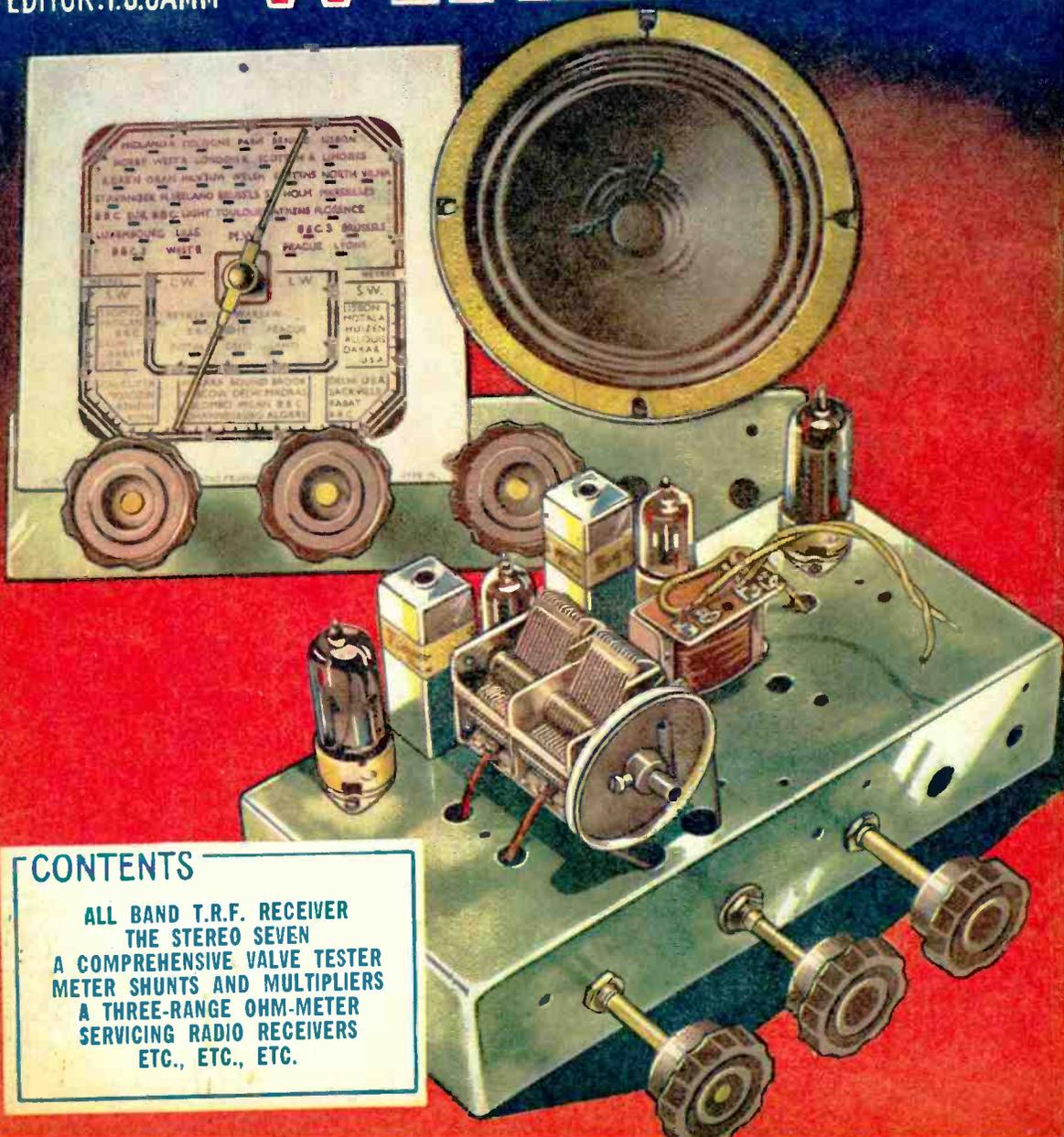


A SHIPPING BAND FOUR-VALVER **PRACTICAL** 13 **WIRELESS**

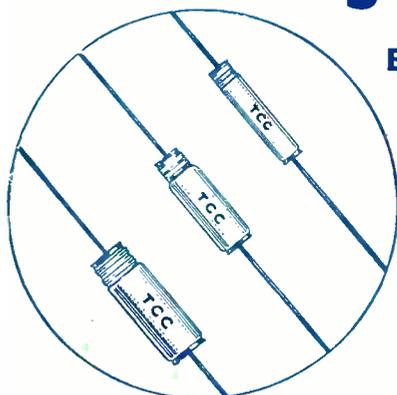
APRIL
 1959
 EDITOR: F.J. CAMM



CONTENTS

ALL BAND T.R.F. RECEIVER
 THE STEREO SEVEN
 A COMPREHENSIVE VALVE TESTER
 METER SHUNTS AND MULTIPLIERS
 A THREE-RANGE OHM-METER
 SERVICING RADIO RECEIVERS
 ETC., ETC., ETC.

