bends in the wire. The resulting bulge occurs on one of the exposed sides of the winding and does not affect the winding space set by the size of the window of the transformer laminations.

The outermost 15 turns were tapped at every turn, the loops being twisted to keep them from coming apart and insulated with small pieces of insulating tape, doubled and pressed around the place at which the tapping is made. When the secondary had been completed it was bound with insulation tape to secure it firmly. The laminations were then inserted from alternate sides and the entire transformer was wax-dipped to improve the insulation and exclude moisture. This seemed worth while, although under continuous working at maximum loading the transformer heats enough for some of the wax to run out.

Sleeving was used outside the transformer where necessary to separate the tappings. This requires to be of at least 2mm to allow the double wire to pass through it and a limp type of sleeving was found suitable.

In arranging the leads to the connector strips most of them required to be shortened slightly. The waxed cotton covering was pushed back and the enamel scraped off. The ends were then twisted together and soldered before insertion into the connector and screwing down the grub screw. As the tappings are loops the current of the winding has to pass through a succession of soldered joints, so it was necessary to ensure a low-resistance junction between the wires at each connector position.

A.C. Ripple Reduction

A power supply delivering a large current at low voltage has a tendency to give too much a.c. ripple, comparing very unfavourably with batteries as regards the background hum produced. Filtering poses a problem because the resistance of any series smoothing component has to be small to avoid a large voltage drop with correspondingly

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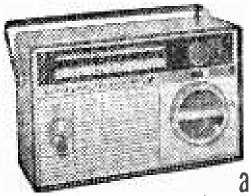

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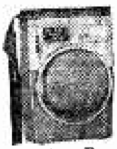

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high power loss (which also adds to the temperature of the power unit).

Apart from decoupling individual transistor stages that do not require large currents, the only satisfactory method of reducing ripple is to include a low-resistance choke.

In this power unit the choke has an inductance of 0·12H with 1A flowing and a d.c. resistance of 4·2Ω. Although the inductance seems small its reactance is 75Ω at 100c/s—the ripple frequency from the full-wave rectifier bridge.

Connected between the output terminals is a 1mF capacitor (usually marked 1,000μF) which has a reactance of 1·6Ω at 100c/s, so the ripple will be attenuated about 46 times to a level which, although not totally imperceptible in a loudspeaker, should serve for working an output stage.

Earlier stages will, however, require additional decoupling, which may not be present in the simpler types of battery receiver where its only function would be to prevent feedback via the battery impedance and not to stop ripple—which does not occur with a battery supply.

Ripple will be greatest when the maximum a.c. input is applied to the rectifiers and it also varies with the load current due to variation in the choke inductance, which is about twice as high at small output currents.

With the entire secondary in circuit the ripple at the output terminals when drawing 1·2A at 14V is 210mV r.m.s. When the load is disconnected the output voltage rises to 24V but the r.m.s. ripple decreases to 90mV.

A reservoir capacitor of about 1,000μF, if added to the circuit, gives little improvement except at small output currents. The ripple voltage at full load is reduced only slightly, so a large ripple current flows through the capacitor. A surge resistor is necessary in series and this becomes quite hot, requiring to be of substantial wattage.

When a large direct current is flowing the reservoir capacitor is unable to charge sufficiently to raise the voltage and so to decrease the ripple (with a reduction in the conducting period of the rectifiers). To do this would apparently require at least 10mF (at 25V working), which is ruled out on the grounds of bulk and because of the large current pulses that would pass in the rectifiers. At least as much ripple reduction would be obtained by connecting such a capacitance across the output terminals.

There is also little improvement to be obtained by tuning the choke with electrolytic capacitors. For example, a 16μF capacitor halved the ripple at full load but slightly increased it at no load. It also distorted the ripple waveform by increasing the higher harmonics. Capacitors of 8μF and 25μF across the choke were even less beneficial.

Details of the Choke

The choke winding contains 400 turns of double silk covered wire of 25s.w.g.

The laminations, of the E and I pattern, are of the type shown in Fig. 3. The gap between the E and I laminations (which occurs as a double gap in the magnetic circuit) was adjusted, using slips of paper. These were cut from a page of a spiral-bound notebook and six pieces gave the optimum gap of 0·02in. As the graph in Fig. 4 shows, any size of gap is better than none. Complete removal of the I laminations gave an inductance of about 0·05H as compared with 0·12H at the optimum gap.

When completed the choke also was wax-dipped. The effect of this on the gapping paper was assumed negligible and the values of output ripple that have already been stated were measured subsequent to this wax impregnation.

The resistance of the choke, 4·2Ω, is not entirely a disadvantage, for it gives the rectifiers some protection against accidental short-circuits of the output, provided that these are only momentary. For this reason it was not considered necessary to add a fuse in the output circuit.

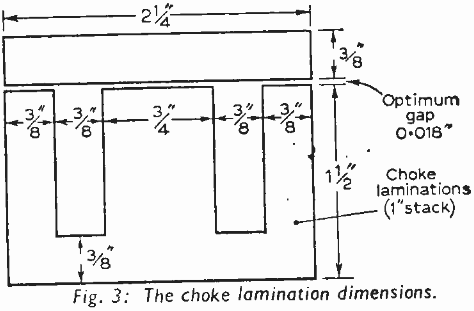

Fig. 3: The choke lamination dimensions.

The 1,000μF, 25V working capacitor connected between the output terminals and positioned over the choke is a miniature type measuring 1½in. x 1in. diameter. It is unnecessary to shorten its leads, but sleeving should be used on these.

Rectifier Assembly

The silicon junction rectifiers can be seen to have one axial lead in electrical connection with the metal case at the end with the circular flange. This lead is of + polarity, corresponding to the cathode of a thermionic diode.

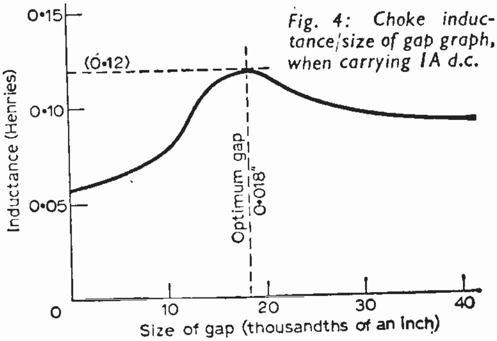

Fig. 4: Choke inductance/size of gap graph, when carrying 1A d.c.

The separation between the rectifiers must be sufficient to ensure that contact cannot occur between them. A suitable tag-board of the usual type was not at hand, so an eyeletted panel was made with 20s.w.g. tinned copper wire linking pairs of eyelets (see Fig. 5) and providing short projections on to which the leads of the rectifiers were hooked and soldered. The lead wires should not be bent close to the seal and are held with pliers during the soldering to keep the heat from reaching the rectifier.

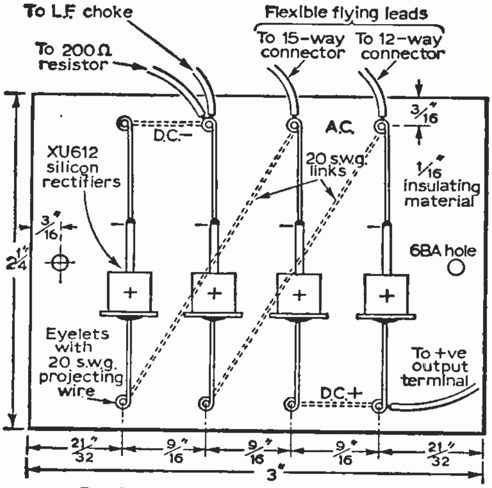

Fig. 5: The rectifier bridge assembly.

The 200Ω resistor is connected on the input side of the choke because in this position it helps to safeguard the rectifiers against any voltage surges, and comes in parallel with the reverse resistances of the rectifiers during their non-conducting half-cycles, thus protecting them against surges via the mains. This resistor should therefore be considered an essential rather than an auxiliary component.

It is anticipated that the power unit will normally be supplying voltages well below the maximum. Where only a 9V supply is needed the much higher voltages available could represent a source of risk to the apparatus being supplied, but the tappings have been marked clearly and external meters would normally be used in adjusting the voltage to circuits under test, beginning at a lower voltage and gradually adjusting upwards until the correct output voltage was obtained on load.

Silicon rectifiers produce less heat as they are much more efficient than selenium rectifiers and drop far less voltage. Losses in the other components, however, make the overall efficiency

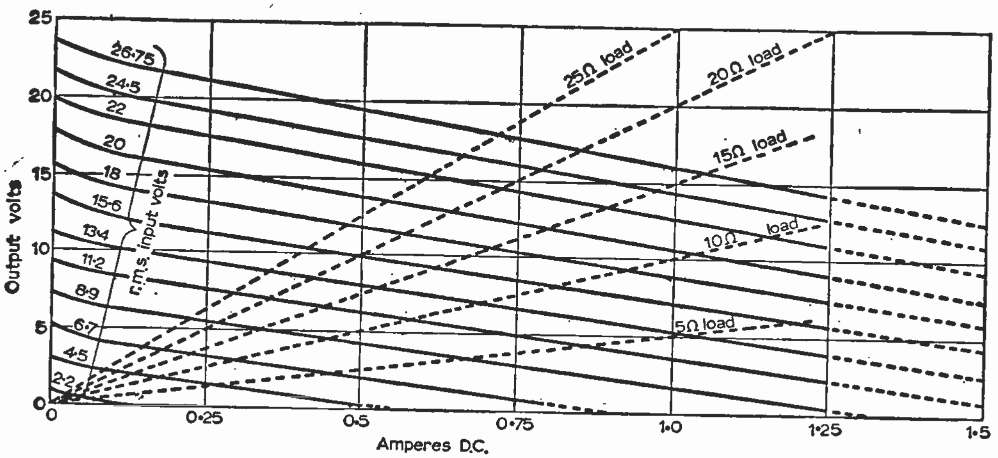

Fig. 6: Regulation curves of external d.c. output at different a.c. input voltages. (There is also an internal resistance of 200Ω taking an additional current.)

All four rectifiers were mounted vertically with the + end downwards, and the tag-board with backing piece is bolted on the inside of the box under the 15-way connector.

The Wire-wound Resistor

A 200Ω wire-wound resistor is connected across the output of the rectifiers. The purpose of this resistor is to prevent the output voltage from rising to an excessive value on no load. It ensures that the open-circuit output voltage is not too high for the electrolytic capacitor, which has a working voltage of 25V. There is a steep rise in the regulation curve at small direct currents and in the absence of this resistor over 30V would appear across the output (using the entire secondary) at zero direct current as against a maximum of 24V with the resistor included. It dissipates up to 3W and is positioned at the transformer end of the power unit.

of the supply much lower. The power unit consumes 35W when supplying an output of 14V at 1·1A, which implies an overall efficiency of 44%. The power losses consist of 5·1W in the choke and 1·7W in the 200Ω resistor. There are also those of the transformer and rectifiers whose combined efficiency at this output is 63%.

Output Characteristics

Except for currents of below 100mA, the source resistance of the supply is constant with loading and has a value of 5 to 7Ω according to the a.c. input voltage. The source resistance rises slightly with a higher a.c. input as more of the secondary is brought into circuit, corresponding to a slight increase in the slope of the upper regulation curves of Fig. 6, which are not quite parallel.

The a.c. input voltage from the transformer secondary falls slightly with increased loading due to the resistance of the transformer windings.

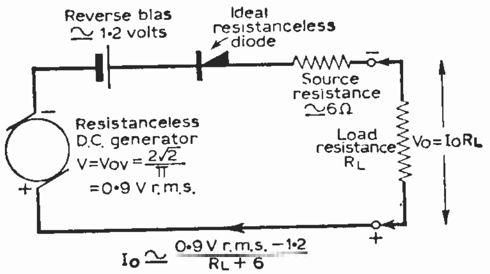

Fig. 7: Equivalent circuit of d.c. output of power supply.

With the entire secondary in circuit the input drops about 2V r.m.s. for an ampere of direct current in the external load.

The d.c. source resistance determines the fall in direct voltage for a given increase of direct current. Thus an increase of half an ampere in the current drawn will cause the output voltage to drop by about 3V. Although not exactly equal to the a.c. source resistance of the supply the d.c. value probably will not differ appreciably from it up to about 25c/s, where the 1,000μF capacitor begins to take over, making the output impedance capacitative with a reactance of only 1·6Ω at 100c/s.

A set of load lines have also been drawn on the regulation curves of Fig. 6. It is thus easy to determine the approximate output voltage and current for a given value of load resistance and input tapping.

The spacing of the regulation curves shows that each additional 2·2V step of a.c. input voltage gives just under 2V increase of direct volts output (for the same current), but there is the usual non-linearity with inputs of about 1V or less which has an effect somewhat like a small reverse bias voltage on an ideal resistanceless diode.

It is possible to draw an approximate equivalent circuit for the d.c. output as in Fig. 7. This is based upon the regulation curves.

Dimensions

The dimensions of the power unit (6¼in. x 3⅞in. x 3⅞in.) are the minimum that will accommodate the transformer and choke and it was necessary to check that the components to be used would in fact fit into this limited space, especially as the bunching of the tappings tended to increase the room taken by the transformer. The arrangement of components and wiring is shown in Fig. 8.

A ready-made pressed-steel box of the required size for the power unit was not available, so a box was specially constructed from 18s.w.g. aluminium. Aluminium of this thickness is easily fretsawed and the narrow flanges required can be accurately formed by stages in a vice. Hammering should be avoided in this process to avoid distorting the metal, but if some proves necessary to flatten a bulge a piece of wood can be interposed to avoid damage. The line of the flange is set just at the top of the vice (with the flange gripped in the vice). The flange then turns out a little deeper while the dimension of the main part is kept close to the original measurement.

Details of the Construction

The top panel, which bridges the gap between the connector strips, is a piece of hardboard as this is less likely to damage the tappings on removal and replacement, Fig. 9(J).

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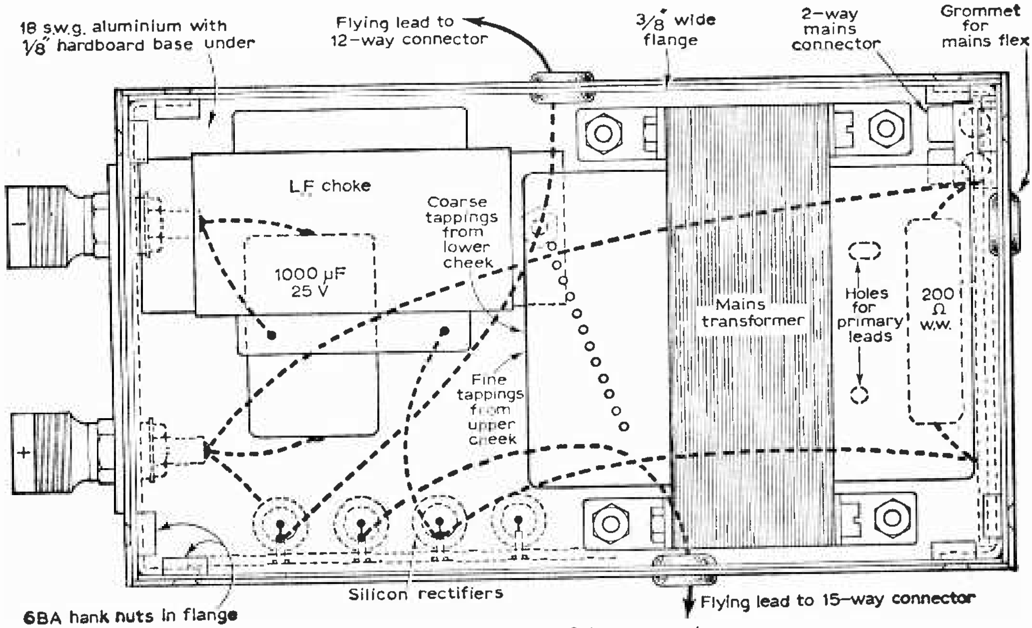

Fig. 8: The arrangement of the power unit.

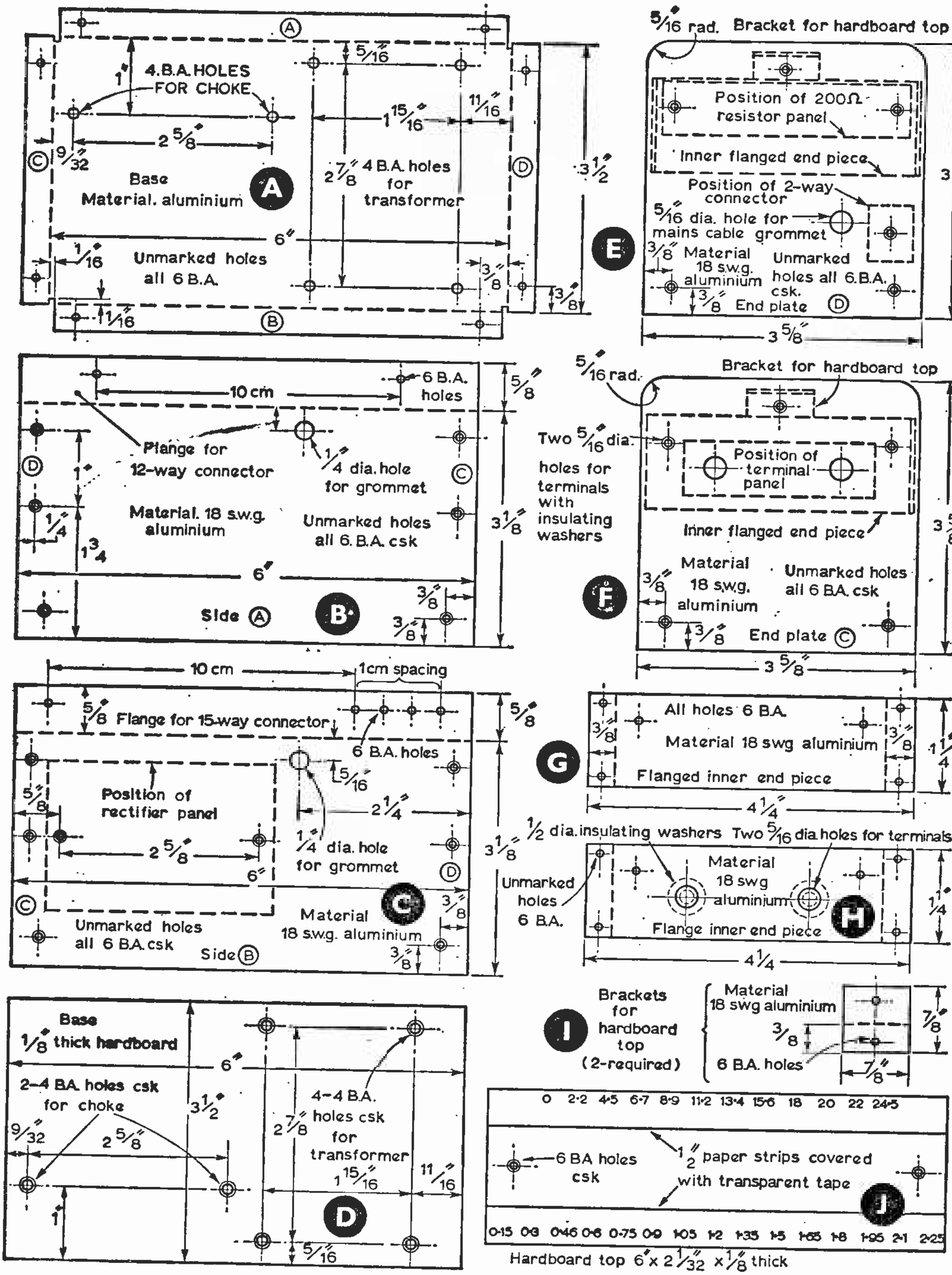

Fig. 9: Details and dimensions of the component parts of the power supply case.

—continued from page 833

Another piece of hardboard, Fig. 9(D), is used under the 18s.w.g. bottom of the box as the latter is too thin to take the 4B.A. countersunk screws which secure the transformer and choke. The rough side of the hardboard base is downwards to provide a non-slip surface which, with the 5½lb weight of the power unit upon it, makes it less likely to be pushed out of position.