SUB-MINIATURE ELECTROLYTIC CONDENSERS



Tolerance of capacity : -20% +50%
Temperature range : -30°C. to +60°C.



THE TELEGRAPH CONDENSER CO. LTD.

RADIO DIVISION NORTH ACTON, LONDON, W.3 Telephone: ACOrn 0061

Since we introduced this range, the use of transistors has become more widespread with the result that the range of capacities has been increased to keep pace with current design. The condenser element is hermetically sealed in an aluminium tube with rubber bungs (T.C.C. Patents 578487, 587072 and 578409) and the general assembly has been modified to permit the wire terminations to be flexed right up to the body of the condenser. Any slight increase in length of some ranges is more than offset by the advantage gained in the reduction of overall space required.

Capacity In μ F	Pk. Wkg. Volts	Dimensions in inches		T.C.C. Type Number	List Price Each
		Length	Diameter		
6	1.5	1.8	.18	CE58	5/-
4	4	1.8	.18	CE58AA	5/-
2	8	1.8	.18	CE58A	5/-
6	3	1.8	.18	CE68AA	4/-
10	3	1.8	.18	CE68AA	4/-
4	6	1.8	.18	CE68A	4/-
2	12	1.8	.18	CE68B	4/-
1	25	1.8	.18	CE68C	4/-
8	6	1.8	.18	CE68B	4/-
2	25	1.8	.18	CE69A	4/-
1	50	1.8	.18	CE69C	4/-
32	1.5	1.8	.18	CE69D	4/-
		1.8	.18	CE67	4/-

THE NEW STENTEREO STEREOPHONIC SPEAKER SYSTEM



(Pat. App. 33293/58)



- Corner Cabinet £7.10.0
Plinth for floor mounting 17/- extra.
- H.F.810 and H.F.812
These are both 8" Units, with a handling capacity of 5 watts. Frequency response, 50 c.p.s. to 13,000 c.p.s. Bass resonance, 45 c.p.s.
- H.F.810 incorporates a 10,000 gauss magnet and has a steel chassis. £3.2.0 (inc. P.T.).
- H.F.812 incorporates a 12,000 gauss magnet, is fitted with cambric cone and universal impedance speech coil, and has a die-cast chassis. £4.3.6 (inc. P.T.).
- S.510 is a 5" unit, with a 10,000 gauss magnet. £2.2.0 (inc. P.T.).
- CX.1500 Crossover Unit. £1.18.3.

This consists of two corner loudspeaker enclosures, each divided into two sections, the lower taking the form of an infinite baffle. Into this may be fitted a W.B. Stenterian speaker, H.F.810 or H.F.812, to provide the lower and part of the middle register of sound. For the upper and remainder of the middle register a W.B. S.510 is used and the two units are coupled by a crossover unit. The high frequency spectrum tends to be directional, and provision is made in the upper section for rotating the baffle to give the best stereo effect.

WHITELEY ELECTRICAL RADIO CO. LTD.
MANSFIELD · NOTTS.



8-WATT PUSH-PULL AMPLIFIER
COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER

A.C. mains 100/250 v. Size 10 1/2 in. x 6 1/2 in. x 2 1/2 in. Incorporating 6 valves, H.F. pent., 2 triodes, 2 output pens. and rectifier. For use with all makes and types of pick-up and mike. Negative feed back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. For use with Std. or L.P. records, music Plus P. & P. 7/6.

cal instruments such as Guitars, etc. **£4.19.6** P. & P. 7/6.
 Or 35/- deposit Plus P. & P. 7/6, and 3 monthly payments of 25/-.

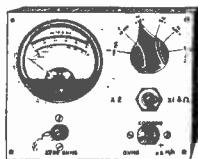
PORTABLE AMPLIFIER

Size 6 1/2 in. long, 5 1/2 in. high, 2 1/2 in. deep. Will suit any type of crystal pick-up. Output approx. 2 watts. Incorporating ECC83 double triode, Cossor 142BT output pentode and contact-cooled rectifier. Fully isolated mains transformer for 200/250 A.C. mains. Base, treble and volume controls.



49/6 Plus P. & P. 3/6.
 5in. SPEAKER with O.P. TRANSFORMER, purchased with the above, 18/6. plus P. & P. 1/6.

AC/DC POCKET MULTI-METER KIT



Comprising 2in. moving coil meter, scale calibrated in AC/DC volts, ohms and milliamperes. Voltage range AC/DC 0-50, 0-100, 0-250, 0-500. Milliamps 0-10, 0-100. Ohms range 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistor and rectifier. In grey hammer finish case.

19/6 Plus P. & P. 1/6 Built and tested 7/6 extra.

Point to point wiring diagram 1/-, free with kit.

COLLARO MIXER 4-SPEED AUTOMATIC CHANGER

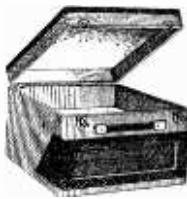


Model 457. Type "O" Pick-up, size 1 1/2 in. x 1 1/2 in. Minimum clearance above baseboard 5in., below 2 1/2 in., 10 records. A.C. mains 200-250 v. Turnover crystal head. BRAND NEW. Fully guaranteed. **£8.19.6**

Plus P. & P. 5/-

MAINS TRANSFORMERS

All with tapped primaries. 200-250 volts. 0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps. 10/6. 320-0-320 v. 75 ma., 6.3 v., 2.5 amp., 5 v., 2 amp., 10/6. 350-0-350 v. 250 ma., 6.3 v. 7 amp., 5 v. 2 amp., 19/6. Postage and packing on the above 3/-.



PLAYER CABINET

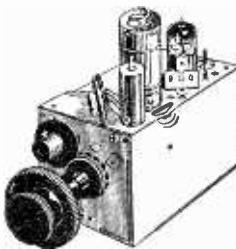
Finished in 2 tone leatherette, will take B.S.R. UA8, with room for amplifier and 7 x 4 speaker. Overall size 15 1/2 in. x 13 1/2 in. x 9 1/2 in.

£2.19.6 Plus 5/- P. & P.

13 CHANNEL TUNER

I.F. 34-38 Mc/s. complete with PCF80 and PCC84. These have been removed from chassis.

19/6 Plus P. & P. 2/6. Knobs 3/6 extra.



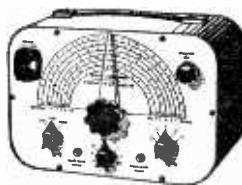
RADIO & T.V. COMPONENTS (Acton) LTD.

23 HIGH STREET, ACTON, LONDON, W.3.

All enquiries S.A.E.

Goods not dispatched outside U.K.

SIGNAL GENERATORS

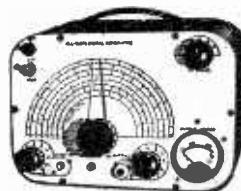


Cash **£8.19.6** or 25/- deposit and 6 monthly payments of 21/6. Post and Packing 5/- extra.

Coverage 100 Kc/s-100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics. Metal case 10 1/2 in. x 6 1/2 in. x 5 1/2 in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%; Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. swtch, variable A.F. output. Incorporating magic eye as output indicator. Accuracy plus or minus 2%.

Cash **£4.19/6** or 25/- deposit and 4 monthly payments of 9/6. Plus Postage and Packing, 5/-.

Coverage 120 Kc/s-84 Mc/s. Metal case 10 1/2 in. x 6 1/2 in. x 4 1/2 in. Size of scale, 6 1/2 in. x 3 1/2 in. 2 valves and rectifier. A.C. mains 200-250 v. Internal modulation of 400 c.p.s. to a depth of 30%, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Grey hammer finished case and white panel. Accuracy plus or minus 2%.



B.S.R. MONARCH

4 WAVE BAND COIL UNIT
 Complete with tuning condenser. Separate sections for Short Wave. Coverage 10-21 m., 21-45 m., 44-100 m., and 150-545 m. I.F. 470 Kc. BRAND NEW, by famous manufacturer. Completely assembled on sub-chassis. With circuit diagram. 19/6. Plus P. & P. 3/6.

UA8

4-speed, plays 10 records 12in., 10in. or 7in. at 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12 1/2 x 10 1/2 in. Space required above baseboard 4 1/2 in., below baseboard 2 1/2 in. Fitted with Full-F1 turnover crystal head.

£6.19.6 Plus 5/- Postage & Packing.

CONSTRUCTORS' PORTABLE PARCEL



Comprising case, chassis, top plate, seal, P.M. speaker with O.P. trans., twin range, 2 470 Kc/s. I.F.s., trimmers, four valve holders, wave-change switch and volume control with switch. **39/6** Plus 3/6 Postage & Packing.

BENTLEY ACOUSTIC CORPORATION LTD.

THE VALVE SPECIALISTS. 38 CHALCOT ROAD, LONDON, N.W.1. Telephone: PRIMROSE 9090.

EXPRESS SERVICE! C.O.D. ORDERS RECEIVED BY 3.30 P.M., EITHER BY LETTER, PHONE OR WIRE, DESPATCHED THE SAME AFTERNOON, ALL ORDERS RECEIVED BY FIRST POST DESPATCHED SAME DAY.

ANY ORDER UP TO £10 INSURED AGAINST DAMAGE IN TRANSIT FOR ONLY 6d. EXTRA. ORDERS OVER £10 INSURED FREE.