The bottom of the box is a flanged tray of 18s.w.g. aluminium measuring 6in. x 3½in. and with ⅜in. flanges as shown in Fig. 9(A).

The sides of the box measure 6in. x 3⅛in. and have $\frac{11}{16}$in. flanges which form ledges supporting the connector strips. Refer to Fig. 9(B) and (C).

Flanging is carried out before drilling. Holes for 6B.A. screws are drilled first in the sides, which are then used as templates for the 6B.A. holes in the flanges. After temporarily fitting the sides, holes are drilled in the ends and similarly transferred to the flanges and inner end pieces, Fig. 9(G) and (H). The end plates are shown in Fig. 9(E) and (F). These plates are without flanges to give the box neater corners and are secured by the flanged end pieces which fit inside.

The top, of ⅛in. hardboard, rests on the edges of the connector strips on each side and fastens at each end by a 6B.A. countersunk screw to a small bracket on the end plate. See Fig. 9(I). The use of countersunk screws throughout, although not essential except in the hardboard base, gives the box a much better appearance, but 18s.w.g. is rather thin and in countersinking the 6B.A. holes it is advisable not to go too deeply as the screw sinks in further than intended when it is tightened. A 60 deg. countersink drill appears to be best for countersinking holes for the 6B.A. screws but a 90 deg. countersink drill is more suitable for the 4B.A. holes in the base.

Final assembly of the power unit is greatly facilitated if 6B.A. hank nuts are fitted to all the flanges. Most of the interior of the box becomes inaccessible when the sides and ends are in position and the usual type of nut would be very awkward to get into position. Where a hank nut is to be fixed the 6B.A. hole previously made in the flange is drilled through with a $\frac{7}{32}$in. drill and then lightly countersunk. The hank nut, which is really a sort of combined nut and rivet, is easily riveted into this hole by hammering.

The box was painted with grey plastic enamel, which it is thought should give better cooling than the polished aluminium left unpainted, although probably less efficient than a coating of black crackle paint.

Connector Strips

The connector strips are of the more compact type with 1cm spacing. The 12-way strip on one side does not extend the full length of the box and leaves a small aperture at each end for ventilation.

The 15-way connector strip that fully occupies the other side consists of a 12-way strip with a three-way portion added at one end. The connectors are retained in position by 6B.A. bolts ⅜in. long, inserted from the top into hank nuts in the flanges, with a washer between the head of each nut and the connector strip. Countersunk bolts should not be used here as they would break the connector strips when tightened.

It is necessary to arrange the tappings in sequence to give an ascending series of voltages. The r.m.s. values are marked with Indian ink at 1cm intervals on ½in. strips of paper which are then covered with Sellotape for protection and glued along the edges of the top panel beside the multi-way connectors.

The ends of the flying leads are doubled and soldered to avoid breaking of the strands.

To guard against interchange of the red and black tops of the output terminals a small disc of paper with a + sign in red was stuck on beside the positive terminal.

Mains Connection

The lack of a switch in the primary circuit might be felt to be a disadvantage. A small snap-action switch could be fitted at the transformer end on the opposite side from the two-way connector. It is advisable to wrap insulating tape around the switch tags to ensure that if the switch should loosen no contact can be made with the metal box.

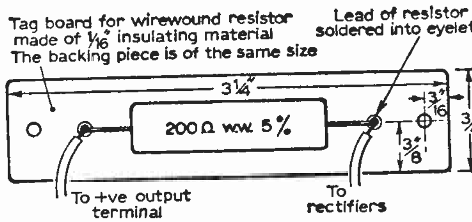

Fig. 10: The tag board mount for the wire-wound resistor.

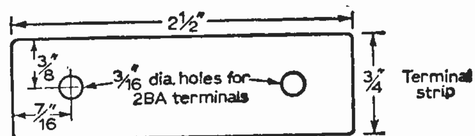

Fig. 11: The terminal strip.

The plastic insulation of the wires entering the connector block must be carried right into the connector. No bare conductors should show in the primary circuit. With a three-pin plug and three-wire flex (red for live, black neutral and green to the large earthing pin) the green wire would be connected to a soldering tag under one of the nuts securing the transformer. In a two-wire system additional insulation is recommended, e.g. insulating tape over the plastic covering and possibly strips of plastic insulating tape covering adjacent metal surfaces.

Before use, an ohmmeter check is made to ensure that the insulation between the metal case and internal circuits is satisfactory. The wiring of the power unit is insulated from the metal box on both the primary and secondary sides. It is also important to check the wiring before connection to the mains. The fault most likely to damage the rectifiers would be connection of one of the flying leads to a wrong part of the rectifier bridge.

If, as a test, the flying leads are first connected to a 9V battery, a voltmeter across the output terminals should read over 7V with the battery connected either way round. ■

DOMESTIC STRAIGH

This simple yet reliable design can be recommended to the newcomer t

by J. B. WILLMC

THERE is a constant stream of "new entrants" to the hobby of radio receiver construction, many of whom are in search of a design for a receiver which, whilst simple to construct, will be reliable in operation and ensure really worthwhile reception of a selection of home and Continental programmes; at the same time the receiver must be inexpensive to construct and comprise only standard, easily obtainable components. With these criteria in view the author constructed the receiver described in the following paragraphs, and it is thoroughly recommended to the novice who has mastered the art of soldering and who, having possibly built one or two simple crystal and transistor receivers, is now desirous of tackling a mains operated valve receiver.

Reference to the theoretical circuit diagram, Fig. 1, will no doubt bring back to the older readers memories of their early efforts at mains receiver construction. Basically the design employed is that which was regarded as "standard" in the early days of mains operated receivers, namely a three-stage t.r.f. ("straight") line-up comprising a vari-mu pentode r.f. amplifier stage, followed by a triode grid leak detector and a.f. amplifier and a pentode power output stage, the whole being fed with the necessary power supplies from a fully isolated mains transformer and full-wave rectifier with choke and capacity smoothing.

Many t.r.f. receiver designs, particularly those of the "midget" type, employ a.c.-d.c. power supply technique or a heater transformer in conjunction with a half-wave rectifier. Admittedly this gives a considerable saving in cost, but in the writer's view the greater safety factor given by the avoidance of a "live" chassis (unavoidable in the a.c.-d.c. type of receiver), when a full-wave power supply with double-wound mains transformer is employed, is particularly desirable in the case of all home-constructed receivers and especially so for those assembled by beginners. A further advantage is that performance of the completed receiver is enhanced by virtue of the fact that an h.t. positive line of a full 250V is available, allowing adequate voltage to be fed to the valve anodes and screen grids even after the "drop" due to load and decoupling resistors and at the same time smoothing is more efficient and the resultant hum level kept to a low order.

Octal-based valves are used throughout, as these are efficient and robust and very cheaply obtainable from numerous advertisers in this magazine, also their comparatively large base connections greatly facilitate wiring up for the novice. In spite of the fact that the basic principles of the circuit date back some 30 years, good results are assured in all but the very poorest reception locations, the inclusion of pre-set reaction in the detector stage greatly enhancing the sensitivity and selectivity of the receiver. Long and medium waveband coverage is provided, but listeners residing in areas where the B.B.C. Light Programme is satisfactorily received on 247 metres (such as the London area, for example) may omit the long waveband if desired, with resultant simplification and saving in cost.

CIRCUIT DESCRIPTION

Signals are fed to the control grid of V1, which is a 6K7, by way of the aerial input coil L1 or L2 (as selected by the wavechange switch S1) and tuned by the section of the two-gang tuning capacitor VC1.

Wearite "P"-type coils are used throughout the receiver. They are easily obtainable, simple to mount and match up to the station markings of the standard type of tuning dial, and the necessary adjustable trimming capacitors can be soldered directly across the tuned windings of the coils themselves (see Fig. 3).

R.F. amplification takes place in V1, the gain of which is made variable by VR1 in the cathode circuit, which thus acts as a volume control. In some locations it would not be possible to reduce the volume sufficiently on strong local stations by variation of bias on V1 alone, so the "cold" end of VR1 is connected to the aerial input, with the result that as the volume control is turned "down" a progressively lower resistance is shunted across the primary of the aerial tuning coils until, at minimum volume setting, the aerial is virtually short-circuited to earth (chassis of the receiver). Conversely, at maximum volume setting, the shunting effect of the full 10kΩ resistance of VR1 is negligible.

The amplified r.f. signal at the anode of V1 is developed across the r.f. choke L3. A choke is used here in preference to a resistor as, being of comparatively low d.c. resistance, practically the full h.t. voltage is thus applied to the anode of V1, giving maximum efficiency.

C4 acts as a d.c. blocking capacitor to prevent flow of h.t. through the detector coils L4 or L5 to chassis but allows the r.f. signal to pass unimpeded, via the wavechange switch S1c, to the appropriate detector coil (tuned by VC2, the second section of

THREE

radio construction

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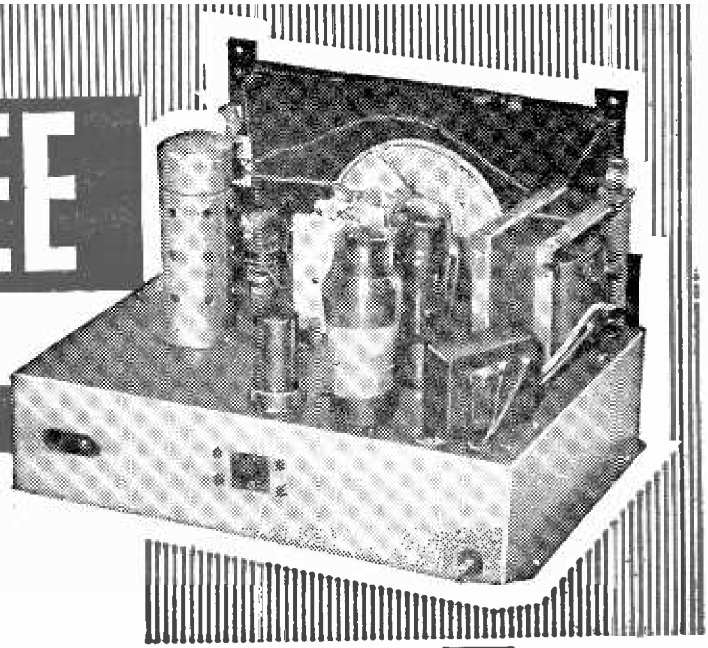


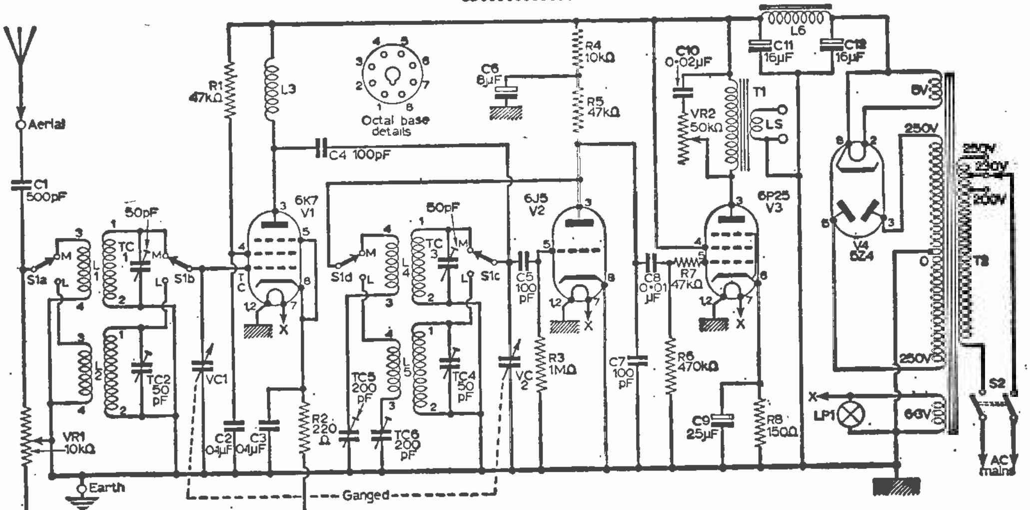


Fig. 1: The complete circuit diagram.

the gang capacitor) and via the grid leak capacitor C5 to the control grid of V2, R3 being the grid leak resistor.

V2 is a 6J5 triode and the cathode of this valve is connected directly to earth and thus the valve combines the functions of demodulation (detection) and a.f. amplification. The values of C5 and R3 have considerable influence on overall performance and those finally chosen and specified in the parts list seemed to give the best compromise between "selectivity" and "quality".

The a.f. voltage appearing at the anode of V2 is developed across the load resistor R5; R4 and C6 provide decoupling from the h.t. line and serve both to prevent unwanted leakage of residual r.f. signals into the h.t. line (with risk of feedback to V1 and instability) and to provide additional smoothing for the h.t. supply to V2.

Grid leak detectors are very prone to "hum" pick-up unless adequately smoothed power supply is provided and neat, short wiring, particularly of the grid input circuit, is a must.

THE OUTPUT STAGE

The a.f. signal is fed via C8 to the control grid of V3, which is a high-slope pentode output valve of the 6P25 type. R7 is a grid stopper resistor inserted as close as possible to the control grid of V3 to prevent any r.f. voltages from reaching this valve, which could cause parasitic oscillation (sometimes at supersonic frequencies) to be set up, with resultant poor reproduction of speech and music.

R8 and C9 provide for correct biasing conditions of V3 and the output is developed across the primary winding of the output transformer T1,

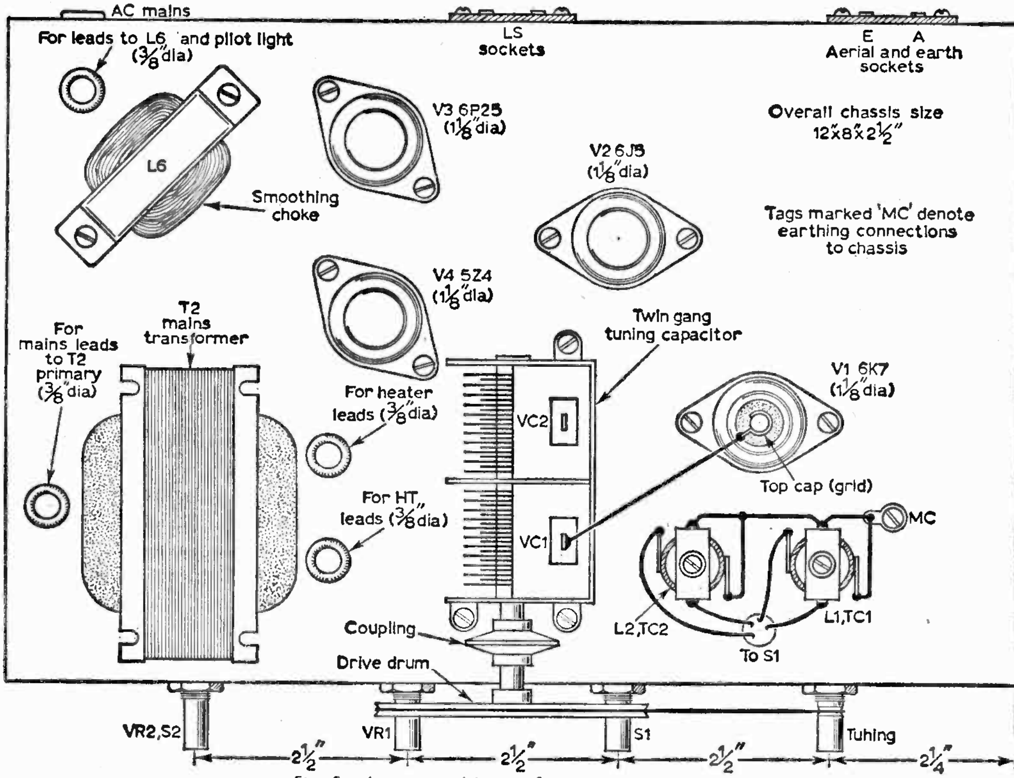


Fig. 2: A suggested layout for major components.

whose secondary winding is "matched" to the loudspeaker speech coil.

A simple type of tone control, comprising C10 and VR2, is connected across the primary of T1 and this gives the necessary control over frequency response. As pentode valves tend to accentuate the higher frequencies, including such unwanted noises as heterodyne whistles caused by transmitting stations radiating on frequencies near to the one being received, the inclusion of a means of "top cut" is very desirable. VR2 is thus useful in reducing background "noise", especially when listening to the more distant stations.

FEEDBACK ARRANGEMENTS

Returning now to the anode circuit of V2, the purpose of the other components connected thereto will now be explained. In addition to the a.f. signal there will be signals at r.f. present at this electrode; a portion of these is bypassed to earth via C7 but the remainder is deliberately fed back through the coupling coils of L4 or L5 (according to setting of the wavechange switch S1d), via the preset trimmer capacitor TC5 or TC6, to earth. Variation of the setting of these trimmers allows the amount of feedback ("reaction") to be controlled and in practice, when the receiver is completed, they are set to give the maximum amount of feedback which can be tolerated without the receiver bursting into self-oscillation, and an enormous increase in both sensitivity and selectivity results from this arrangement. It should be noted that the windings of the feedback coils must be connected in the correct "sense", otherwise a diminution in signal strength, instead of an increase, will take place. The correct method of connecting the specified coils is indicated by reference to Figs. 1 and 3.

POWER SUPPLY

The power supply section comprises a double-wound mains transformer T2, provided with primary tappings to suit the various standard

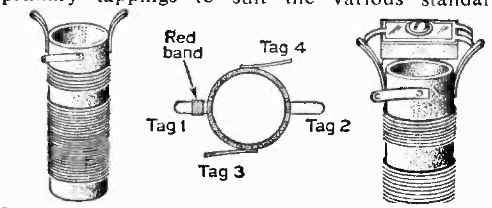


Fig. 3: The Wearite coils with the additional trimmers.

mains supply voltages. An on/off switch S2 (actually combined with VR2) is inserted in one of the primary leads. Two separate secondary windings provide 5V at 2A to feed the heater of the rectifier valve V4 (which is a 5Z4) and 6·3V at 3A to feed the heaters of all the other valves, plus any pilot bulb(s) provided for illumination of the tuning dial. The centre tapped 250—0—250V h.t. secondary winding of T2 should be rated at not less than 60mA.

Full-wave rectification takes place in V4 and the resultant d.c. is smoothed by the reservoir capacitor C12, l.f. choke L6 and smoothing capacitor C11. The choke should be rated at about 10H for a current of 60mA. C11 and C12 can conveniently be a "double" electrolytic capacitor of 8+16 or 16+16μF of not less than 350V working. These values will be found to give adequate smoothing and the resultant h.t. voltage available at C11 should be approximately 250V "on load".

Provided that the stated values and voltage ratings of the components given in the parts list are adhered to they can be of any make; only the tuning coils (Wearite "P" type) are specified by name, and as these were used in the original and connection data for these is given the beginner in particular is advised to adhere to the specification.

If alternative makes of coils are used the manufacturer's data as to connections must, of course, be adopted. It is not recommended that dual-range types (i.e., those having both long and medium waveband coils on one former) be employed, as these normally have only one coupling or feedback winding common to both wavebands. This would render the separate preset

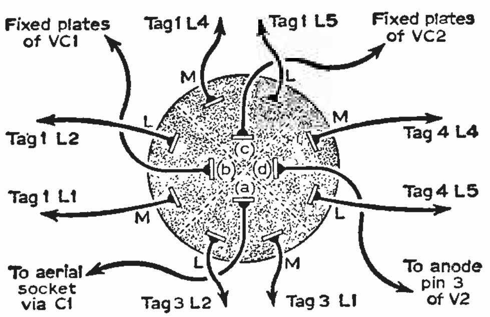


Fig. 4: The wavechange switch details.

adjustment of reaction in the detector stage no longer possible on the two wavebands, with the result that whilst it might be found possible to advance the reaction to a certain level on medium waves, the same setting would not hold good on long waves and a compromise setting would have to be accepted, with consequent loss of performance. The slight extra expense and complication of separate coils is fully justified.