0A71	6/-	6BW7	8/-	6U7G	8/6	19AQ5	11/-	7475	7/6	EK32	10/-	EK32	8/6	KTW63	8/-	PZ30	20/11	UCC85	10/4
0B2	17/6	5BX6	8/-	6V6G	7/-	19B6G6		9002	5/6	DL2	15/-	EL32	5/-	KTZ41	8/-	QP21	7/-	UCF80	23/4
0Z4	6/-	6C4	7/-	6V6GTG	8/-		24/4	9006	6/-	DL33	9/6	EL33	20/2	KTZ63	10/6	QP25	15/-	UCH21	24/4
1A3	3/-	6C5	6/6	6X4	7/-	19H1	10/-	AC/PEN (5		DL66	15/-	EL34	17/6	L63	6/6	OS150/15		UCH42	11/6
1A5	6/-	6C6	6/6	6X5GT	6/6	20D1	16/-	or 7 pin)	24/4	DL92	7/6	EL38	27/10	LN152	14/-		10/6	UCH81	11/6
1A7GT	23/-	6C8	12/6	6Z4/84	12/6	20F2	27/10	AC2PEN		DL94	9/-	EL41	11/-	LZ319	9/-	QV04/7	15/-	UCL82	15/6
1C5	12/6	6C9	12/6	6/30L2	10/-	20L1	27/10		24/4	DL96	10/-	EL42	11/6	MH4	7/6	R2	10/-	UCL83	25/9
1D5	17/6	6C10	12/6	7A7	12/6	20P1	27/10	AC2PEN/		DL510	10/6	EL81	15/-	MHD4	25/9	R12	10/6	UF41	9/4
1D6	12/6	6CD6G	31/4	7B7	8/6	20P3	24/4	DD	27/10	DM70	8/6	EL84	10/6	MHL4	7/6	R18	17/6	UF42	19/6
1H5GT	11/-	6CH6	12/6	7C5	8/-	20P4	27/10	AC4PEN		EA50	7/-	EL91	5/-	MHLD6	12/6	R19	25/11	UF80	10/6
1L4	6/6	6D3	20/11	7C6	8/-	20P5	24/4		27/10	EA76	9/6	EL95	10/6	ML4	12/6	SD6	12/7	UF85	10/6
1L5	5/-	6D6	6/6	7D5	24/4	25AG6	20/2	AC5PEN		EABC80	9/-	EM34	10/-	ML6	6/6	SP4(7)	15/-	UF86	24/4
1LN5	5/-	6E5	12/6	7H7	8/-	25L6GT	10/-		24/4	EA91	7/6	EM74	24/4	MPT4 (5 or		SP41	3/6	UF89	10/6
1NSGT	11/-	6F1	27/10	7R7	12/6	25Y5	10/6	AC5PEN/		EAF42	10/6	EM80	10/6	7 pin)	24/4	SP42	12/6	UL41	19/6
1R5	8/-	6F6G	7/-	7S7	10/6	25Y5G	10/-	DD	27/10	EB34	2/6	EM81	10/6	MU14	10/-	SP61	3/6	UL44	27/10
1S5	8/-	6F6GTM	8/-	7V7	8/6	25Z5	10/6	AC6PEN 7/5		EB41	8/6	EN31	34/9	MX40	27/10	SU25	27/10	UL46	15/6
1T4	6/6	6F8	12/6	7Y4	8/-	25Z4G	10/-	AC/HL/		EB91	6/6	EY51	10/6	N37	20/11	SU61	10/6	UL84	11/6
1U5	10/-	6F11	18/1	3D2	3/6	25Z6G	10/-	DDD	15/-	EBC33	7/6	EY83	17/6	N78	20/11	T41	24/4	UR4	18/1
2A7	10/6	6F12	7/6	8D3	7/6	25Z6GT 17/5		AC/P4	8/-	EBC41	10/-	EY86	14/6	N108	19/6	TDD4	25/9	UUA	25/9
2C26	4/-	6F13	12/6	9D2	4/-	27S0	20/11	AC/TP	34/9	EBC81	14/8	EZ35	6/6	N308	21/7	TDD13C		UUB	20/11
2D13C	7/6	6F14	27/10	10C1	15/-	28D7	7/-	AC/VP1		EBC80	10/-	EZ40	8/-	OA70	5/-			UYIN	17/5
2P	27/10	6F15	16/-	10C2	27/10	30C1	9/-		15/-	EBC89	9/6	EZ41	10/-	OC72	30/6			UY21	17/10
2X2	4/6	6F16	9/6	10F1	19/6	30F5	8/-	AC/VP2		EBL21	24/4	EZ80	9/6	P61	3/6			UY41	8/6
3A4	7/-	6F17	12/6	10F9	11/6	30FL1	10/-		27/10	EBL31	24/4	EZ81	9/6	PABC80				UY85	10/6
3A5	12/6	6F32	10/6	10F18	12/6	30L1	9/-	AL60	10/-	EC52	5/6	FC2A	25/9					VMP4G	15/-
3B7	12/6	6F33	7/6	10LD3	8/6	30P12	12/6	ATP4	5/6	EC54	6/6	FC4	27/10	PCC84	9/-	TP22	15/6	VP(2)7	12/6
3D5	5/-	6G6	6/6	10LD11	16/9	30P16	10/-	AZ1	17/5	EC70	12/6	FC13	27/10	PCF80	9/6	TP2620	34/9	YP4(7)	15/6
30E	10/6	5H6GTG 3/6		10P13	17/5	30P11	14/-	AZ31	10/6	EC83	15/-	FW4/500		PCF82	12/6	TY86F	20/11	YP48	24/4
30Q4	7/5	5H6GTG 3/6		10P14	20/2	31	7/6	AZ41	14/8	EC83	8/6		10/-	PC82	12/6	U12/14	12/-	YP13C	7/-
30SGT	9/6	6I5G	5/-	11D3	25/9	33A/158M		B36	25/9	EC34	25/9	FW4/800		PC83	14/-	U16	12/6	VP23	6/6
354	7/6	6I5GTG	5/6	11E3	15/-	36	12/6	BL63	7/6	EC35	8/6		10/-	PEN4DD		U18/20	10/6	VP41	6/6
3V4	9/-	6I5GTG	5/6	12A6	6/6	35/51	12/6	C1	12/6	EC35	8/6		10/-	PEN4DD		U22	8/-	VR105/30	
5R4GY	17/6	6I6	5/6	12AC6	14/-	35L6GT	9/6	C1C	12/6	EC40	23/7	GZ30	13/6		27/10	U22	8/-		