The r.f. choke should be of the standard "all wave" type; the one used in the original was taken from an old receiver but a Denco RFC Type 7A or an Osmor Type QC1 should perform satisfactorily in this position.

In the case of valves the specified octal types are very easily obtainable; a "metal" type is recommended for V2 and if a "metal" type is used for V1 the screening can shown in the illustration and parts list can be omitted. If desired an EF39 can be substituted for V1 and either a KT61 or an EL33 substituted for V3 without any circuit changes. It would also be possible to use a directly heated rectifier such as a 5Y3 in the V4 position, but in the writer's opinion the use of the indirectly heated 5Z4 is to be preferred as it prevents the rise of the h.t. voltage to too high a

COMPONENTS LIST

Resistors:

R1	47kΩ	R5	47kΩ
R2	220Ω	R6	470kΩ
R3	1MΩ	R7	47kΩ
R4	10kΩ	R8	150Ω

All 20%, $\frac{1}{2}$W carbon

VR1 10kΩ wire-wound potentiometer
VR2 50kΩ carbon potentiometer, with switch (S2)

Capacitors:

C1 500pF mica or ceramic
C2 0·1μF paper 350V
C3 0·1μF paper 350V
C4 100pF silver mica or ceramic
C5 100pF silver mica or ceramic
C6 8μF electrolytic 350V
C7 100pF silver mica or ceramic
C8 0·01μF paper 100V
C9 25μF electrolytic 25V
C10 0·02μF paper 100V
C11 16μF electrolytic 350V
C12 16μF electrolytic 350V
VC1 500pF, VC2 500pF } twin-gang variable
TC1 50pF compression type trimmer
TC2 50pF compression type trimmer
TC3 50pF compression type trimmer
TC4 50pF compression type trimmer
TC5 200pF, TC6 200pF } double compression-type trimmer

Inductors:

L1 M.W. aerial coil (Wearite PA2)
L2 L.W. aerial coil (Wearite PA1)
L3 All-wave r.f. choke (Denco RFC7)
L4 M.W. h.f. coil (Wearite PHF2)
L5 L.W. h.f. coil (Wearite PHF1)
L6 Smoothing choke 10H 60mA

Transformers:

T1 Output transformer 5,000Ω primary, 3Ω secondary
T2 Mains transformer. Tapped primary. Secondaries: 250-0-250V 60mA; 5V 2A; 6·3V 3A

Other Circuit Components:

S1 4-pole 2-way wafer switch

Valves:

V1	6K7	V2	6P25
V2	6J5	V3	5Z4

Miscellaneous:

Chassis 12 x 8 x 2½in. Dial and drive assembly (Jackson SL8). Four I.O. valveholders. One grid clip. One loudspeaker socket strip. One aerial and earth socket strip. Pilot lamps 6·3V, and bulbholders.

level while the other valves in the receiver are warming up.

Considerable latitude of layout is permissible in a receiver of this sort, provided that short and direct wiring of the r.f. circuits is adopted. In actual fact the prototype was constructed on the chassis of a former 5-valve superhet receiver which had been stripped of all components except the two-gang tuning capacitor, drive mechanism and tuning dial; and it may well be that the novice constructor will have such a chassis in his possession—discarded as "junk" at some time in the past! If this is the case and provided the existing valveholder mounting holes are large enough to accommodate octal valveholders (or are capable of enlargement to enable this to be done), and that the gang capacitor is undamaged by rough storage or mishandling, much tedious metalwork can be avoided.

The use of a top-mounting type of mains transformer will obviate any need to cut out a large rectangular hole in the chassis such as would be needed to accommodate a component of the drop-through type. However, to suit the constructor who has not a suitable chassis already available, or who wishes to make a neater and more workmanlike job, a suggested layout plan, with the major dimensions indicated, is given in Fig. 2.

It is suggested that the components be mounted in the following order: Firstly the four international octal valveholders, which should be fixed with their locating spigots orientated as near as possible to that shown in Fig. 2 to facilitate short and direct wiring. This can be followed by bolting into position the mains transformer, output transformer, smoothing choke and the dual electrolytic capacitor C11/C12 (using a fixing clip for the purpose).

Next mount the controls, namely the volume control VR1, wavechange switch S1, tone control (with switch) VR2 and tuning drive spindle if this latter is not already fitted in the case of those utilising a "second-hand" chassis.

Aerial and earth and loudspeaker socket connecting strips can then be added and, lastly, the tuning coils.

The aerial coils (L1 and L2) should be mounted above chassis and the detector coils below chassis; any attempt to mount both sets of coils below chassis is almost certain to lead to uncontrollable feedback between the r.f. and detector stages, rendering the receiver completely unworkable.

Naturally a number of holes will be required in the chassis to permit the passage of leads from above-chassis components to those below; in the case of leads carrying supplies to and from the mains transformer the holes should be fitted with insulating rubber grommets; in all other cases the insulation of the wires themselves may be relied upon to give sufficient protection.

WIRING UP THE RECEIVER

Wiring up can now be carried out and reference to Fig. 5 and Fig. 1 should make this clear even to the beginner; even so it is recommended that a logical sequence be followed to obviate errors.

It is a good plan to start by carrying out all the wiring associated with the mains transformer, e.g. starting from the mains supply lead, connect these to the appropriate voltage tapping on the primary winding, including the on/off switch in one lead. Next connect the rectifier heater winding (5V) to the appropriate tags on V4 valveholder, noting that in the case of a 5Z4 valve this is pins 2 and 8; follow up by wiring the high-voltage secondary windings to the rectifier anodes (pins 3 and 5), not forgetting the connection from centre tap to earth. This leaves only the 6·3V heater supply to wire in and this is done by connecting one side of the

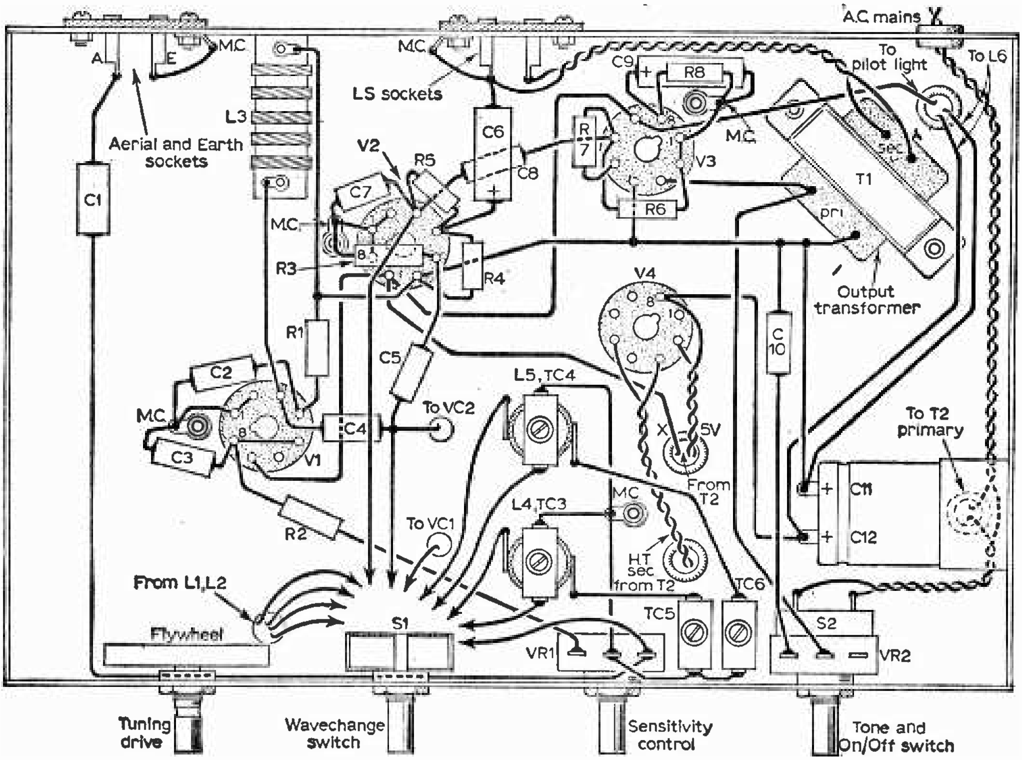


Fig. 5: The underchassis wiring diagram.

6·3V winding to earth and taking an insulated wire from the other end of this winding to pin 7 on the valveholders V1, V2 and V3, also to any pilot bulbholder(s), by the shortest convenient route. This wire should be pressed as close down to the chassis as possible. The return path for the heater supply is via the metal chassis itself and to provide for this pins 1 and 2 of V1, V2 and V3 are wired to earth (solder tags mounted on valveholder fixing bolts). Note that in the case of V2 pin 8 (cathode) is also earthed in this way.

Complete the power supply circuits by wiring in the smoothing choke L6 and the electrolytic capacitors C11/C12. Make sure that C12 does in fact form the reservoir capacitor, i.e. that which is connected to the cathode of V4; normally this section of the capacitor will be distinguished by a red-marked tag. The wiring of the h.t. supply can now be proceeded with, noting the use of pin 6 on V2 and V1 as anchoring points (these are "spare" pins with no internal valve connections); pin 4 of V2 is also used as an anchor point for the junction of R4, R5 and C6.

Interstage wiring is best carried out with bare tinned copper wire of about 22s.w.g. This wire is covered with systoflex sleeving. Resistors and capacitors are, of course, wired into place with their own lead-out wires, shortening where necessary and insulating with systoflex wherever there is any danger of accidental contact between wires or wiring and chassis.

The connections between the h.t. line and various valve electrodes, together with their associated decoupling capacitors, should now be completed; note the polarity of C6. Components associated with the cathode circuits of V1 and V3 can now be added, referring to Fig. 5 for correct method of wiring VR1 in order to ensure that the volume control works in the correct "sense" (clockwise rotation giving increased volume).

Last of all the "signal path" must be wired in. Starting from the aerial socket and including the various coils and capacitors as shown on the circuit diagram right through to the anode of V3.

Fig. 3 clearly shows the tag connections to the Wearite coils and these numbers are repeated on the theoretical diagram (Fig. 1), while Fig. 4 clearly shows the method of wiring up the wavechange switch. It is this latter that is most likely to puzzle the beginner, but if it is tackled methodically, working steadily round the tags of the switch in order, no trouble should be experienced.

As was mentioned earlier, the trimmer capacitors TC1, 2, 3 and 4 are sweated directly to the coil tags, while the large value reaction trimmers TC5 and TC6 are mounted on a small fixing bracket cut from scrap aluminium and mounted on the front chassis runner as close to the coils as possible.

TESTING AND ALIGNMENT

Unscrew all trimmer capacitors approximately three full turns from their "fully screwed up" position. If a meter or continuity checker is available test for any possible shorts between the h.t. line and chassis and verify that there is continuity between the main h.t. supply (pin 8 of 5Z4), through the smoothing circuits, to the anode and screen grid pins on V1, V2 and V3.

If no meter is available it will be as well carefully to check overall wiring once again. Insert all valves except V4, connect up to mains supply point and switch on. The pilot bulb(s) should light up immediately and the valve heaters glow in a few seconds. Naturally, if "metal" valves are used in V1 and V2 positions, the heater glow cannot be seen, but after a couple of minutes or so the outer envelope of these valves should feel warm to the touch.

If all is well switch off, insert V4 and again switch on. Watch carefully for any signs of stress in V4; if there is a "tizzing" sound, or signs of flashing as V4 warms up, switch off immediately as you have a short-circuit between the h.t. line and chassis at some point which must be put right before proceeding.

If the above test proves satisfactory turn up the volume control VR1 to maximum and insert an aerial in the aerial socket when, on swinging the tuning capacitor across the dial, some stations will almost certainly be heard. If no sign of life, gently tap the metal blade of a screwdriver on to pin 5 (the control grid) of V3, when a steady hum should be audible from the loudspeaker. Now transfer the screwdriver to pin 5 of V2, when a much louder hum should result. Finally, tapping the screwdriver on the aerial socket should produce a loud click in the speaker. Try this test with the wavechange switch in both positions.

If at any of the above test points the expected response is not obtained, investigate the wiring to that particular valve stage for possible errors or faulty components. Naturally, if a test meter is available, voltage readings taken at the valve electrodes will quickly reveal any faults. However, it is more than probable that in the case of a simple receiver of this sort first-time results will be achieved.

Set the wavechange switch to medium waves (clockwise) and endeavour to tune in a station near the low wavelength end of the dial such as Radio Luxembourg (or even the BBC Light Programme) and adjust the trimmers TC1 and TC3 for maximum volume consistent with reasonably accurate indication on the tuning dial. Reduce the volume with VR1 so that the effect of small changes in volume are more easily noticeable.

Having done this, swing the ganged capacitor across the full range of the medium waveband, when a number of stations should be receivable at their correct dial indications. Now select any weak transmission and gradually screw up the medium wave reaction trimmer TC3; there should be a noticeable increase in signal strength until a point is reached where the set bursts into self-oscillation. Slacken the trimmer sufficiently to stop the oscillation and then swing the tuning back and forth across the dial. If at any setting the set tends to go into oscillation, slacken TC3 a little further. Now switch over to long waves and locate the BBC Light Programme on 1,500 metres. Adjust TC2 and TC4 for maximum volume at correct dial setting and screw up reaction trimmer TC6 until just below point of oscillation. Ensure that the receiver is stable at all settings of the tuning capacitor and alignment is then complete.

AERIAL AND EARTH

The type and position of aerial used will have a marked effect on the ability of the receiver to

—continued on page 865

Simple Impedance and Reactance Calculations

BY G. A. W. PARTRIDGE

CONTINUED FROM PAGE 745 OF THE DECEMBER ISSUE.

CHECKING the impedance of a coil or the reactance of a capacitor may prove necessary from time to time. The impedance is the total resistance an inductive or capacitive circuit offers to alternating current. The resistance that a capacitor offers to d.c. can be regarded as infinite, so only its reactance is considered here.

Inductor Measurements

There are instruments such as impedance meters for this purpose, but they are rather expensive, so for reasonable accuracy the simple ammeter and voltmeter method when applied to coils is most suitable. Fig. 6 illustrates the basic circuit. The impedance (Z) is equal to the voltage divided by the current in amperes.

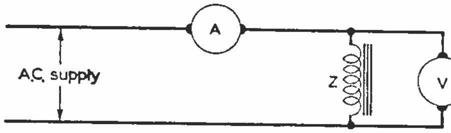


Fig. 6: The basic circuit for inductor measurements.

It is obvious that such a circuit needs considerable modification. First, the voltmeter will have to be extremely sensitive. In other words it will have to have a very high internal resistance. For this reason an electronic voltmeter or a calibrated oscillograph will have to be used. Second, a low reading milliammeter or in some cases a microammeter will be necessary to measure the small current.

Failing this a non-inductive resistor may have to be connected in series with the impedance and the current found by dividing the voltage across it by its resistance. Fig. 7 shows the modified circuit. The value of R depends upon the safe current consumption of the impedance. For example, if the current is 1mA, it will need a 10,000Ω resistor to give a deflection of 10V. The most suitable resistance is most usually found by experiment.

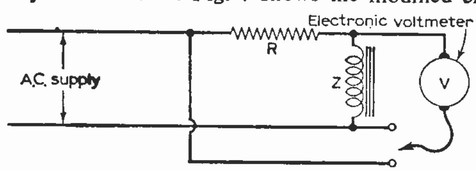


Fig. 7: The modified circuit of Fig. 6.

The voltage across R is first measured and then the voltage across Z. The current consumption in amperes is:

$$I = \frac{\text{Voltage across R}}{\text{Resistance of R}}$$

The impedance of Z is:

$$Z = \frac{\text{Voltage across Z}}{\text{The current consumption in amperes}}$$

Milliamperes or microamperes have to be converted to fractions of an ampere for the impedance formula. Remember that the supply must be also at the frequency which the impedance will be operating on. Impedance varies with frequency.

This method is suitable for low frequencies only. Anything above 5kc/s would usually require more elaborate apparatus. However, there are other ways of calculating impedances provided a few facts are known. Take the formula:

$$Z=\sqrt{(L2\pi f)^2+R^2}$$

where Z=Impedance in ohms
L=Inductance in henries
$\pi=3{\cdot}142$
f=Frequency in cycles per second
R=D.C. resistance in ohms.

The inductance may have to be measured if it is not marked on the coil. The d.c. resistance can be checked with an ohmmeter, Wheatstone bridge, or d.c. milliammeter and voltmeter method.

For example, a coil has an inductance of 300 henries and the d.c. resistance is 250 ohms. What is its impedance at 1,000 cycles per second?

$$\begin{aligned} Z &= \sqrt{(L2\pi f)^2+R^2} \\ &= \sqrt{(300\times 2\times 3.142\times 1{,}000)^2+(250)^2} \\ &= \sqrt{1885200+62500} \\ &= \sqrt{1947700} \end{aligned}$$

Therefore $Z=1{,}396\Omega$ approximately.

Capacitor Measurements

Much the same idea can be applied to a capacitor. The formula in this case is:

$$X_c = \frac{1}{2\pi fC}$$

X_c=Capacitive reactance in ohms
where $\pi=3{\cdot}142$
f=Frequency in cycles per second
C=Capacitance in Farads.

An $0{\cdot}2\mu F$ capacitor is connected to a 100c/s supply. What is its reactance?

$$X_c = \frac{1}{2\pi fC}$$

$$= \cfrac{1}{2\times 3{\cdot}142\times 100\times \cfrac{0{\cdot}2}{1{,}000{,}000}}$$

$$= \frac{1{,}000{,}000}{2\times 3{\cdot}142\times 100\times 0{\cdot}2}$$

$$= \frac{1{,}000{,}000}{125{\cdot}68}$$

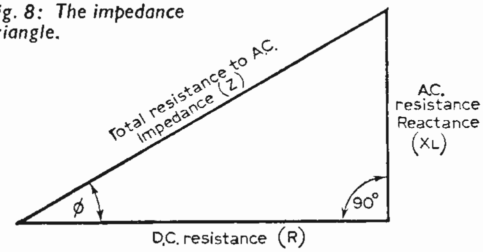
Therefore Xc=7,956Ω approximately.

These formulae are suitable for a.f. and r.f. circuits, but the results must be regarded as approximate, especially on the higher frequencies due to stray capacitances and inductances.

IMPEDANCE TRIANGLES AND L.F. COILS

Testing low frequency coils can be very interesting as well as instructive. Such work is also necessary when the efficiency of a coil is in question. The impedance triangle can be used to find out all sorts of information without using expensive apparatus. Fig. 8 shows how it adds up the three great resistive quantities.

Fig. 8: The impedance triangle.



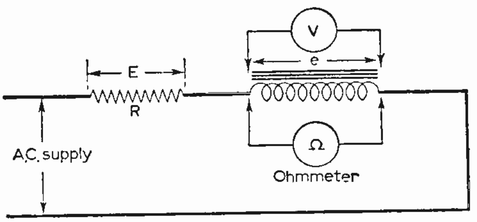


Fig. 9: The circuit required to provide the measurements used in the impedance triangle.

R represents the resistance the coil offers to d.c. only. This is due to the length and cross sectional area of the wire that makes up the coil. XL known as the inductive reactance is the resistance to a.c. due to magnetism. Both these quantities make up the impedance (Z).

The angle θ is also important. It tells us about the efficiency of the coil. The greater the angle the less efficient it is.

Fig. 9 illustrates the circuit required to determine these measurements. The coil to be tested is connected to a suitable voltage at the required frequency through a resistor (R) of known value. The voltage (e) across the coil is checked and the current found by measuring the voltage (E) across the resistor (R).

$$I=\frac{E}{R}$$

Now the impedance is calculated from:

$$Z=\frac{e}{I}$$

The d.c. resistance of the coil can be checked with an ohmmeter after disconnecting it from the a.c. supply.

We now know two sides of the triangle. The reactance can be found from:

$$XL=\sqrt{Z^2-r^2}$$

All sides of the triangle are now known.

The power factor which is the cosine of the angle θ is found by:

$$\text{Cos }\theta=\frac{r}{Z}$$

The nearer the power factor comes to one the greater is the efficiency of the coil.

Finally, the inductance in henries is:

$$L=\frac{XL}{2\pi f}$$

where π=3·142

f=frequency in cycles per second.

Here is an example:

A coil is tested at a frequency of 50c/s. The resistor R is 100Ω and the voltage (E) developed across it is 30. The voltage (e) across the coil is 150, while its d.c. resistance (r) is 450Ω.

The current (I) flowing through the coil and resistor is:

$$I=\frac{E}{R}$$

$$=\frac{30}{100}$$

$$=\frac{3}{10}\text{ or }0{\cdot}3\text{A}$$

The impedance is:

$$Z=\frac{e}{I}$$

$$=\frac{150}{0{\cdot}3}$$

$$\doteq 500\Omega.$$

The reactance is:

$$\begin{aligned}XL&=\sqrt{Z^2-r^2}\\&=\sqrt{(500)^2-(450)^2}\\&=\sqrt{250{,}000-202{,}500}\\&=\sqrt{47{,}500}\\&=218\Omega\text{ approx. (by logs).}\end{aligned}$$

The power factor is:

$$\text{Cos }\theta=\frac{r}{Z}$$

$$=\frac{450}{50}$$

$$=\frac{9}{10}$$

=0·9 power factor.

This is a very efficient coil.

The inductance is:

$$L=\frac{XL}{2\pi f}$$

$$=\frac{217{\cdot}9}{2\times3{\cdot}142\times50}$$

$$=\frac{217{\cdot}9}{314{\cdot}2}$$

$$=0{\cdot}69\text{H}.$$

We have now completed the impedance triangle which gives us useful information about the coil we have tested.

IMPEDANCE TRIANGLES and CAPACITORS

It is obvious that the impedance triangle cannot really be applied to a capacitor alone. First of all a good capacitor would have almost infinite resistance to d.c., so the base of the triangle (Fig. 10) would be undecided. The power factor would be at almost zero lead, so the angle θ would be about 90 deg.

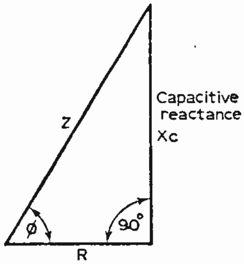


Fig. 10: The impedance triangle as applied to capacitors.

A capacitor can, however, be tested with a known non-inductive resistor connected in series with it, as shown in Fig. 11. The capacity is measured on a capacity bridge and the capacitive reactance (Xc) calculated from

$$Xc=\frac{1}{2\pi fC}$$

where f=frequency in cycles per second.
C =capacity in farads.

Two sides of the triangle, Xc and R are now known. The third side Z is calculated from:

$$Z=\sqrt{R^2+Xc^2}$$

This gives the correct impedance of the circuit. Now this impedance is checked directly. The correct impedance (Z) has only so far been calculated. It remains to be seen if the circuit really has this value.

The voltages Es and E are carefully measured with a valve voltmeter.

$$Z=\frac{Es}{I}\times\frac{R}{E}$$

A good capacitor should have $\frac{Es}{I}\times\frac{R}{E}$ equal to $\sqrt{R^2+Xc^2}$ or very close to it.

The correct power factor of the circuit can be calculated from:

$$\text{Correct power factor}=\frac{R}{\sqrt{R^2+Xc^2}}$$

The actual power factor will be:

$$\text{Actual power factor}=\frac{R}{\frac{Es}{I}\times\frac{R}{E}}$$

Here again both calculations should be much the same.

For example:

A capacitor is found to have a value of $0{\cdot}01\mu$F and it is connected to a non-inductive resistance of 1,000Ω. The circuit is connected to a 100V 50kc/s supply (Fig. 11).

Before starting the test calculate the correct capacitive reactance:

$$Xc=\frac{1}{2\pi fC}$$

$$=\frac{1}{\frac{2\times3{\cdot}142\times50\times1{,}000\times0{\cdot}01}{1{,}000{,}000}}$$

$$=\frac{1}{\frac{3142}{1{,}000{,}000}}$$

$$=\frac{1}{0{\cdot}003}$$

$$=333\Omega.$$

Now calculate the impedance

$$Z=\sqrt{R^2+Xc^2}$$
$$=\sqrt{(1{,}000)^2+(333)^2}$$
$$=\sqrt{1{,}000{.}000+110{,}889}$$
$$=\sqrt{1{,}110{,}889}$$
$$=1053 \text{ (by logs).}$$

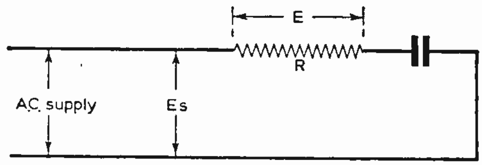


Fig. 11: The test circuit for a capacitor.

The circuit is checked with the valve voltmeter. Es is found to be 100 and E 90V. The actual impedance is:

$$Z=\frac{Es}{I}\times\frac{R}{E}$$

$$=\frac{100}{1}\times\frac{1{,}000}{90}$$

$$=1{,}111\Omega.$$

There is a difference of 58Ω, which is probably due to leakage in the capacitor.

The correct power factor of the circuit will be:

$$\text{Correct power factor}=\frac{R}{R^2+Xc^2}$$

$$=\frac{1{,}000}{1{,}053}$$

$$0{\cdot}95 \text{ lead.}$$

The actual power factor of the circuit is:

$$\text{Actual power factor}=\frac{R}{Z}$$

$$=\frac{1{,}000}{1{,}111}$$

$$=0{\cdot}90 \text{ lead.}$$

The difference in the correct and actual power factors is very close, which is quite good. A large difference would indicate a faulty capacitor. ■

Challenge your friends to BEAT the 'BEAM'

A Novel Device to keep your Christmas Guests Amused

By G. A. MELLOR

SOME kind of electronic game was required to provide an amusing distraction at a recent party. The unit had to be fairly inexpensive to build and automatic in operation. With these points in mind the following unit was devised, which may be constructed in two forms, beatable and non-beatable.

The finished product is a square box with perspex windows, internally illuminated by a 100W lamp. In the front is a hole 6in. square through which the competitor must put his hand to reach a prize placed on a shelf at the rear of the box. A beam of light is projected across the inside of the hole, the light falling on a photo-sensitive device. Immediately a hand is put through the hole, the beam of light is interrupted, causing a relay to become energised. This relay performs two operations, (a) switches off the interior light, (b) brings a "cheat" alarm to the ready.

The idea of the game is to reach in the box and remove the prize before the interior light goes out; if the prize is lifted from the shelf when the light is out, the "cheat" alarm rings.

Light Sensitive Unit and Amplifier

Various methods were tried to sense the cutting of the beam of light. The method finally adopted uses a glass encased transistor with the protective paint removed.

This transistor TR1 is mounted in the reflector from a disused torch, the reflector then being pushed into a 35mm film tin, see Fig. 1. The transistor leads are brought through a hole in the base of the tin and fastened to a three-way terminal strip. Connections to the transistor should be made with twin core screened cable. A number of transistors were tried in the prototype and all worked very well, even one which had been slightly damaged by heat gave good results as a detecting device.

TR2 acts as a d.c. coupled amplifier. When light reaches the junction of TR1, its collector current increases, this increase is accompanied by an even greater rise in TR2. When TR2 collector current reaches 750μA the relay RLA energises. If the light beam to TR1 is interrupted RLA de-energises.

RLA is a Carpenters type polarised relay in which the contact screws have been adjusted to make it a monostable type, this is a simple adjustment. Any other type of relay would work in RLA position, the only requirements being a low resistance coil and a low energising current.

Light Source

The light beam to the transistor is provided by a 6·3V 3W bulb. This bulb LP1 is also contained in a film tin, connections being made to a two-way terminal strip bolted to the bottom of the tin. A reflector was used in the prototype, but was found to be unnecessary if the tin be polished on the inside to give a good reflecting surface. Lamp brilliance is adjusted by RV1.

Switching Circuits

Fig. 2 shows the relay switching circuits, and the sequence of operation is as follows. When the light beam to TR1 is interrupted, RLA de-energises, its contacts RLA1 make, feeding 50V

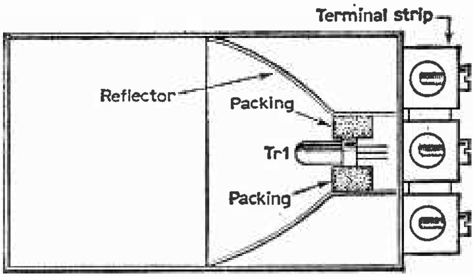


Fig. 1: The method of mounting Tr1.

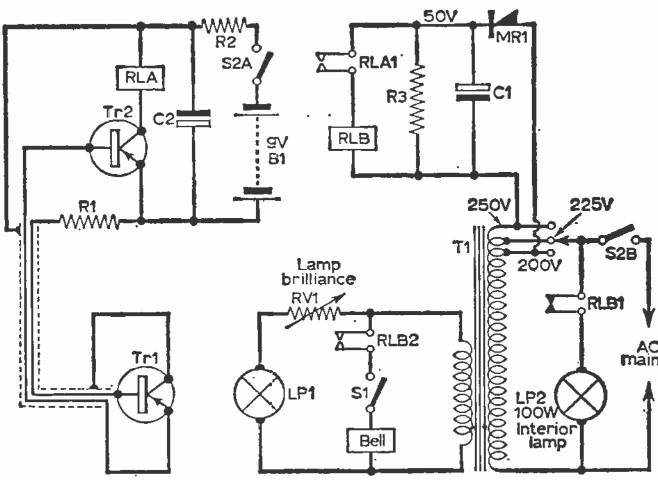


Fig. 2: The relay switching circuits.

to RLB. This second relay RLB energises, contacts RLB1 open so switching off the 100W lamp LP2; contacts RLB2 close, feeding 6·3V to S1.

If now the prize is lifted from the shelf, S1 closes putting 6·3V across the alarm bell, the bell will commence to ring and will not stop until the prize is replaced or the hand is withdrawn from the unit.

The microswitch S1 is mounted as shown in Fig. 3. The button should be sufficiently proud of the shelf to ensure reliable operation. In the prototype a ¼lb box of chocolates operated the switch reliably.

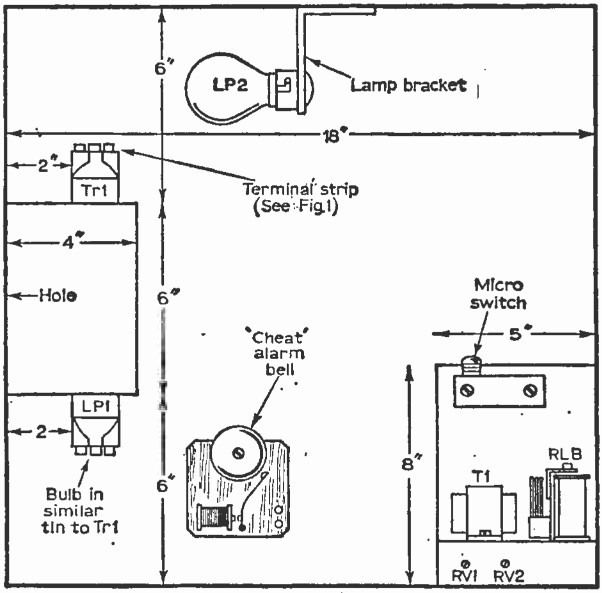


Fig. 3: The mounting for S1.

Power Supplies

As the maximum consumption of the amplifier was only 1mA it was considered unnecessary to build a mains power unit, so instead two 4·5V flat batteries were used, one half of S2 being utilised to switch off this supply with the rest of the equipment.

The lamp LP2 is powered from the mains, while LP1 and the alarm bell are fed from a 6·3V heater transformer, T1. The 50V for RLB is also taken from this transformer, a tap being made between the 200V and the 250V windings. This a.c. supply is rectified by MR1 and smoothed by C1, the value of C1 need only be sufficient to prevent relay chatter. It should be noted at this point that the coil and contacts of RLB and the contacts of RLA are all at mains potential, these contacts should therefore be well out of reach of the hand in the box!

COMPONENTS LIST

R1	180kΩ ½W
R2	100Ω ½W
R3	10kΩ ½W
RV1	50Ω wire-wound potentiometer
RV2	50kΩ wire-wound potentiometer
C1	16μF electrolytic 100V
C2	12μF electrolytic 12V
C3	500μF electrolytic 100V
TR1	See text
TR2	OC71 or any audio type
LP1	6·3V 3W
LP2	240V 100W
RLA	Carpenters type polarised relay. Low resistance coil
RLB	Relay with double c/o contacts, 3,000Ω coil
MR1	115V 30mA half wave rectifier
S1	Microswitch
S2	D.P.S.T. toggle switch
T1	Heater transformer. Primary 200/230/250V. Secondary 6·3V 5A
Bell	6V a.c. type

Construction

The box is 18in. square with perspex windows as shown in Fig. 3.

The amplifier, bell and transformer are all mounted on a small sub-chassis beneath the shelf. It is advisable to conceal the main on/off switch or the constructor may find himself buying a large number of prizes!

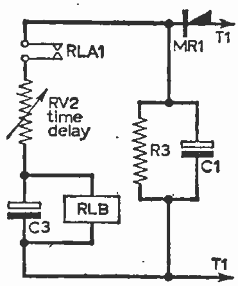


Fig. 4: The C-R network necessary to provide a time delay.

One important point to note in the construction is the position of the interior lamp. This must have no effect on TR1, for this reason it has been mounted above and behind TR1 as shown.

Setting Up

When the unit is finished, turn RV1 to maximum resistance and switch on, relay RLA should not hold in. Increase the lamp brilliance until RLA becomes energised. Cutting the light beam should now operate the unit.

If RLB is fed directly from the 50V supply it will energise as soon as RLA1 contacts make, and the competitor therefore has no chance of reaching the prize before the light goes out. To give the competitor a chance to win a prize it is possible to insert a long C-R network into the supply of RLB as shown in Fig. 4. The time delay may be varied by adjusting RV2. The component values shown gave a delay from almost zero to four seconds in the original model. ■

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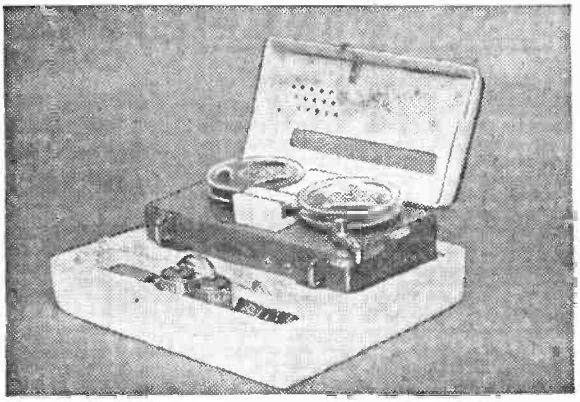

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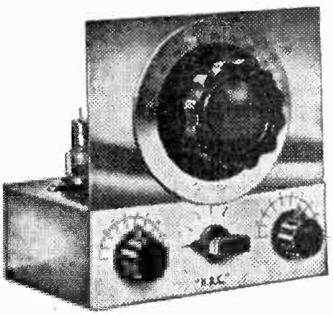

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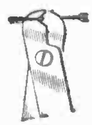

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MULTICORE SOLDERS LTD.
MULTICORE WORKS · HEMEL HEMPSTEAD · HERTS. (BOXMOOR 3636)

CMMS 34

The Progressive PORTABLE

This receiver is built in successive stages, each new stage adding to the performance of the set and culminating in a six-transistor, two waveband portable.

CONTINUED FROM PAGE 745 OF THE DECEMBER ISSUE

By R. F. Graham

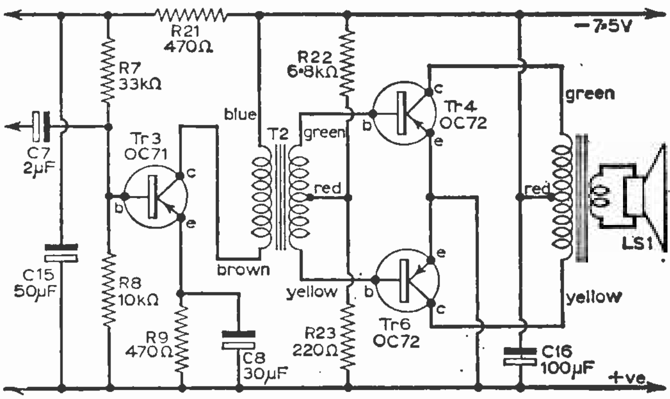


Fig. 7: The driver and Class B push-pull output stage.

WITH the Class B output stage, the output transistors are so operated that they pass very little current when no signal is present. Current rises in proportion to volume, and the Class B output stage will provide very much more power with greater economy of current, than was available from the single transistor.

Both driver and push-pull output stages are shown in Fig. 7, but the OC71 driver stage (Tr3) will already be present, and will have been tested. Converting to the push-pull stage is thus quite an easy modification.

The output transformer T1 is already fitted, and the driver transformer T2 is located as in Fig. 10, taking care to position it so that the coloured leads emerge as in Fig. 11. The 2·7kΩ resistor R10 wired to the collector of the OC71 is removed, and the driver transformer primary is wired in its place.

Other components and wiring, as in Fig. 7 can then be added. The physical arrangement should agree with Figs. 10 and 11.

Take care that the centre taps of both transformers are correctly connected. In addition, it is only necessary to connect the 6·8kΩ (R22) and 220Ω (R23) resistors, and the additional OC72 (Tr6). The 100μF capacitor C16 is also added. The 50μF capacitor C10 originally used with the Class A OC72, now decouples the negative battery line to all earlier stages, and becomes C15 of Fig. 7 subsequent diagrams.

When the stage is finished, a meter in one battery lead should show approximately 10mA to 12mA or so, with no station tuned in. As a station is tuned in, and volume is increased, the current will rise. On peaks, with average volume, it will jump up to 20mA to 25mA or so. If maximum volume is obtained from a powerful local station, peaks of current may be considerably higher than 25mA. For many purposes indoors, sufficient volume will give peaks of only 15mA or so.

Reproduction should be of good quality. If the no signal current is very low, and results are distorted, reduce the 6·8kΩ (R22) resistor slightly in value. Should the no signal current be high, the 220Ω (R23) resistor is probably too high in value, or the 6·8kΩ resistor too low. Normally, no adjustment to these values should be wanted.

When the set is found to work correctly, negative feedback may be added to driver and out-

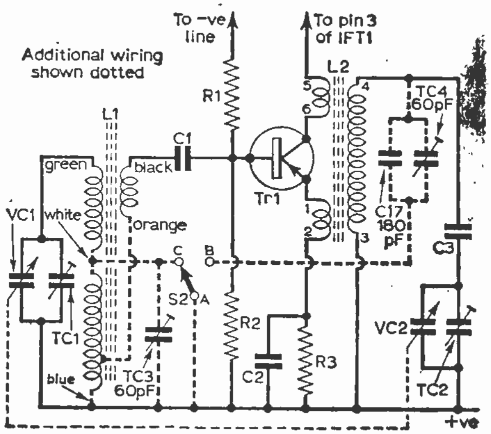


Fig. 8: The circuit for dual-wave coverage.

SUMMARY OF REQUIREMENTS FOR FOURTH, FIFTH AND SIXTH STAGES

Driver and Class B Push-Pull Output (Fig. 7)
Resistors: R20-22
Capacitors: C15-C16
Transistor: Tr6
Transformer: T2

Long Wave Coverage (Fig. 8)
Capacitors: C17, TC3, TC4
Inductor: l.w. winding for L1
Switch: S2

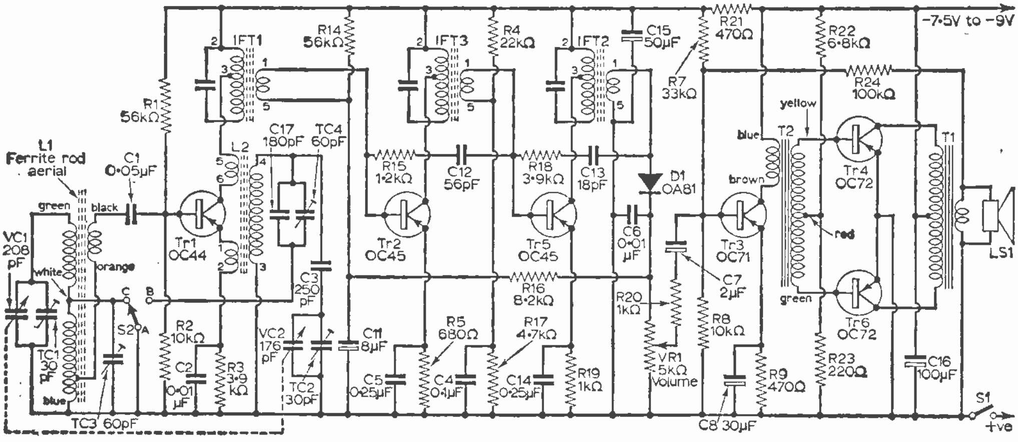


Fig. 9: The complete 6-transistor, dual-wave receiver circuit.

put stages. This is obtained by means of the 100kΩ resistor R24 in Figs. 9, 10 and 11.