5U4G	8/6	6I7G	6/6	12AD6	13/-	35W4	8/6	CB11	27/10	EC89	8/-	GZ32	12/6	PEN25	10/11	U24	31/4		9/-
5V4G	11/6	6I7GT	10/6	12AE6	14/8	35Z3	10/6	CB131	24/4	EC82	7/6	GZ34	14/6	PEN36C		U25	24/4	VR150/30	
3X4G	12/6	6K6GT	8/6	12AH7	8/-	35Z4	7/6	CK35	24/4	EC83	10/-	H30	5/-		24/4	U26	12/6		9/-
5Y3G	8/-	6K7G	5/-	12AH8	10/6	35Z5GT	9/-	CK506	6/6	EC84	10/-	H63	12/6	PEN40DD		U31	10/-	VT61A	5/-
5Y3GT	8/6	6K7GT	6/6	12AT6	10/6	41MTL	8/-	CL33	20/2	EC85	9/6	HABC80			25/-	U33	27/10	VT501	5/-
5Y4	12/6	6K8G	8/-	12AT7	8/-	42	24/4	CV63	10/6	EC89	5/6		13/6	PEN44		U35	27/10	W61M	27/10
5Z3	12/6	6K8GTG	8/6	12AU6	24/4	43	24/4	CV85	12/6	ECF80	13/6	HK90	10/-		27/10	U37	27/10	W76	7/6
5Z4G	10/6	12/6		12AU7	7/5	50C5	12/6	CV271	10/6	ECF82	13/6	HL133DD		PEN45	19/6	U43	10/6	W81M	6/6
5Z4GT	12/6	6K25	20/11	12AX7	10/-	50CD6G		CV428	30/-	ECH3	27/10		12/6	PEN45DD		U45	10/6	W107	12/6
6A7	27/10	6L1	24/4	12BA6	9/-		31/4	CY1	17/5	ECH21	24/4	HL23	10/6		27/10	U50	8/6	W729	19/6
6A8	10/-	6L6G	9/6	12BE6	10/-	50L6GT	9/6	CY31	17/5	ECH35	7/6	HL23DD		PEN46	7/6	U52	8/6	X31	27/10
6A87	8/-	6L7GT	12/6	12BE7	22/3	53KU	20/11	D1	3/6	ECH42	9/6		18/1	PEN383	24/4	U76	7/6	X41	27/10
6A88	14/-	6L18	13/-	12C8	15/-	72	4/6	D15	10/6	ECH81	9/-	HL41	12/6	PEN453DD		U78	7/6	X42	27/10
6AC7	6/6	6L19	24/4	12E1	30/-	75	25/9	D42	10/6	ECL80	14/-	HL41DD			34/9	U107	17/5	X61	12/6
6AG5	6/6	6LD20	16/9	12ISGT	4/6	77	9/-	D63	5/-	ECL82	12/6		20/2	PEN/DD		U191	20/11	X61M	27/10
6AJ8	9/-	6N7	8/-	12J7GT	10/6	78	8/6	D77	6/6	EF9	24/4	HL42DD		4020	27/10	U251	15/-	X63	10/6
6AK5	8/-	6P25	24/4	12K5	18/10	80	9/-	DAC32	11/-	EF22	14/-		20/2	PL33	20/2	U281	20/11	X65	12/6
6AK8	9/-	6P28	27/10	12K7GT	7/6	83	15/-	DAF91	8/-	EF36	6/-	HN309	25/9	PL36	24/4	U282	23/8	X66	12/6
6AL5	6/6	6Q7G	10/-	12K8GT	83V	12/6	DAF96	10/-	EF37A	8/-	HVR2	20/-	PL38	27/10	U301	24/4	X76M	14/6	
6AM6	7/6	6Q7GT	11/-		14/-	85A2	15/-	DD41	14/8	EF39	6/-	HVR2A	6/-	PL81	16/10	U329	15/-	X78	22/3
6AQ5	8/6	6R7G	10/-	12Q7GT	7/6	150B2	15/-	DDT4	25/9	EF40	15/-	KF35	8/6	PL82	10/-	U339	20/11	X79	22/3
6AT6	8/6	6SA7GT	8/6	12S7	8/6	185BT	34/9	DF33	11/-	EF41	9/6	KK32	23/-	PL83	11/6	U404	10/6	X109	18/1
6AU6	10/6	6S7G	10/6	12SC7	3/6	185BTA	34/9	DF91	6/6	EF42	12/6	KL35	8/6	PM28	12/6	U801	31/4	XD(1.5)	6/6
6B4G	6/6	6SG7GT	8/-	12SG7	8/6	203THA		DF96	10/6	EF50(A)	7/-	KL32	25/9	PM12	6/6	U4020	17/5	XFG1	18/-
6B7	10/6	6SH7	8/-	12SH7	8/6		27/10	DH63	10/-	EF50(E)	5/-	KT2	5/-	PM12M	6/6	UABC80		XH(1.5)	6/6
6B8G	4/6	6S17	8/-	12S17	8/6	220TH	25/9	DH63(M)		EF54	5/-	KT33C	10/-	PX4	34/9		10/6	XSG(1.5)	6/6
6BBGT	5/-	6SK7GT	8/-	12SK7	8/6	402PENA		EF73	17/6	EF73	10/6	KT36	31/4	PX25	62/7	UAF42	10/6		6/6
6BA6	7/6	6SL7GT	8/-	12SQ7	12/6		24/4	DH76	7/6	EF80	8/-	KT41	21/7	PY31	17/5	UB41	12/7	Y63	7/6
6BE6	7/6	6SN7GT	7/6	12SR7	8/6	807	8/6	DH77	7/6	EF85	7/6	KT44	15/-	PY32	20/11	UBC41	10/-	Z63	10/6
6BG6G	24/4	6SQ7GT	9/-	12Y4	10/6	956	3/-	DH107	14/8	EF86	14/6	KT61	20/2	PY80	8/-	UBC81	14/8	Z66	20/6
6BH6	9/-	6S57	8/-	14S7	17/-	1821	17/5	DK32	23/-	EF89	10/-	KT63	7/-	PY81	9/-	UBF90	9/6	Z77	7/6
6B16	7/6	6U4GT	12/6	15D1	27/10	5763	12/6	DK91	8/6	EF91	7/6	KTW61	8/-	PY82	9/-	UBF89	10/6	Z719	8/-
6BV6	9/6	6USG	7/6	18	24/4	7193	5/-	DK92	10/6	EF92	5/6	KTW62	8/-	PY83	9/6	UBL21	24/4	Z729	14/-