One loudspeaker tag is returned to the "earth" line, as in Fig. 10. The 100kΩ resistor is taken from the other loudspeaker tag, to the OC71 base (Fig. 11). There should be a slight drop in volume, as the resistor is connected. If oscillation results instead, switch off and reverse the two wires which go from the output transformer secondary to the loudspeaker.

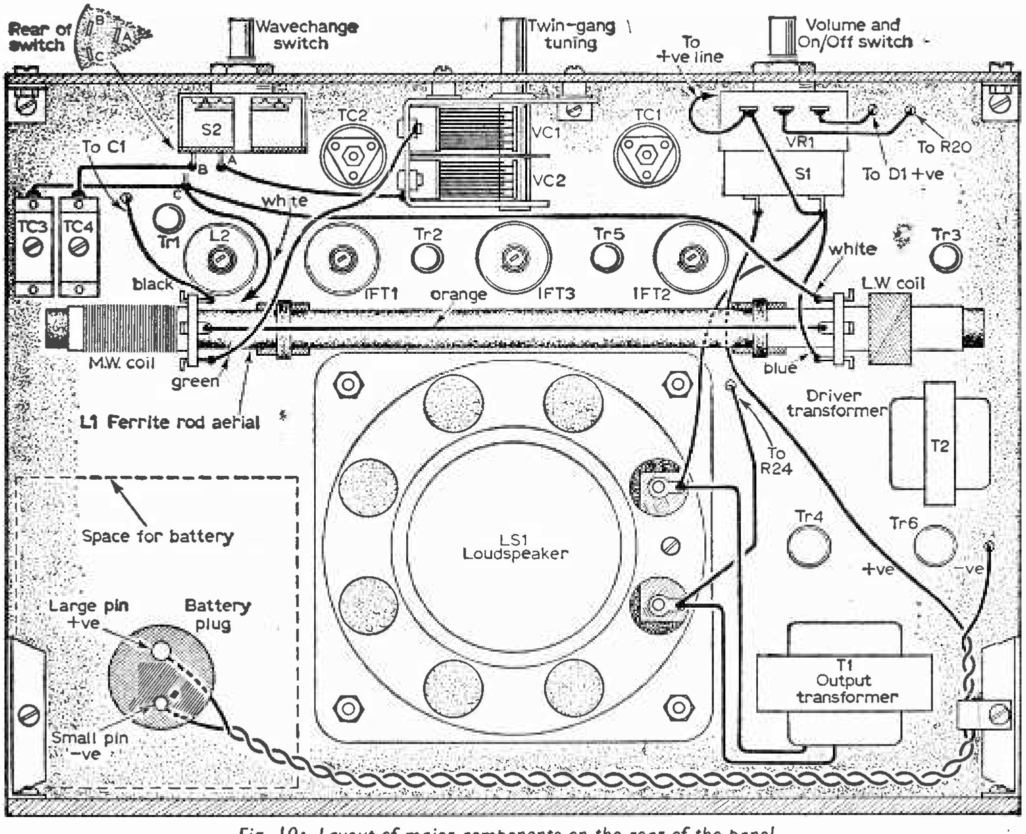


Fig. 10: Layout of major components on the rear of the panel.

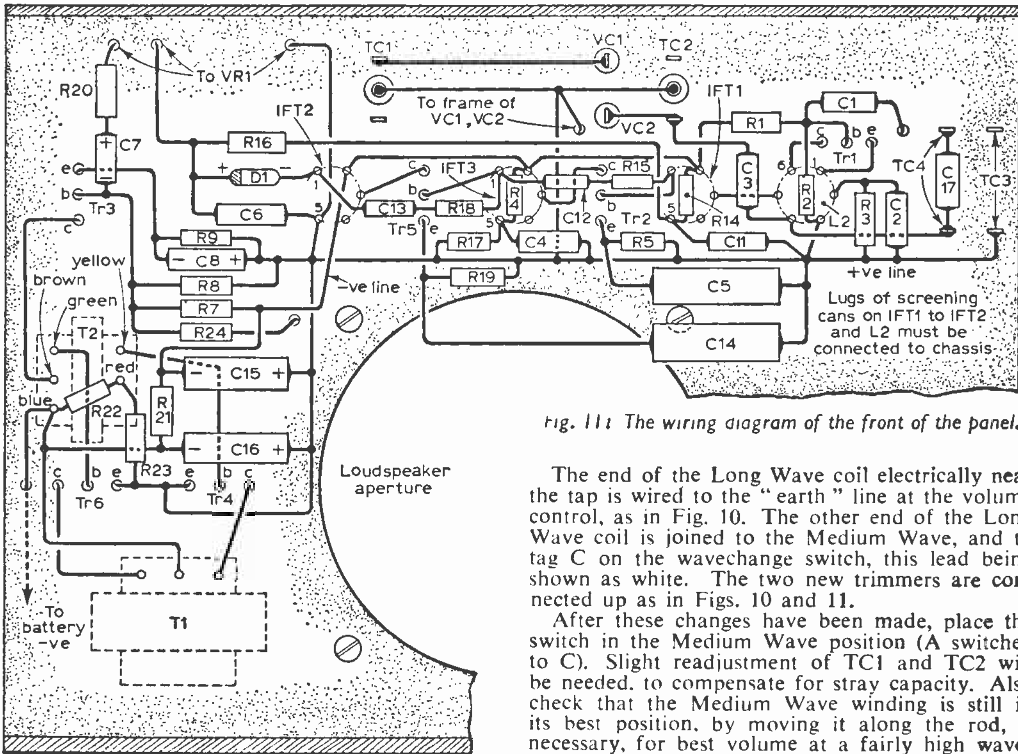


Fig. 11: The wiring diagram of the front of the panel.

Adding Long Waves

The required additions for dual-wave tuning can be made at any time, irrespective of the number of stages so far provided in the receiver. When adding long waves, no changes have to be made to the other parts of the receiver. In the same way, if long wave tuning has already been fitted at an earlier stage, this has no effect on the other constructional details.

The extra items required, to permit dual-wave coverage, are shown in Fig. 8. A Long Wave winding section is added to the ferrite rod. There is a 180pF fixed capacitor C17, and two 60pF compression trimmers TC3, TC4, in addition to the single pole two-way wavechange switch S2.

The two trimmers, TC3 and TC4, are positioned as in Fig. 10. Holes are drilled to clear the projecting tags, and also the adjusting screws. Bending the tags slightly will hold the trimmers in place.

The actual wiring will be clear from Figs. 10 and 11. Green is used for the beginning of the Medium Wave winding, which already goes to VC1, and is unchanged. Black is used for the coupling winding, and already goes to C1, this being unchanged.

The free end of the coupling winding no longer goes to the "earth" line, but is wired to the tapping on the Long Wave coil; this lead is shown as orange in Figs. 8, 9 and 10.

The end of the Long Wave coil electrically near the tap is wired to the "earth" line at the volume control, as in Fig. 10. The other end of the Long Wave coil is joined to the Medium Wave, and to tag C on the wavechange switch, this lead being shown as white. The two new trimmers are connected up as in Figs. 10 and 11.

After these changes have been made, place the switch in the Medium Wave position (A switched to C). Slight readjustment of TC1 and TC2 will be needed, to compensate for stray capacity. Also check that the Medium Wave winding is still in its best position, by moving it along the rod, if necessary, for best volume at a fairly high wavelength on the Medium Wave band (tuning capacitor fairly well closed).

Turn the switch for long waves (A switched to

—continued on page 865

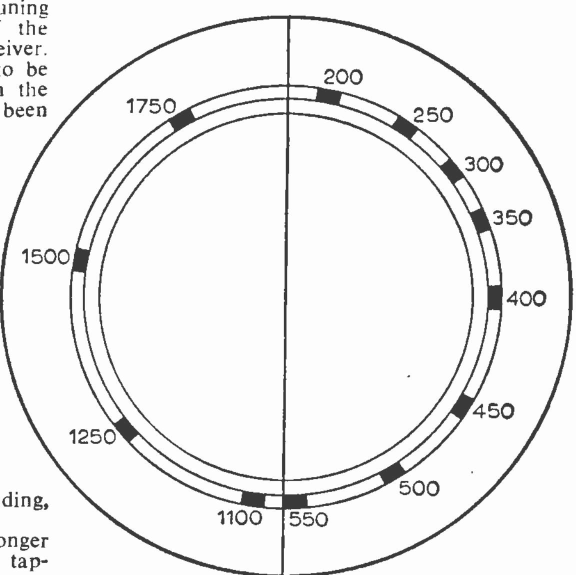


Fig. 12: The tuning scale of the receiver, drawn actual size.

Alternative Tape Decks for the Malvern

By T. Snowball

Many readers have written to the author of the series of articles which described the construction of this tape recorder, requesting modification details for using different tape decks. For their benefit and for any other readers contemplating building the Malvern, this present article has been prepared, showing how two very popular decks are used with the original design.

THE recorder circuitry, as described in July, August and September issues of P.W. is suitable for all decks with medium to high impedance record play heads and low impedance erase heads. However it only gives correct frequency response for $3\frac{3}{4}$in/sec; so below will be found information on how to convert the Malvern tape recorder for use with a very popular deck.

THE COLLARO STUDIO DECK

The inductance of heads fitted on the Collaro studio deck is similar to those on the B.S.R. deck, thus no change is required to the output stage or input circuit. The bias and erasure circuits will also stay unchanged.

Compensation to the frequency response of the amplifier is necessary for the three speeds. Frequency responses which should be easily obtainable are given below:

$1\frac{7}{8}$in/sec	80c/s to 4kc/s	At a recording
$3\frac{3}{4}$in/sec	60c/s to 6kc/s	current of 100μA
$7\frac{1}{2}$in/sec	50c/s to 12kc/s	and bias of 0·9mA

The circuit changes to obtain these responses are indicated below: and in Fig. 1.

On Record

The treble boost inductor L1 has to be tuned to 4, 6 and 12kc/s with a boost of 10dB, involving the addition of two capacitors, C25 and C26, and also changing the value of C11, C12 and R16.

On Playback

The time constant of the integrator has to be changed from 100μS at $7\frac{1}{2}$in/sec to 200μS and 300μS at $3\frac{3}{4}$in/sec and $1\frac{7}{8}$in/sec respectively.

This is achieved by adding C27 and C28, also changing the values of C5 and C4 and R8. See Fig. 2.

This corrects the low frequency end of the characteristic, but some top boost is best applied by varying the value of C13 as shown in Fig. 3.

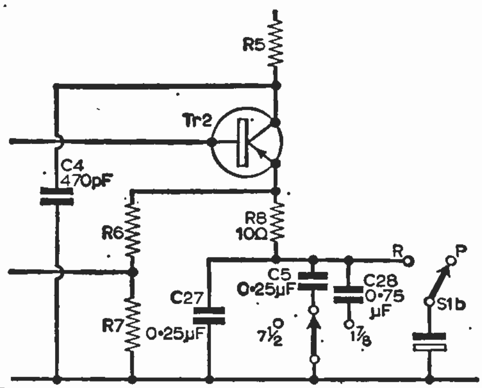


Fig. 2: Changes necessary to alter the time constant of the integrator.

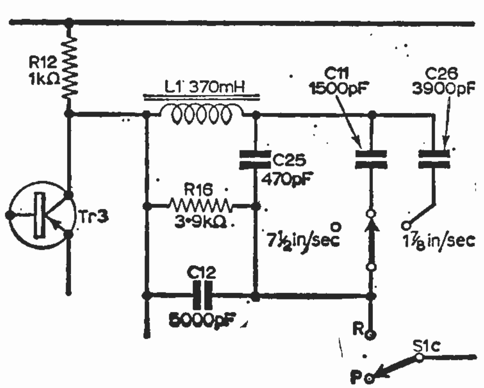


Fig. 1: This shows the circuit changes necessary to obtain the frequency responses given in the text.

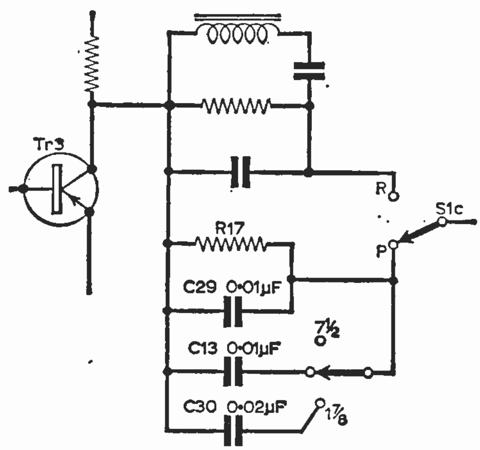
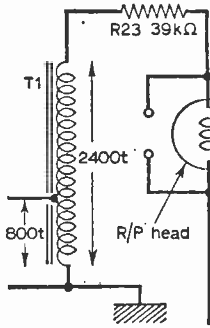


Fig. 3: Varying the value of C13 gives some top boost to the characteristic.

Fig. 4: The re-designed transformer in circuit.



This completes the modifications for use with the Collaro deck, but since the article was originally published, a considerable number of constructors have requested details on how to make the recorder completely portable.

Obviously a battery driven tape deck is the main requirement here, and the Garrard Battery Tape Deck, which runs at $1\frac{7}{8}$in/sec and $3\frac{3}{4}$in/sec and is powered from a 9V battery, supplies this need.

THE GARRARD BATTERY TAPE DECK

The modifications required when this deck is used are similar to those just given for the Collaro deck. However, only two speeds are involved, and because of the lower inductance heads the output stage can be advantageously changed.

In the output stage there are at least three possibilities, each one having its own particular merit.

(a) Leave the output circuit as designed.

(b) Leave the output circuit unchanged but change the head transformer.

(c) Change the output circuit and head transformer.

Method (a) is perfectly correct, but it uses expensive output transistors, which are not needed unless high power (0·35 to 2W) is required. It also demands large batteries, PP1 or "Lantern" type cells as a minimum.

Considering (b), there is a case for redesign of the output transformer, because of the different head inductance.

This head inductance is given as 0·11H with a recording current of 60-200μA r.m.s. If the 10dB of top boost is used then, as the amplifier will give out 3·8V r.m.s. in this condition; a normal output is 10dB down on 3·8V r.m.s., or 1·25V, which should give a recording current of approximately 100μA.

The impedance of the head at 5kc/s is 3·5kΩ from $X_L = 2\pi fL$. So in order to get a constant recording current the series resistor is made ten times larger, i.e. 39kΩ. The transformer output of 3·9V r.m.s. will give a recording current of 100μA. Therefore the output transformer ratio should be

$$\frac{3{\cdot}9}{1{\cdot}25} = 1/3.$$

Winding the transformer on the same core LA1, now means that a higher primary inductance can be used, thus demanding less amplifier current and reduced risk of core saturation at low frequencies.

The redesigned transformer should therefore have 2,400 turns of 44 s.w.g. enamelled wire, tapped at 800 turns. This gives a primary

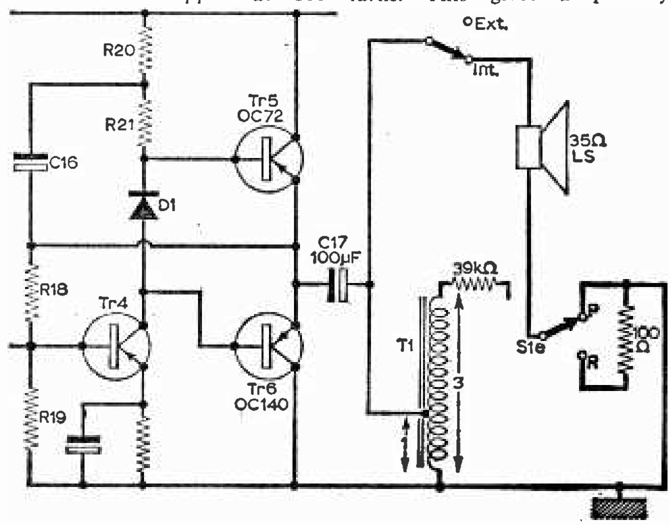


Fig. 5: The output stage for a 35Ω speaker.

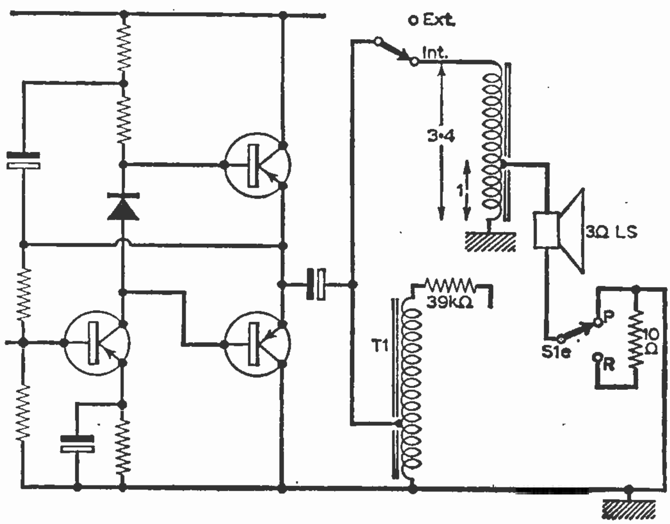


Fig. 6: The output stage for a 3Ω speaker.

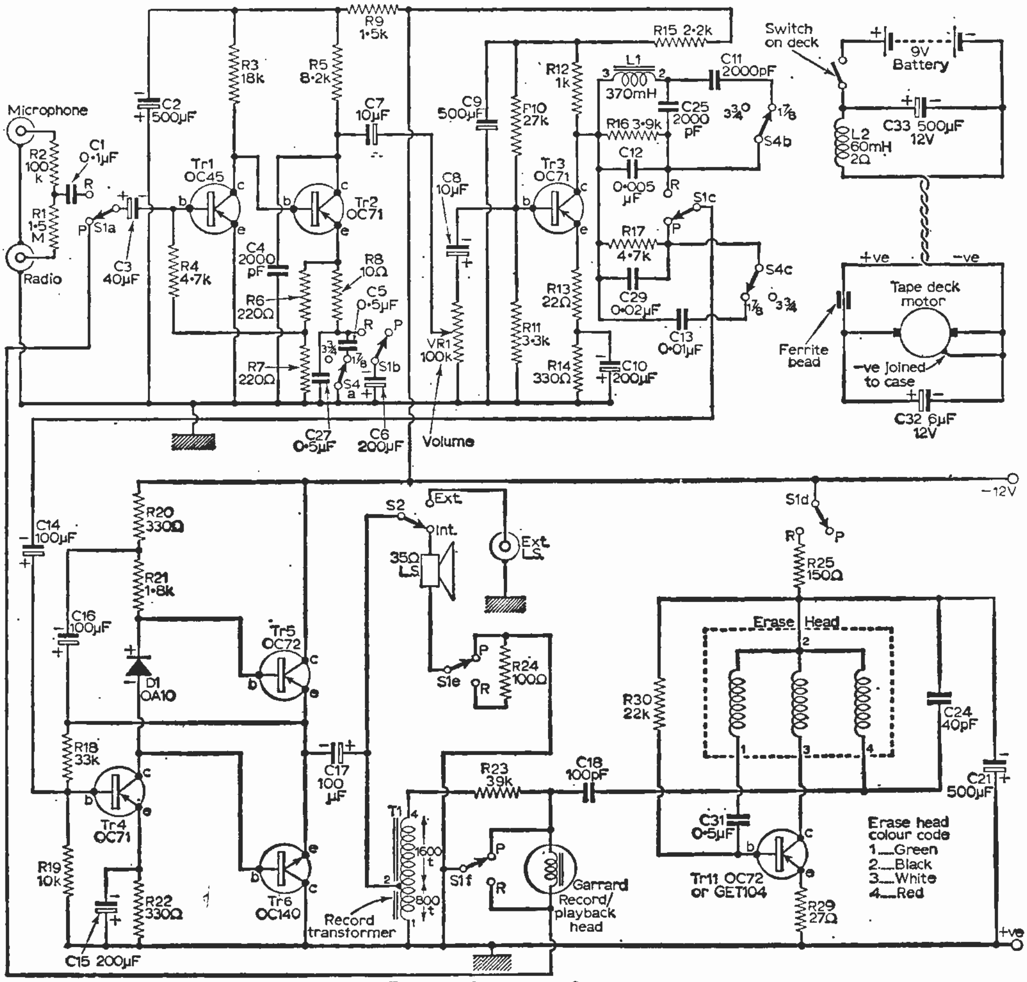


Fig. 7: The modified circuit for the Garrard deck.

inductance of 220mH, and presents a load of 60Ω at 50c/s, whereas the original transformer only presented 12Ω.

Now for method (c). The last fact mentioned above means that with the rewound transformer the circuit can be simplified for less battery drain.

The modification limits the audio output on playback to 350mW which is, of course, eminently suitable for a small portable tape recorder. In this modification the two power output transistors are omitted and the head transformer is driven directly from the OC140 and OC72 as shown in Fig. 5.

The loudspeaker can still monitor on record, but the loading must be matched by means of an output transformer or a 35Ω loudspeaker must be used. If a 3Ω loudspeaker is used, the transformer ratio needs to be $\sqrt{\frac{35}{3}}=3{\cdot}4/1$, with a primary inductance of at least 50mH. See Fig. 6. This can be easily made by the constructor because, as the inductance required is low, so are the number of turns. And on a normal loudspeaker transformer core, which is about ½in. x ½in., the required inductance is given by 250 turns, tapped at 70 turns. The gauge of wire is chosen so as to fairly well fill the bobbin, 30 s.w.g. is a good guide. C17 can be reduced to 100µF because of the higher output impedance.

So to review these three types of output stages:

(a) Is suitable if large batteries and output power is needed, and requires no extra work.

(b) Is the best theoretical answer and is recommended.

(c) Is suitable if reduced battery and audio power satisfies the constructor's requirement.

Now to finish the circuit modifications.

On Record

The treble boost circuit should be similar to the Collaro circuit, keeping only C25 and C11.

C25=200pF, C11=200pF, C26=not used.

Also on record, which of course includes the function of erasure and bias, the circuit needs to

COMPONENTS LIST

Additional Components:

C27	0·5μF paper
C25	2,000pF mica
C29	0·02μF paper
C31	0·5μF paper
C32	6μF electrolytic 12V
C33	500μF electrolytic 12V
R29	27Ω 1W 10%
R30	22kΩ 1W 10%
S4	Equalisation switch, 3-pole 2-way
L2	60mH 2Ω filter choke
LS	35Ω transistor type
TR11	OC72, GET104 or NKT243

Change in Value:

C4	470pF ceramic
C5	0·5μF paper
C11	2,000pF mica
C12	0·005μF paper
C13	0·01μF paper
C24	40pF ceramic or mica
C18	100pF ceramic or mica
C17	100μF electrolytic 12V
R8	10Ω 1W
R16	3·9kΩ 1W
R23	39kΩ 1W
R24	100Ω 1W
R25	150Ω 1W
T1	2,400 turns of 44 s.w.g. e.w. tapped at 800 turns on LA1

be changed considerably. Here because of the high efficiency of the Garrard heads a great saving of battery current is possible.

The erase oscillator employs only one transistor—an OC72, GET104, or NKT243. The erase head is also the oscillator coil and the consumption is very small; 20mA at 9V is quoted.

Bias is supplied from an overwind on the oscillator coil, this develops 65V which is applied to the recording head via a 100μF capacitor.

On Replay

Once again as the Collaro modifications with:

C27=0·5μF C5=0·5μF C28=not used.
C29=0·02μF C13=0·01μF C30=not used.

When using the Garrard deck a separate 9V battery is recommended for the motor. Because the motor is governor-controlled, some interference may enter the amplifier unless some supply filtering is done.

A circuit which has proved satisfactory is included in the redrawn diagram (Fig. 7). The choke may consist of about 300 turns of 28 s.w.g. enamelled, wound in an old small speaker transformer core. The resistance of the choke should not exceed 2Ω. A battery switch for the deck motor is mounted on the deck and operated by the wind and play controls.

The recording switch is carried below as in the B.S.R. deck and the wafers for S1 can be fitted. Suitable size wafers are the Plessey type GA1 size 2.

The approximate consumption of the modified amplifier will be as follows:

	Record	Play
(a)	35—330mA	12—300mA
(b)	35—330mA	12—300mA
(c)	30— 80mA	8— 60mA

Tape deck consumption is 100mA at 3¾in/sec. and up to 200mA for fast wind. ■

Progressive Portable

—*continued from page 857*

B) and adjust TC4 and the position of the Long Wave coil on the rod, for best sensitivity, at a high wavelength. Then tune to a low wavelength on this band (tuning capacitor fairly well open) and adjust TC3 for best results. In reasonable circumstances, some Long Wave stations other than the Light Programme on 1500m should be received, and these can be used for adjustments.

For maximum possible performance, it is usual to repeat all adjustments on both Medium Wave and Long Wave bands, until no further improvement can be obtained.

Figs. 9, 10 and 11 show the complete receiver, using six transistors, and covering both wavebands. The type of connector illustrated in Fig. 10 is for a 7½V battery, which has a very long working life indeed.

Tuning Dial

The tuning dial is shown in Fig. 12, and is marked in wavelengths, for Medium and Long Waves. This dial is fitted on the panel under the tuning knob, and held with adhesive. A piece of thin Perspex or other transparent material will protect the dial.

To obtain best agreement with the wavelengths marked, adjust the trimmers at a low wavelength, and the oscillator coil and aerial windings at a high wavelength, on each band, in the previously described manner. ■

DOMESTIC STRAIGHT THREE

—*continued from page 841*

pick up the weaker transmissions, but in almost every case a picture-rail aerial, comprising some 12 to 20ft of insulated wire, will suffice. The use of a good earth connection will also be found beneficial in the poorer reception areas.

Volume obtainable from the local BBC transmissions should be more than adequate for all domestic requirements and the quality of reproduction will be found to be remarkably good, particularly in view of the simple nature of the circuit and few components employed.

FADING

It is only in especially adverse situations, such as the East Coast of England, where after dark there is trouble from fading of BBC stations and interference from the more powerful Continentals, that results may disappoint; there is no easy remedy for this, as even quite elaborate superhet receivers are frequently incapable of giving a satisfactory performance in these areas. Sometimes the use of a short indoor aerial is beneficial, but this, of course, renders it impossible to receive more distant stations when these are required. But in the vast majority of cases this receiver will prove a fitting reward to the effort of building it, particularly in the case of the novice building his first mains operated set and will, it is hoped, provide the spur to go ahead with more ambitious designs in due course. ■

Trade News

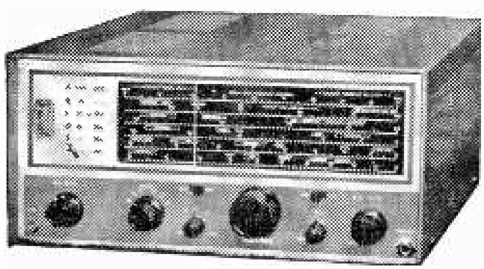
General-coverage Receiver Kit

THE model RG-1 general-coverage receiver is available from Heathkit either in kit form or ready-assembled. It tunes over the medium wave band and short wave bands from 1·7Mc/s to 32Mc/s in five ranges.

The sensitivity of the receiver on short waves is 3μV for 10dB signal/noise ratio or better. The eight valve circuit incorporates a variable noise limiter and a half-lattice crystal filter. When built, the set has an i.f. of 1621kc/s and an audio output of 2W.

The kit includes an attractive, robust steel cabinet measuring $13\frac{3}{4}$in. x $11\frac{1}{2}$in. x $6\frac{1}{2}$in., and a tuning meter is a feature of the front panel.

The Heathkit RG-1 is made by *Daystrom Limited, Gloucester.*



Heathkit's new general coverage receiver.

Dual-trace Oscilloscope

THE new dual trace oscilloscope, type CD.1183, designed by the Solartron Electronic Group, Ltd., has made use of the principle of modular construction so that the "X" and "Y" self-contained modules may be interchanged speedily and easily when required.

The main unit contains a high resolution c.r.t., a multi-range 1kc/s calibrator, two main vertical deflection amplifiers, one main horizontal deflection amplifier, and all power supplies.

The type CD.1183 oscilloscope is manufactured by the *Solartron Electronic Group, Ltd., Farnborough, Hampshire.*

New Range of Hi-Fi Equipment

A NEW range of high fidelity tuners and amplifiers has recently been introduced by Armstrong Audio Limited. Included in this range is an integrated stereo amplifier, model 222, which delivers 20W output. It has been designed to accommodate the high quality ceramic pick-ups which are now coming on to the market. The controls include wide range bass, treble and balance controls and the circuit incorporates a rumble filter. The price of this amplifier is £27 10s.

Also in the new Armstrong range are two tuners; the type 224, which is an f.m. tuner costing £22 10s., and the type 223, which is an a.m./f.m. model and costs £28 15s. The manufacturers of this new range of equipment are *Armstrong Audio Limited, Warlters Road, Holloway, London, N.7.*

The Armstrong type 223 a.m./f.m. tuner.

Sound Effects Records

A NEW series of sound effects records has recently been introduced by Recorded Tuition Ltd. On the Contrast label, MFX1 has a general selection of 14 sound effects, including train, car, ship and aircraft sounds, storm effects, etc. MFX2 augments this with a further selection of 12 assorted effects with the emphasis on footsteps, American police cars, but includes other effects such as applause, car crash, etc. Between them, these two records present a good general purpose library of 26 different sound effects.

More specialised is Contrast TFX1, which is devoted entirely to train sounds and the 11 tracks provide a comprehensive selection ranging from a tank loco to a diesel express. Contrast AFX1 is also specialised, this time the subject being wild animals—there are 15 tracks.

Electronic sounds are dealt with on Castle EFX1. Side 1 is taken up with electronic music intended for dramatic introduction and background in plays, documentaries, etc. Side 2 has several tracks devoted to "space ship" effects, the remainder being a selection of miscellaneous electronic sounds suitable for a variety of applications.

All these records are 7in. e.p.'s (45r.p.m.) and all the sounds were recorded by F. C. Judd, A.Inst.E. The quality of reproduction justifies the "hi-fi" claim, the realism is first rate. There are two practical points to note: the length of every individual item is given in seconds on the record sleeves and, secondly, all the tracks are free of copyright to all *amateur* users.

The standard price for any of these records is 8s. 0d., including tax, postage and packing. They may be obtained from *Recorded Tuition Ltd., 174 Maybank Road, Woodford, London, E.17.*

HOME CONSTRUCTORS LOOK!

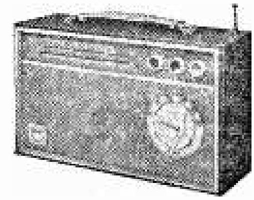
AT THESE OUTSTANDING CHRISTMAS GIFT BARGAINS

THE SKYROVER

7 TRANSISTOR PORTABLE RECEIVER

THE SKYROVER De Luxe

7 TRANSISTOR PORTABLE



GENERAL SPECIFICATION FOR BOTH MODELS

7 transistor and 2 diode superhet—6 waveband portable receiver, covering the full Medium Waveband (180-576 M) and Short Waveband (31-94 M) and in addition 4 separate switched Band Spread Ranges on 13M, 16M, 19M, and 25M/bands—with manual Band Spread Tuning for accurate Station selection. I.F. frequency 470 Kc/s. Output 500 MW. 5in. Ceramic Magnet P.M. Speaker. Telescopic and Internal Ferrite Rod Aerial. All Mullard Transistors and Diodes. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our detailed and easy to follow instructions. Operates on four 1.5V torch batts. (U2 or equivalent).

THE SKYROVER Individual Details—controls: Waveband Selector. Volume Control with on/off switch. Tuning Control with easy to read Dial Scale. In attractive plastic cabinet, size: 10 x 6½ x 3¼in., with metal trim and carrying handle.

MAY BE BUILT FOR £10.19.6

All Parts Sold Separately.

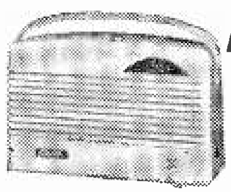
THE SKYROVER De Luxe. Tone Control Circuit is incorporated with separate Tone Control in addition to Volume and Tuning Controls and Waveband Selector. In sturdy wood cabinet, size: 11½ x 6¾ x 3in. covered in washable material with plastic trim and carrying handle. Also Car Aerial socket.

MAY BE BUILT FOR £12.19.6

All Parts Sold Separately.

Circuit diagram and data for each set 2/6 extra, free if all parts bought. Four U2 batteries 2/8 extra. Four Leak-Proof Batteries 3/4 extra. **Add 5/- P. & P. on each set.**

THE 'REALISTIC 7' AND REALISTIC 7 De-Luxe

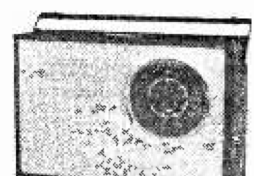


A fully transistorised Portable Receiver made to the highest professional standards—is now available to the home constructor. Comprises 7 Mullard Trans. OC44, 2 OC45's, OC71, OC81D, and 2 OC81's plus OA70 Crystal Diode. Delivers 350 milliwatt output to 4in. high flux speaker—I.F. frequency 470 Kc/s.—fully tunable over medium and long wavebands. All components mounted on single printed circuit board, size 5¼ x 5¼in. Attractive two-tone plastic cabinet with carrying handle—size 7 x 10 x 3½in. with easy to read dial and socket for car aerial, choice of Red/Grey, Blue/Grey or all Grey. Complete with full instructions.

MAY BE BUILT FOR £5.19.6 **All parts sold separately.** Battery 3/9 extra.

P. & P. 4/6 extra. (Circuit diagram 2/6, free if all parts bought.)

A "De Luxe" version of the well proven "Realistic 7" is now available, with the same specification as the standard model **PLUS** a restyled superior wood cabinet covered in attractive washable material, with chrome trim and carrying handle. **AND ALSO** a full vision circular tuning dial (externally mounted) to further improve this wonderful set.



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P. & P. etc. as Standard Model.

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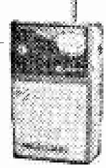
IDEAL GIFTS FOR ALL FROM 8 TO 80 !!

2 TRANSISTOR POCKET RADIO—COMPLETELY BUILT

Ready made as illustrated—complete with personal earpiece, telescopic aerial, battery and carrying case! Wonderful value and performance—full medium waveband coverage—built in 2¼in. speaker gives full tone reproduction. Works on single PP3 9v. battery. In attractive plastic case—size only 4 x 2¼ x 1in. All accessories included in the price.

WIRECOMP'S PRICE COMPLETE 42/- P. & P. 2/6



ALSO 6 TRANSISTOR POCKET RADIO—FULLY BUILT

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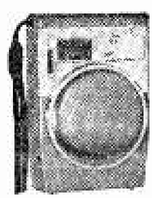
WIRECOMP'S PRICE COMPLETE 79/6 P. & P. 2/6

THE 'SPRITE'



A unique Wirecomp offer. The Sprite is a Six transistor superhet Miniature Pocket Radio of Commercial Quality—offered to you in three main pre-assembled units—which together with simple wiring—enable you to build it in only one hour! Fully tunable over Long and Medium wavebands. Uses printed circuit and High sensitivity internal ferrite rod aerial. I.F. frequency 470 Kc/s. Transistors: 3 Philco 2067's, 2 Mullard OC81M, OC81DM and OA90 diode. 3 inch speaker. Works on single PP3 battery. Supplied with the complete R.F. and I.F. stages. Driver and Output stages, ready built and mounted on the printed circuit; for final assembly you only have to fit the wave-change switch, tuning condenser and drive, volume control, earphone socket and aerial rod. In very attractive plastic case, size 4 x 2¼ x ⅞in.

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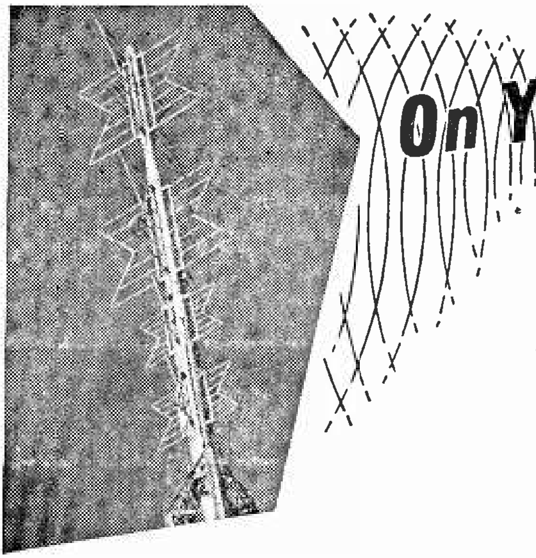

On Your Wavelength

By THERMION

JUDGING by our correspondence it seems that large numbers of beginners are unable (or unwilling) to make the effort and do their own shopping for radio parts, but seek a complete kit even for some of the most basic receiver designs. Is this a lack of enterprise by the beginners of today or is it just another manifestation of the affluent age? At any rate it set me thinking of those far-off days when I embarked upon the construction of my first one-valver.

Private Enterprise

First, the piecemeal collection of components—a few purchased but most obtained through divers other methods not involving the transfer of currency, such as exchange or the badgering of elders to donate parts. The preparation of the bread-board and front panel, the winding of the coil, the assembly of components and the wiring up. All ready now except for that one vital but expensive article—the valve.

Weeks of careful hoarding of pocket money would culminate in a Saturday morning expedition to the local radio shop and the dissipation of this accumulated wealth in one glorious fling. The brand new HL210 would be carried home in triumph, where trembling fingers would insert it in the long-vacant socket. The receiver was complete! Dare we connect up the accumulator and battery? Eagerness to try out the receiver would be tempered by fear of irrevocably damaging the valve, and so yet once more the wiring would be checked. Finally, the excitement and thrill as the phones became alive and emitted growls and squeals which were eventually coaxed away, leaving the broadcast signal in the clear.

The Way to Learn

Prepared kits of components are unquestionably a boon in many respects, on the other hand I do feel that the youngsters taking up radio construction as a hobby will obtain far more satisfaction from a piece of apparatus which has been built up from a host of individually selected parts. The many ensuing visits to radio shops in the process will provide valuable experience and a sense of judgment and discrimination over the disadvantages and advantages of various types and makes of component will, in this manner, soon be developed.

Finally, a word of advice. Even the rawest beginners should appreciate the need to present an orderly shopping list at the counter. This is particularly important when a large number of resistors or capacitors are to be purchased. Tot up the quantity of each value required and tick these off on the published components list as a check before setting out.

R.S.G.B. Exhibition

Upon visiting the Seymour Hall in London last month my first impressions of the ponderously (and, perhaps, misleadingly) named "International Radio Communication Exhibition" were that I had entered a commercial equipment-cum-Forces' recruiting show. Wandering past the proud and magnificent factory-made receivers and transmitters, I was suitably humbled as thoughts of the chaste appearance of the homespun equipment in my garden shack flashed across my mind. Still, I mentally cheered myself, a highly garnished facia panel does not help when trying to pull in that much-desired VR or HP.