NEW METAL RECTIFIERS—FULLY GUARANTEED

DRM-1B	15/4	RM-2	9/-	WX3	3/6	14A100	27/-	14R4 1-2-3-2	19/-	16R2 1-1-8-1	8/6
DRM-2B	16/2	RM-3	9/6	WX4	3/6	14A124	28/-	14R4 1-2-8-3	23/6	18R4 1-1-8-1	4/6
DRM-3B	23/3	RM-4	18/-	WX6	3/6	14A163	38/-	14R4 1-1-15-1	21/-	18R4 1-1-16-1	6/6
LW7	22/6	RM-5	24/-	14A86	18/-	14B130	35/-	16R4 1-1-16-1	8/6	18R4 1-2-8-1	11/-
RM-O	7/11	W4	3/6	14A97	25/-	14B261	11/6	16R2 2-2-8-1	12/-	18R2 2-2-8-	

The "NEW" 1959

Stern's "fidelity" TAPE RECORDER

for truly "Hi-Fi" Recordings

IT INCORPORATES

- The latest COLLARO TRANSCRIBTOR TAPE DECK.
- The model HF/TR3 "fidelity" AMPLIFIER. (Described below.)
- Matching elliptical 7in. x 4in. P.M. Speaker.
- 1,200 reel EMI tape.
- ACOS Crystal Microphone.

BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THIS MODEL—TRULY "HI-FI" RECORDINGS ARE OBTAINABLE and it is comparable to much higher-priced Recorders.
Alternatively send S.A.E. for ILLUSTRATED LEAFLET.

(Plus £11/10/0 Carriage and Insurance, of which £1 is refunded on return of Packing Case.)



PRICE
£49.10.0

Terms: Dep. £9.18.0 and 12 monthly payments of £3.12.7 or Dep. £16.10.0 and 12 monthly payments of £3.0.6.

THE LEGS SHOWN IN THE ILLUSTRATION ARE READILY DETACHABLE, AND ARE AN OPTIONAL EXTRA AT £1.2.6.

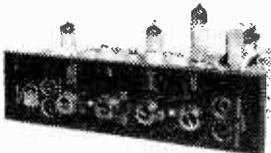
THE MODEL HF/TR3 TAPE AMPLIFIER

INCORPORATING

3-SPEED TREBLE EQUALISATION by means of the LATEST FERROXCUBE POT CORE INDUCTOR.

PRICE for COMPLETE KIT OF PARTS **£12.15.0**

PRICE FULLY ASSEMBLED & TESTED **£16.10.0**



HIRE PURCHASE. Deposit £3.6.6 and 12 monthly payments of £1.4.2. A very high-quality Amplifier based on the very successful TYPE "A" design completed in the MULLARD LABORATORIES. ONLY NEW HIGH-GRADE COMPONENTS are incorporated including MULLARD VALVES and a GILSON OUTPUT TRANSFORMER. Other features are—Magic Eye Recording hand indicator—Effective Tone Control—Monitoring and Extension Speaker Sockets—Has own Power Supply and can be used as independent Amplifier for direct reproduction of Gram Records or from Radio Tuner. Overall size 11in. x 6in. x 6in. Can be supplied for use with Truvox—Collaro—Lane—Brenell or Motek Decks. Please specify W.R.H.

Send S.A.E. for leaflet or 2/6 for the complete Assembly Manual.

THE NEW MULLARD TYPE "C" TAPE PRE-AMPLIFIER-ERASE UNIT

INCORPORATING THE NEW FERROXCUBE POT CORE PUSH-PULL OSCILLATOR and 3-SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.

PRICES . . . INCLUDING SEPARATE SMALL POWER SUPPLY

COMPLETE KIT OF PARTS **£14.0.0**

ASSEMBLED AND TESTED **£17.0.0**

Deposit **£3.8.0** and 12 months of **£1.4.11.**

ALSO AVAILABLE EXCLUDING POWER SUPPLY UNIT FOR **£11.15.0** and **£14.10.0** respectively.

(Carriage and Insurance is 5/- extra.)

WHEN ORDERING PLEASE STATE MAKE OF TAPES DECK TO BE USED. We present this "Hi-Fi" Pre-amplifier strictly to Mullard's specification incorporating ONLY NEW HIGH-GRADE COMPONENTS and the SPECIFIED NEW MULLARD VALVES. It comprises a COMPLETELY SELF-CONTAINED UNIT, all components and valves being contained in a well-ventilated Box. Chassis neatly finished in Hammered Gold with a very attractively engraved PERSEPEX FRONT PANEL.



HOME CONSTRUCTORS YOU CAN BUILD THIS PORTABLE TAPE RECORDER from £41.10.0

TO ADD FULL TAPE RECORDING FACILITIES



WE OFFER YOU THIS SELECTION
(a) The PORTABLE CASE illustrated here (£5.0.0), 1,200ft. E.M.I. TAPE (£1.15.0), ACOS CRYSTAL MIKE (£1.15.0), ROLA 10in. x 6in. LOUD-SPEAKER (£1.10.0). ALL FOR . . . **£9.0.0**

AVAILABLE ON HIRE PURCHASE WITH (b) or (d) below.
(b) The COLLARO MK. IV TAPE DECK (£25.0.0) and the HF/TR3 AMPLIFIER Assembled and Tested. FOR . . . **£36.0.0**

(c) As in (b) above, but HF/TR3 supplied as COMPLETE KIT OF PARTS. **£32.10.0**

(d) The TRUVOX MK. IV TAPE DECK incorporating Precision Rev. Counter (£30.9.0) and the HF/TR3 AMPLIFIER Assembled and Tested. **£41.10.0**

H.P. Deposit **£3.6.0** and 12 months of **£3.0.10.**
(e) As in (d) above, but the HF/TR3 supplied as COMPLETE KIT OF PARTS. **£38.0.0**

(Carriage and Insurance on above quotes 10/- extra.)
NOTE: Messrs. Collaro when supplying the MK. IV Deck do not wire up the Deck Switches. We will do this at charge of £1.0.0, or supply a Wiring Diagram to the Home Constructor.

Please send S.A.E. with all correspondence.

To any modern "HI-FI" AUDIO AMPLIFIER (such as our Mullard "5-10" and 2 valve Pre-amplifier) . . . ALL YOU NEED IS . . . THE TYPE "C" PRE-AMPLIFIER and a TAPE DECK . . . WE OFFER . . .