I did regret the blatant professionalism everywhere and the abundance of shamateur operating stations, but on the credit side both the BATC exhibit, which included a demonstration of the reception of an actual ham TV transmission (from Harrow), and the teleprinter demonstration provided a touch of real amateur enterprise. It was interesting also to gaze upon the bygones of wireless in a display of components and equipment ranging from the 1920's to the middle 1930's.

But the most heartening sight as far as your scribe was concerned was not even in the main hall. In the far end of a small backstage room, beyond a surplus components shop, I found the Roding Boys' Society stand. Here were examples of radio equipment built entirely by the young members of this organisation, each item a happy reminder that the spirit of amateur radio is very much alive among the lads of today, emphasising once again that enthusiasm and ability to use one's hands are the most important assets for success in this hobby.

On departing, I thought that the R.S.G.B. had done a great injustice in placing this boys' club exhibit in a remote corner apart from the main show, then upon reflection it occurred to me that perhaps this arrangement will (albiet unintentionally) bring home to the visitor the gulf, not merely in space but in mind, that exists between the genuine and the pseudo amateur.

Home Inter-com Unit Mk II

A RECENTLY published circuit for a home intercom unit contained a fundamental error and this has not escaped the attention of many of our hawk-eyed readers! (See page 442, Sept. issue.)

A number of different re-arrangements have been proposed and we are publishing here (Fig. 1) one revised version which will perform satisfactorily while not requiring too drastic changes to the original design.

It will be seen that the telephone rest switch now has two contacts ' A ' and ' B ', and when one makes, the other is open.

Since the two poles of this switch must be completely isolated from each other, a different form of construction is needed for the handset rest. A suitable design is given in Fig. 2, where the rest is shown in the unloaded position, i.e. handset removed.

The main portion of the rest consists of a strip of Paxolin or other insulating material. The springs are soldered to the brass wing pieces, and the latter are screwed or rivetted to the Paxolin. Brass strip is used for the two switch contact arms; ' B ' is made a fixture to the top of the wooden housing, while ' A ' is fixed to the insulated part of the rest. Contact arm ' A ' operates a spring contact—this should be made from a piece of phosphor bronze. ■

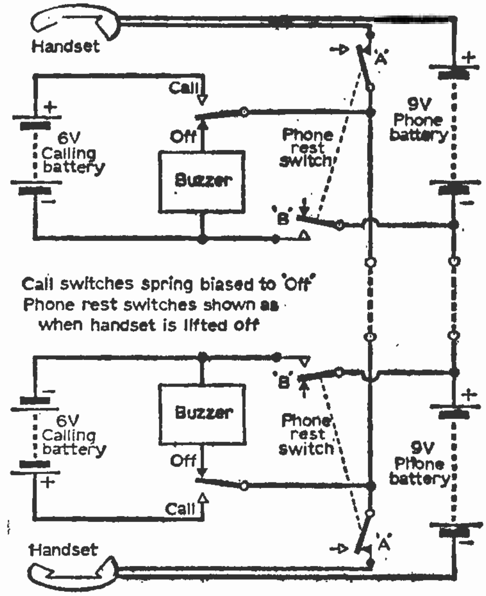

Fig. 1 The revised circuit.

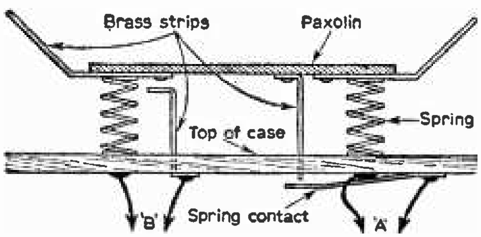

Fig. 2: The construction of the handset rest.

Wide Range L.F. Oscillator

—continued from page 815

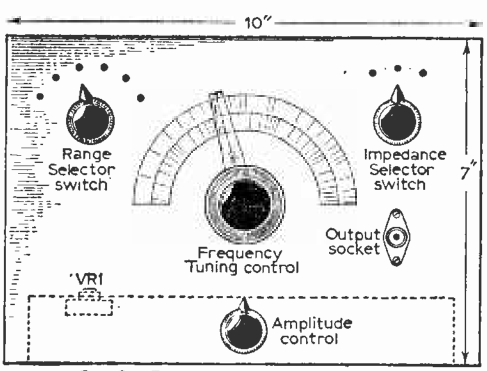

Fig. 3: The front panel of the unit.

Checking with an Oscilloscope

It will not be possible to check range 6 and the h.f. end of range 5 by the method described, these frequencies being above the normal audible hearing range. These can be checked on an oscilloscope, if available. An oscilloscope would also be an advantage when setting up the other ranges as any distortion would be at once evident.

If possible the oscillator should be calibrated against a commercially built instrument by the use of Lissajous figures on an oscilloscope, this giving extremely high accuracy. Another simple frequency check is to compare the audio tones heard in the headphones with the notes of a piano scale, this giving an approximate calibration over the audio range.

The calibration points may be marked on a large radio type dial with transparent cursor, or a simple pointer knob used with a 100° or 180° scale, a graph or table being drawn for each range, degrees against frequency.

Finally, the impedance of the low impedance output is of the order of 1000Ω and any external load much below this value may cause distortion. If the unit is to work into a lower impedance load, a series resistance should be used (in series with the output lead), to increase the total impedance to about 1000Ω level. Another method is to use a step-down transformer of the correct ratio. ■

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A 24 gns. Tape Recorder offered at the bargain price of only 15 gns. plus 10/- carr. Supplied in 3 Units already wired and tested. A modern Circuit for quality recording from Mike, Gram or Radio, using latest B.S.R. Twin Track Monardeck Type TD2. Magic Eye recording Indicator, Ext. spkr., switch, super-impose and straight-through amplifier facilities, etc.

Valve line up EF86, ECL82, EM84, EZ80 and Silicon Diode.

2 tone Cabinet and 8" x 5" Speaker Size 14" x 10½" x 7½"	£3.10.0	+ 5/- Carr.
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B.S.R. Monardeck Type T.D.2	£7.7.0	+ 4/6 Carr.
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Famous Manufacturer. Bulk purchase, genuine recommended Tape Bargain. Unconditional Guarantee. Fitted Leader & Stop Foils (except 3in.).

	Standard (PVC base)		Long Play (P.V.C. base)		D'ble Play (Mylar base)	
3in.	150ft.	3/9	225ft.	4/9	300ft.	6/6
5in.	600ft.	11/6	900ft.	15/-	1200ft.	25/-
5¾in.	850ft.	14/6	1200ft.	17/6	1800ft.	32/6
7in.	1200ft.	17/6	1800ft.	22/6	2400ft.	42/6

Post and Packing—3in. Reels, 6d. Each additional Reel, 3d. 4in. to 7in. Reels 1/-. Each additional Reel, 6d.

EMPTY TAPE REELS (Plastic): 3in. 1/3, 4in. 2/- 5in. 2/-, 5¾in. 2/-, 7in. 2/3.
PLASTIC REEL CONTAINERS (Casettes): 5in. 1/9, 5¾in. 2/-, 7in. 2/3.

Condensers—Silver Mica. All values 2pF to 1,000pF 6d. each. Ditto, Ceramics 9d. Tub. 450V T.C.C. etc. 0.001 mFd to 0.01 and 0.1/350V., 9d. 0.02-0.1/500V., 1/-. 0.25 Hunts 1/6. 0.5 T.C.C. 1/9, etc. etc. Close Tol. S/Micas—10% 5pF-500pF, 8d. 600-5,000pF, 1/-. 1% 2pF-100pF, 9d. 100pF-500pF, 11d. 575pF-5,000pF, 1/6. **Resistors**—Full Range 10 ohms-10 meg. ohms 20% ¼ and ½W, 3d., ½W, 5d. (Midget type modern rating) 1W, 6d., 2W, 9d. **Hi-Stab.** 5% ¼W, ½W, 6d. (100 ohms-1 meg). Other values 9d. 1% ½W, 1/6, etc., etc.

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25/25v. 50/12v. 1/9; 8+8/450v. 4/6 50/50v. 100/125v. 2/-; 32+32/275v. 4/6 8/450v. 4/350v. 2/3; 50/50/350v. 6/6 16+16/450v. 5/6; 60/250/275v. 12/6 32+32/450v. 6/6; 100+200/275v. 12/6

Volume Controls—5K-2 Meg. ohms, 3in. Spindles. Morganite Midget Type 1¼in. diam. Guar. 1 year. LOG or LIN ratios less Sw. 3/-. DP. Sw. 4/6. Twin Stereo less Sw. 6/6. DP. Sw. 8/-. Specials to order.

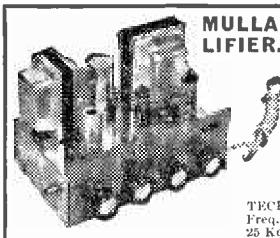
JASON FM TUNER UNITS. Designer-approved kits of parts. **FMT1,** 5 gns. 4 valves, 20/-. **FMT2,** £7. 5 valves, 35/-. **JTV MERCURY 10 gns. JTV2 £13.19.6.** 4 valves, **28/6. NEW JASON FM HANDBOOK, 2/6.** 48 hr. Alignment Services, **7/6.** P. & P. 2/6.

TRIMMERS, Ceramic (Compression Type)—30pF, 50pF, 70pF, 9d; 100pF, 150pF, 1/3; 250pF, 1/6; 600pF, 1/9. **PHILIPS. Bee Hive Type** (conc. air spaced)—2-8pF, 1/-; 3-30pF, 1/-. **KNOBS**—Modern Continental types. Brown or Ivory with Gold Ring; 1" dia., 9d. each; 1½", 1/- each; Brown or Ivory with Gold Centre, 1" dia., 10d. each; 1½", 1/3 each. LARGE SELECTION AVAILABLE. **METAL RECTIFIERS. STC Types**—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

BARGAIN CORNER

Brand New, Mfrs. 1st grade. 1 OC44 & 2 OC45, 15/6, 1 OC81D & 2 OC81, 15/6. All above and OA81, 32/6. Post Free.
½ Meg. VOL. Controls D.P. Sw. ¼" flatted spindle. Famous Mfrs. 4 for 10/-, post free.

MULLARD "3-3" HI-FI AMPLIFIER. 3 VALVES 3 WATT



3 ohm and 15 ohm Output. A really first-class Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86, EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

TECHNICAL SPECIFICATION—Freq. Response: + or — 1 dB 40 c/s-25 Kc/s. Tone controls: Max. Treble Cut 12 dB at 10 Kc/s. Max. Bass Boost 14 dB at 80 c/s. Sensitivity: 100 Mv for 3 w. output. Output Power (at 400 c/s): 3 w. at 1% total harmonic distortion. Hum and Noise Level: At least 70 dB below 3 w.

COMPLETE KIT (incl. valves, all components wiring diagram and special quality sectional Output Trans.). Bgn. Price £6.19.6. Carr. 4/6. Complete wired and tested, 8 gns. Wired power O/P socket and additional smoothing for Tuner Unit. 10/6 extra.

Bronze Escutcheon, Printed Vol. Treble, Bass, On-Off, supplied with each Kit.
Recommended Speakers—WB. HF 1012, £4.7.6. Goodmans AXIOM 10, £6.5.0. 8in. AXIETTE £5.5.0 or AUDIOM 51 £8.10.0.

DE-LUXE RECORD PLAYER KIT

Incorporating 4 Sp. Garrard Auto-Slim unit and Mullard latest 3 watt amplifier (ECL 86 and EZ 80), vol., bass and treble controls, with 8" x 5" 10,000 line speaker.
Amplifier Kit, price inc. speaker **£4.19.6** (carr. 4/6). The front panel unit containing amplifier and speaker is detachable from the cabinet and can be purchased separately for stereo reproduction. Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue relief. Size 17¼" x 16" x 8".

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Carr. and ins. 10s.
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TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s 9/16in. diam. 5/3
Osc. Coil M. & L.W.......... 5/9
Midget Driver Trans. 3.5:1 6/9
Midget Output Trans. Push-Pull—3 ohms 6/9
Elect. Condensers—Midget Type 1 mfd.-50 mfd. ca. 1/9, 100 mfd. 2/-, 12V.
Condensers 150 v. working: .01 mfd., .02 mfd., .03 mfd., .04 mfd. 9d.; .05 mfd., .1 mfd., 1/-. .25 mfd., 1/3; .5 mfd., 1/6, etc.
Midget Tuning Condensers. J.B. "OO" 208 pF and 176 pF, 8/6, ditto with trimmers, 9/6. J.B. 220pF and 105pF conc. slow motion 10/6. 365pF single 7/6. Sub. Min. ¾in. Dilemin 100 pF, 300pF, 500pF, 7/- each.
FERRITE AERIALS. M. & L.W. car aerial coil 9/3.
Midget Vol. Control with edge control knob, 5 K/ohms, with switch 4/9; Ditto less switch 3/9.
Speakers: P.M.: 2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms, 13/6. 7 x 4in. Plessey 35 ohms, 23/6.
Ear Plug Phones—Min. Continental type 3ft. lead, jack plug and socket. High Imp., 8/-. Low Imp., 7/6.
Tinned Copper Wire. 16-22g., 2/6 ½lb.

RECORD PLAYER CABINETS 59/6 Carr. & Ins. 5/-

Contemporary style, rexine covered cabinet in two-tone maroon and cream. Size 15½" x 14¼" x 8½", fitted with all accessories including baffle board and Vinair fret. Space available for all modern amplifiers and auto-changers etc. Uncut record player mounting board 14½" x 12¼" supplied.

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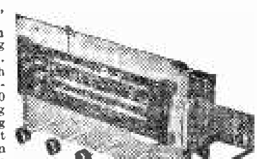
COMPLETE R/PLAYER KIT. As ill. inc. BSR UA14 Unit. New Bargain Price Now Only £11.10.0. 7/6 carr. **Double wound mains Tfr. no live chassis!**

7 VALVE AM/FM RADIOGRAM CHASSIS



Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.
Three Waveband and Switched Gram positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Philips Continental Tuning Insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ x 6¾in. Height 7½in. Edge illuminated glass dial 11½ x 3¾in.
Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250v. operation. Magic-eye tuning. Cct. diagram now available.

Aligned and tested ready for use **£13.10.0** *Carr. & Ins. 7/6*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra. 3 ohm P.M. Speaker only required. Recommended Quality Speakers 10in. Elac H/D, 30/-; 13½ x 8in. E.M.I. "Fidelity", 35/-; 12in. R.A. with conc. Tweeter, 42/6. Carr. 2/6.

TYGAN FRET (Contem. pat.), 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/-, etc.
EXPANDED ANODISED METAL. Attractive gilt finish ¼ in. x ¼ in. diamond mesh 4/6 sq.ft. Multiples of 6in. cut. Max. size 4ft. x 3ft., 47/6, plus carr.
ENAMELLED COPPER WIRE—¼lb. reels 14g-20g, 2/6; 22g-28g, 3/-; 30g-34g, 3/9; 36g-38g, 4/3; 39g-40g, 4/6. etc.

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THO 2188. *Terms C.W.O. or C.O.D. Post and Packing up to ½ lb. 9d.; 1lb. 1/3; 3lb. 2/3; 5lb. 2/9; 8lb. 3/6.*

BOOKS REVIEWED

MODERN TAPE RECORDING AND HI-FI

By Ken Peters; published by Faber and Faber, 24 Russell Square, London, W.C.1.
248 pages, 6½ in. x 5½ in. Price 30s.

MORE than 2,000 tape recorders are sold each week. Yet, the author points out, they are prone to a strange hibernating instinct that afflicts them three or four months after their purchase. driving them into cupboards, under beds and into attics where they lie inactive.

It is this phenomena that the author seeks to remedy, by the simple process of exploring, and explaining, some of the myriad uses to which a tape recorder may be put. And although dyed-in-the-wool radio enthusiasts are less likely to neglect their tape recorders than non-technical members of the public who often buy a machine on impulse for its novelty value which soon evaporates, they too will find a great deal of interest in this book.

It is essentially a practical book, its aim being to investigate a possibility, explain the principles, give an example. Apart from advice and information provided, it also leaves room for individual experiment by virtue of the ideas it propounds. The treatment is non-mathematical and essentially non-technical. But although it is aimed at the non-technical reader, this need not deter those with technical knowledge, for it incorporates subjects on which information is not too readily available.

There are two introductory chapters which are designed to assist prospective owners to choose a tape recorder and there is a lot of good practical advice here. This is followed by chapters on conventional usage of tape recorders, with some interesting ideas on things such as sound effects and continuous loops (marred only by a curiously incorrect drawing on page 56).

From here the author delves into such subjects as interviewing techniques, "audible colour" (tape-slide, tape and cine combinations), and "music on tape" utilising the potentialities of the tape recorder as a musical instrument itself.

This takes up to little under half the book. Chapters follow on indexing systems for sound libraries, "tapesponding" and tape clubs, home plays, party ideas. There is a chapter on hi-fi, again containing some good advice for the less well informed, followed by some notes on stereo.

The book rounds off with some general observations on audio maintenance, with a trouble-shooting chart, and a section listing the various accessories which the keen enthusiast might require. In this, as in other chapters dealing with products, prices are given as a guide.

All in all, despite the rather high price, the book should prove most informative to those with limited technical knowledge about to buy a tape recorder and to those who already have one lying inactive in some dark hideaway in the house. It certainly shows that the tape recorder has many facets for the enthusiast, some of them largely unexplored.—*W.N.S.*

FREQUENCY DIVIDER ORGANS FOR THE CONSTRUCTOR

By Alan Douglas, I.E.E.E.; published by Sir Isaac Pitman & Sons Ltd.
72 pages, 67 diagrams, 5½ in. x 8½ in. Price 25s.

THIS book concentrates on the practical aspects of electronic organ building and the theory of the circuitry involved is not explained, although a general descriptive treatment is given.

There are two main chapters and these describe (1) a resistance-capacitance valve frequency-divider organ and (2) a gas-tube frequency-divider organ.

Both of these chapters contain full design details for the essential electronic components such as oscillator coils as well as chassis layout diagrams and circuit diagrams of all the units, e.g. tone-forming circuits, keying arrangements and oscillator and divider chains, etc. The construction of the electro-mechanical devices such as stop keys and pedal controls is also well covered in diagram and text.

Another chapter gives details of an instrument described as a simple melodic transistorised keyboard. This instrument operates from dry batteries and will provide sufficient audio output for an average-sized room.

The final chapter contains information concerning frequency-divider circuits at present used in commercial electronic organs and so may well give the amateur constructor further ideas to develop for his own purpose.—*D.D.R.*

RADIO AND TELEVISION REFERENCE DATA

Compiled by J. P. Hawker; published by George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.
96 pages, 9 in. x 6 in. Price 10s. 6d.

THIS is a handy reference book containing, as the title implies, data of interest to radio and TV service engineers, amateur constructors and enthusiasts. Contents include a section on formulae in frequent use, details of colour codes, formulae and dimensions relating to aerials (including a frequency-wavelength conversion table) and a section on symbols and abbreviations.

Also featured is a list of broadcasting allocations and station frequencies, including a list of the major European broadcasting stations, together with details of television broadcasting standards. A short section on amateur radio gives a summary of facilities available, amateur radio abbreviations and prefixes, and a list of i.f.'s used in a wide range of commercial communications receivers.

Other information deals with mathematical data, including log tables, wire and cable data and battery equivalents. There is also a listing of valve, transistor and cathode ray tube pin connections, ratings, bases and equivalents, including selected CV types.—*D.C.*

CLUB NEWS

BURSLEM AMATEUR RADIO CLUB
Hon. Sec.: W. Luscott, 36 Rothsay Avenue, Sneyd Green, Stoke-on-Trent, Staffordshire.
Any local radio enthusiasts who are interested in joining the Club are invited to contact the Secretary. A full programme of film shows, lectures, etc., has been arranged for Club meetings, which are held on the third Wednesday of each month.

CLIFTON AMATEUR RADIO SOCIETY
Hon. Sec.: G3OGE, 63 Broomfield Road, Beckenham, Kent.
On 16th November, members of this Society made a visit to the headquarters of the Crystal Palace Amateur Radio Club for a "hi-fi" demonstration. Later in the month, on the 22nd, members took part in a quiz organised by the Secretary.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.; F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.
A social evening—which included a supper—was organised by T. Darn on 13th November. 20th November was declared an open evening and Juniors' Night.
A week later a demonstration on providing the finishing touch to home-built equipment was given by A. Hitchcock.
December began, as usual, with a surplus sale on the 4th.

MELTON MOWBRAY AMATEUR RADIO SOCIETY
Hon. Sec.: D. W. Lilley, G3FDF, 23 Melton Road, Asfordby Hill, Melton Mowbray, Leicestershire.
On 21st November the Secretary was "at home" to members when the Society made a visit to his shack.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax.
This Society reports increasing membership and attendance figures, with a growing proportion of licensed amateurs among its members.
"Antenna Problems" was the title of the lecture given by A. Bailey (G3IBN) on 4th December.

PETERBOROUGH AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: D. Byrne, G3KPO, Jersey House, Eye, Peterborough.
At the recent meeting which officially opened the Society's winter session, Frank Crabtree (G3BK) demonstrated the KW77 communications receiver.

PLYMOUTH RADIO CLUB
Hon. Sec.: B. J. Curnow, 112 Mount Gold Road, Plymouth, Devon.
On 9th November, members of this Club faced members of Torbay A.R.S. in a friendly battle of wits, organised by the two societies.

READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook Road, Reading, Berkshire.
For members who attended the meeting of 30th November, G3HGE gave a demonstration of some equipment about which members were invited to discuss any points that arose.

RODING BOYS' SOCIETY: RADIO SECTION
R. Marchant, 154 Essex Road, London, E.10.
Recently much of the Society's activity has been directed towards a Club stand at a local exhibition.

SCARBOROUGH AMATEUR RADIO SOCIETY
Hon. Sec.: P. B. Briscombe, G8KU, "Roseacre", Irton, Scarborough, Yorkshire.
November began with a surplus sale on the 7th. At the second meeting of the month, however, members enjoyed a film show.
The first meeting of December—which was on the 5th—was also a sale of surplus gear.

SPEN VALLEY AMATEUR RADIO SOCIETY
Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Leeds.
"The Electronic Marshalling Yard" was the title of the lecture given by Mr. S. Jones at the meeting on 14th November. On 12th November, the Society travelled to Bradford to see a film show at St. George's Hall.
On 28th November, J. Spivey (G2HHV) talked about "Office Electronics" and on 5th December, a party of members visited the Basinghall Street telephone exchange in Leeds.

STRATFORD-ON-AVON AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: N. Smith, 54 Clopton Road, Stratford-on-Avon, Warwickshire.
The meeting for 8th November was an open evening, but a week later, on the 15th, G3OMP gave a lecture on "Transistors". This was followed on the 22nd by a film show and the month ended with another open evening on the 29th.

THAMES VALLEY AMATEUR RADIO TRANSMITTERS SOCIETY
Hon. Sec.: K. Rogers, G3LIU, 21 Links Road, Epsom, Surrey.
November began with a constructional contest at the meeting on the 6th. One of the Society's foremost events of the year was held on 9th November, when members attended the 30th Annual Dinner.
On 4th December, A. Taylor gave a lecture entitled "Nuclear Power".

WESSEX AMATEUR RADIO GROUP
Hon. Sec.: G. J. Fowle, 138 Surrey Road, Branksome, Poole, Dorset.
On 14th November a group of members visited the headquarters of the Bournemouth Police, when the radio equipment installed in the police cars came in for some close scrutiny. The home of the President of the Group became the meeting place for members on 25th November.
A film show, which included a record of the Group's activities for the year, was given on 2nd December.

WEST KENT AMATEUR RADIO SOCIETY
R. Trevitt, 28 Dales Avenue, Tunbridge Wells, Kent.
At the meeting on 8th November, Ben Pooley gave an interesting talk on his experiences of VE-, VR2- and VK-lands. The only other meeting for November was on the 22nd when L. King gave a talk and demonstration called "SSB and the Linear Amplifier".

WIRRAL AMATEUR RADIO SOCIETY
Hon. Sec.: A. Seed, G3FOO, 31 Withert Avenue, Bebington, Wirral, Cheshire.
"On First Working Single Side Band" was the title of the lecture given by Mr. J. Wylde on 6th November. The Society's Annual Dinner was held on 9th November, and on the 20th the Secretary gave a lecture on "Electronics in Industry".
The first meeting in December was devoted to a surplus sale.

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

AS YOU WERE

SIR,—I agree entirely with the opinion expressed by Mr. P. A. Roe in the November issue, that considerable confusion exists as to the correct meaning of the words 'vibrato' and 'tremolo', but I feel that Mr. Roe has done little to clear the air. In fact, by setting himself up as an authority, he will have, no doubt, made matters worse.

If Mr. Roe consults the available literature on orchestral and electronic musical instruments, he will find that the universally accepted definition of the terms vibrato and tremolo are exactly opposite to those given in his letter.—A. G. BRIDGE (Dagenham, Essex).

SIR,—I would refer to the comments of Mr. P. A. Roe in the November P.W. relating to tremolo and vibrato. While I agree that these terms are sometimes incorrectly used, Mr. Roe now wishes to place on record a statement which I cannot accept.

After reading books and articles on the subject for over twenty years, it would now appear that writers like R. H. Dorf, Robert Eby, Emeron Anderson, to mention but a few, have been using the incorrect terms all along the line. Without going into too much detail, I quote from a glossary of these terms which will be confirmed by any book of reference: Tremolo—the variation in *volume* of a tone; Vibrato—the periodic variation in *frequency* of a tone.

If you accept these definitions, this completely contradicts Mr. Roe's statements. — S. J. LEWIS (Narberth, Pembrokeshire)

DECLINING MORSE STANDARDS

SIR,—As a S.W.L. of the tender age of fifty-six, I find myself in absolute agreement with those of your correspondents who observe that amateur operators should be well technically qualified. When I listen to some of the amateur transmissions, I sometimes wonder if the G.P.O. should not stiffen the examination.

I am however, in disagreement with the present morse code qualification. This is said to be neccessary, firstly by the G.P.O., because any amateur must be able to receive any traffic directed to him, and secondly by already licensed amateurs, mainly on the basis that because they had to undergo the test, so should everyone else.

Yet after a certain amount of listening to stations from all over the U.K., no one can help but be astonished by the number of amateurs who openly admit that their morse is not up to the required standard, either because they have never indulged in it since taking the test, or because they have been off the air for as long as eight, ten and thirteen years.

How can such people as these be in a position to satisfy the G.P.O.'s requirements? It is my contention that the G.P.O. should re-test each licence holder at least every two years, or end what appears to be a farcical situation. — J. W. KENNETH (Manchester, 21).

BLUEPRINT APPRECIATION

SIR,—After buying the November issue of P.W. which contained the blueprint for the Beginner's Short Wave Two, I decided to build this set. This has now turned out to be a remarkable little receiver, far superior to the commercially produced kit that I had previously built. I have achieved good reception on several bands with only the simplest aerials.

I did not have a 954 valve as specified and so I used an EF80 which was to hand. Thank you for an exceptionally easy but effective circuit to build and use.—TONY SKAIFE (York).

Sir—I would be grateful if any reader could sell or loan me . . .

. . . information and equivalents for the following valves: VT62, VT26A, AT20, AT570, CV125, PT15 and 8013.—P. LAYTON, 26 Grattan Hill, Cork, Ireland.

. . . the circuit or any details of the H.M.V. model 1423 transistor receiver.—R. PETTAS, 66 Beethoven Street, Paddington, London, W.10.

. . . the circuit and/or manual of the Eddystone 358 type B receiver.—H. MULLIGAN, 103 Beresford Road, Longsight, Manchester.

. . . the August 1961 issue of P.W.—M. C. Green, 6 The College, Malvern, Worcestershire.

. . . any information concerning the R1155 receiver.—I. P. GREEN, 171 Easterly Road, Leeds 8.

. . . the circuit or any information on the American receiver R-3/ARR -2X.—L. E. NICHOLLS, 5 Centre Drive, Newmarket, Suffolk.

. . . circuit information on the set 22 and set 62 MkII and the W2113A transmitter.—V. G. W. EGGLETON, 30 Mincinglake Road, Stoke Hill, Exeter, Devon.

. . . the circuit for a transistorised process timer with a range of 0 to 120 seconds.—W. DEIGHAM, 2 Browning Road, Manor Park, London, E.12.

. . . information on the plug-in crystals originally fitted to a Collins receiver, type COL 46159. Also I would like any circuit information and details of power supply requirements.—N. T. FRANCIS, 71 Oxford Grove, Bolton, Lancashire.

NOTES TO MEDIUM-WAVE DX FANS

Now that the medium wave DX season is with us again, "Medium Wave News" is again being issued. This is an extremely informative news letter publication which is issued through the winter months. Edited by Ken Brownless and published by Bernard Brown, it contains news of DX stations logged, notes on how to hear m.w. DX and competitive features. For those interested in this sideline of DX listening it is highly recommended. Details are available from Bernard Brown, 60 White Street, Derby. Please enclose a S.A.E.

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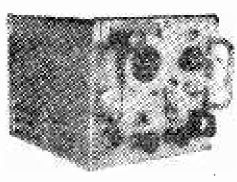

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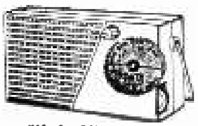

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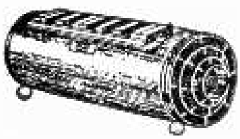

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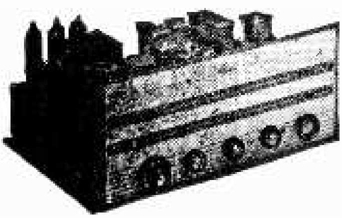

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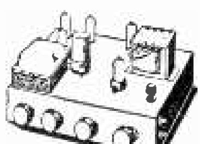

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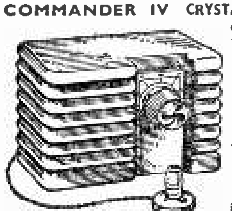

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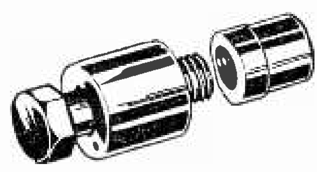

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N37	14/-
N78	22/6
N108	15/-
N308	18/-
N339	30/-
N369	10/6
OD3	5/-
OZ4	5/-
P2	10/-
PABC80	13/-
PCC84	8/-
PCC85	9/6
PCC88	12/6
PCC89	8/6
PCF80	9/-
PCF82	7/-
PCF84	12/6
PCF86	12/6
PCL82	9/-
PCL83	10/-
PCL84	7/-
PCL85	9/-
PCL86	12/6
PENA4	19/6
PENB4	17/6
PEN4DD	22/6
PEN4VA	17/6
PEN36C	20/-
PEN45	10/-
PEN45DD	25/-
PEN46	5/-
PEN453DD	20/-
PENDD4020	20/-
PL33	15/-
PL36	12/6
PL38	21/-
PL81	9/-
PL82	8/-
PL83	7/6
PL84	8/-
PL820	18/-
PM24M	13/6
PX4	15/-
PX25	25/-
PY31	15/-
PY32	12/6
PY33	10/6
PY80	7/6
PY81	7/6
PY82	6/9
PY83	8/-
PY88	10/-
PY800	10/-
PZ30	15/-
Q595/10	10/-
QS150/15	10/-
R2	10/-
R16	17/6
R19	16/-
R20	16/-
SP41	3/6
SP61	3/6
T41	15/-
TDD4	12/6
TDD13C	17/6
TH41	20/-
TY86F	12/6
U10	9/-
U12	9/-
U14	9/-
U22	8/-
U24	21/-
U25	11/-
U26	10/-
U31	9/-
U35	17/6
U37	17/6
U47	11/-
U50	7/-
U52	4/-
U76	7/6
U78	4/6
U145	10/6
U191	13/6
U251	15/-
U281	15/-
U282	19/6
U301	18/6
U329	15/-
U339	13/6
U403	10/-
U404	10/-
U801	19/6
UABC80	7/-
UAF42	8/6
UB41	7/6
UBC41	8/6
UBC81	10/-
UBF80	8/-
UBF89	7/6
UBL21	20/-
UCC84	11/6
UCC85	7/6
UCF80	12/6
UCH21	20/-
UCH42	8/6
UCH81	8/-
UCL82	9/6
UCL83	13/6
UF41	7/6
UF42	7/6
UF80	7/-
UF85	7/6
UF86	12/6
UF89	6/6
UL41	8/-
UL44	20/-
UL46	14/6
UL84	6/6
UL85	7/6
UM80	10/6
URIC	15/-
UU6	17/6
UU8	15/-
UU9	7/6
UYIN	12/6
UY21	15/6
UY41	7/6
UY85	6/6
VP4	15/-
VP4A	15/-
VP4B	15/-
VR105/30	7/-
VR150/30	7/-
W61	11/-
W76	5/-
W77	4/-
W81	6/-
W81M	6/-
X41	22/6
X61M	10/-
X65	12/6
X76	12/6
X76M	12/6
X78	26/-
X79	40/-
Y61	10/-
Y63	10/-
Z63	7/6
Z66	10/-
Z77	4/-
Z152	5/-
1A7	11/-
1C5	10/-
1D5	8/6
1D6	10/-
1H5	9/6
1L4	5/-
1N5	9/6
1R5	6/-
1S4	8/-
1S5	5/6
1T4	4/-
1U5	5/9
2P	22/6
3A4	5/-
3A5	10/6
3Q4	8/-
3Q5	9/-
3S4	6/-
3V4	7/6
5U4	4/-
5V4G	7/9
5Y3G	5/6
5Y3GT	6/6
5Z4G	9/6
5Z4GT	12/6
6A7	9/-
6A8G	8/6
6A8GT	13/6
6AC7	6/-
6AK5	5/-
6AL5	4/-
6AM5	5/-
6AM6	4/-
6AQ5	6/6
6AT6	6/-
6AU6	9/-
6B8G	3/-
6BA6	6/-
6BE6	6/-
6BG6G	15/-
6BJ6	6/-
6BQ7A	12/6
6BR7	10/6
6BS7	12/6
6BW6	8/-
6BW7	8/-
6C4	3/6
6C5GT	8/-
6C6	6/6
6C9	12/6
6CD6G	27/6
6CH6	10/-
6CW4	16/-
6D2	4/-
6D6	5/6
6E5	10/-
6F1	10/6
6F6	6/9
6F12	4/-
6F13	10/-
6F14	10/-
6F15	12/6
6F19	12/6
6F23	10/6
6F25	16/6
6F26	13/6
6F33	5/6
6H6	2/-
6J5	5/6
6J5G	4/6
6J5GT	5/-
6J7	7/6
6J7G	5/-
6J7GT	7/6
6K7	7/6
6K7G	2/-
6K7GT	7/6
6K8	9/6
6K8G	5/-
6K8GT	9/6
6K25	17/6
6L1	10/-
6L6	7/6
6L7	10/-
6L18	10/-
6L19	15/-
6N7GT	9/6
6P25	10/6
6P28	12/6
6Q7	9/6
6Q7G	6/6
6Q7GT	8/6
6SA7	7/-
6SC7	8/6
6SF5	10/-
6SG7	7/-
6SH7	6/-
6SJ7	6/6
6SK7	5/6
6SL7GT	6/-
6SN7GT	5/6
6SQ7	8/6
6U4GT	10/-
6U5G	7/6
6V6G	4/6
6V6GT	8/-
6X4	4/6
6X5G	6/-
6X5GT	8/6
6/30L2	10/-
7B5	12/6
7B7	8/6
7C5	8/-
7C6	8/6
7D5	15/-
7D6	15/-
7D8	15/-
7H7	6/-
7R7	10/-
7Y4	6/6
8D3	4/-
9BW6	12/6
10C1	12/6
10C2	17/6
10F1	10/-
10F9	12/6
10LD11	15/-
10P13	15/-
10P14	19/-
11D5	23/6
12A6	6/6
12AH8	9/-
12AT6	7/6
12AT7	5/-
12AU6	17/6
12AU7	5/-
12AX7	5/-
12BA6	7/6
12BE6	7/6
12BH7	10/-
12C8	8/6
12J5GT	4/-
12J7GT	8/6
12K7GT	5/-
12K8GT	10/-
12Q7GT	6/6
12SA7	8/6
12SJ7	8/-
12SK7	6/-
12SL7	8/-
12SN7	10/-
12SQ7	12/-
14H7	10/-
14R7	10/-
19AQ5	8/-
19BG6G	15/-
20D1	10/-
20D2	21/-
20F2	17/6
20L1	22/6
20P1	15/-
20P3	24/-
20P4	20/-
20P5	20/-
25A6	8/-
25L6	8/-
25Y5	8/-
25Y5G	8/-
25Z4	7/6
25Z5	8/-
25Z6	8/6
27SU	19/6
30C1	9/-
30C15	12/6
30F5	10/-
30FL1	10/6
30L1	8/6
30L15	11/-
30P4	18/-
30P12	10/-
30P16	9/-
30P19	17/6
30PL1	15/-
30PL13	12/6
30PL14	16/6
35A5	15/-
35L6GT	8/6
35W4	7/6
35Z3	15/-
35Z4	7/6
35Z5	8/6
41STH	22/6
42	12/6
50C5	10/-
50CD6G	30/-
50L6	8/6
75	8/-
78	7/6
80	9/-
85A2	12/6
185BT	30/-
807A	7/6
807B	7/-

COMPLETE VALVE LIST FREE WITH ORDER

METAL RECTIFIERS

RM1 7/6	14A86 23/-	16RD 2-2-8-1 12/- (FC142)
RM2 8/-	14A97 26/-	16RE 2-1-8-1 10/- (FC150)
RM3 10/-	14A100 28/-	18RA 1-1-8-1 5/- (FC118)
RM4 17/6	14RA 1-2-8-2 21/- (FC301)	18RA 1-1-16-1 7/- (FC116)
RM5 19/6	14RA 1-2-8-3 25/- (FC31)	18RA 2N-1-8-1 12/-
	16RC 1-1-16-1 10/-	18RD 2-2-8-1 16/- (FC124)

BRAND NEW TRANSISTORS

OC44	5/-	OC74	6/-	OC81D	6/-
OC45	5/-	OC75	6/-	OC81m/pr.	16/-
OC71	5/-	OC77	6/-	OC82	8/-
OC72	6/-	OC81	6/-	OC82D	8/-

SILICON RECTIFIERS

400 volts 350 mA ... ... 7/6 each

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SETS OF VALVES

1R5, 1S5, 1T4, 3S4, 3V4 ... ... Set of 4, 19/-
DAF91, DF91, DK91, DL92, DL94 ... Set of 4, 19/-
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Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London W.C.2.

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The Berkeley Loudspeaker Enclosure / The Luxembourg Tuner	*	5/-
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The PW Britannic Two / The PW Mercury Six	*	6/-
The PW Regency / The PW International Short Wave Two	*	5/-

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The Tutor *		3/-
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Modern One-valver	PW96	2/6
All-dry Three	PW97	3/6
Modern Two-valver	PW98	3/6
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A.C. Coronet-4	PW100	4/-
A.C. D.C. Coronet	PW101	4/-
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The PW 3-speed Autogram	8/-
The PW Monophonic Electric Organ	8/-
The PW Roadfarer *	5/-
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The Mini-amp *	5/-
The PT Olympic *	7/6
The PT Multimeter *	5/-

SOME EARLIER DESIGNS

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. *The majority of the components for these receivers are no longer stocked by retailers.*

Experimenter's Short Wave	PW30a	2/6
Midget Short Wave Two	PW38a	2/6
Simple S.W. One-valver	PW88	2/6
Pyramid One-valver	PW93	2/6
BBC Special One-valver	AW387	2/6
A One-valver for America	AW429	2/6
Short-Wave World Beater	AW436	3/6
Standard Four Valve S.W.	WM383	3/6
Enthusiast's Power Amplifier	WM387	3/6
Standard Four Valve	WM391	3/6
Listener's 5-Watt Amplifier	WM392	3/6

QUERY COUPON

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