(a) The COLLARO MK. IV TAPE DECK and the MULLARD TYPE "C" PRE-AMPLIFIER with Power Unit **£37.0.0** Assembled and Tested

H.P. Deposit **£7.8.0** and 12 months of **£2.14.3.**
(b) As in (a) above but the Type "C" supplied as COMPLETE KIT OF PARTS. **£34.0.0**

(c) The TRUVOX MK. IV TAPE DECK incorporating Precision Rev. Counter and the MULLARD TYPE "C" PRE-AMPLIFIER with Power Unit Assembled and Tested **£42.10.0**

H.P. Deposit **£8.10.0** and 12 months of **£3.2.4.**
(d) As in (c) above but the TYPE "C" supplied as COMPLETE KIT OF PARTS. **£39.10.0**

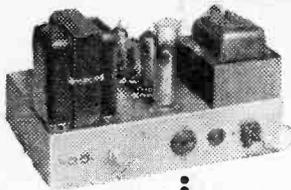
(Carriage and Insurance on above quotes 10/- extra.)

STERN RADIO LTD.
109 & 115 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812,3/4

**AMPLIFIERS
PRE-AMPLIFIERS
FOR THE "HI-FI" ENTHUSIAST**

**MULLARD DESIGNS FOR
THE
HOME CONSTRUCTOR**

**THE VERY
POPULAR
MULLARD
"5-10" MAIN
AMPLIFIER**



Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "Hi-Fi" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S Specification with specified valves and components and including the latest PARMEKO Ultra-linear Output Transformer and the PARMEKO Mains Transformer which has power available to drive Radio Tuning Unit.

COMPLETE KIT £10.00 Alternatively we supply **ASSEMBLED & TESTED £11.10.0**
OF PARTS (Carriage & Insurance 5/- extra.)

THIS "5-10" with the latest PARTRIDGE for £1.6.0 extra

A completely new design employing two EF96 valves, and in particular designed to operate with the Mullard range of Power Amplifiers, but also perfectly suitable for other makes, etc. Briefly it incorporates:

- Equalisation for the latest R.I.A.A. characteristics.
- Input for variable reluctance. ● Magnetic Pick-Ups.
- Input for Crystal Pick-Ups. ● Input for Tape Replay.
- (a) Direct from High Impedance Tape Head.
- (b) From a Tape Amplifier or Pre-amplifier.
- Sensitive Microphone Channel.
- Wide range Bass and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION.

COMPLETE KIT OF £6.6.0 Alternatively we supply **ASSEMBLED & TESTED £8.0.0**
PARTS (Carriage & Insurance 5/- extra.)

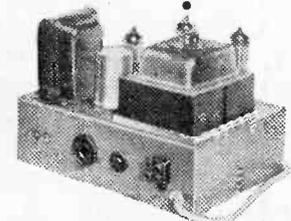
Based entirely on the present very popular "3-3" model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown left) thus providing all the facilities associated with the more expensive "Hi-Fi" Equipment. We recommend it as the IDEAL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts). We supply completely to MULLARD'S SPECIFICATION including the latest PARMEKO Output Transformer, specified Valves and Components. Has power available to drive a Radio Tuning Unit.

COMPLETE KIT OF £7.0.0 Alternatively we supply **ASSEMBLED & TESTED £8.0.0**
PARTS (Carriage & Insurance 5/- extra.)

**MULLARD'S
NEW 2-STAGE
PRE-AMPLIFIER
TONE CONTROL**



**THE NEW
MULLARD 3-3
MAIN
AMPLIFIER**



Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required; the ASSEMBLY MANUALS, containing Practical Drawings, etc., are available at 1/6 each.

Only NEW HIGH GRADE Components and MULLARD VALVES are supplied with these Kits.

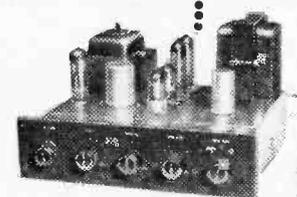
SPECIAL PRICE REDUCTIONS
(a) THE COMPLETE KIT OF PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£12.10.0**
(b) THE COMPLETE KIT OF PARTS to build the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£15.15.0**
PRICES FOR THE "5-10" ARE SUBJECT TO £1.6.0 EXTRA IF THE PARTRIDGE TRANSFORMER IS REQUIRED.

(a) The "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£15.0.0**
H.P. Terms: DEPOSIT £3.0.0 and 12 Monthly Payments of £1.2.0.

(b) The "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£18.18.0**
H.P. Terms: DEPOSIT £3.18.0 and 12 Monthly Payments of £1.7.5.
When ordering include an extra 7/6 to cover Carriage and Insurance.

MODEL 510/RC

**THE NEW
COMPLETE
MULLARD 5-10
AMPLIFIER**



Designed for a simple domestic installation with Genuine High Quality reproduction up to a maximum of 10 watts. Separate BASS and TREBLE Controls are incorporated with switched inputs for 78 and L.P. Records plus Radio Tuning Unit.

We incorporate SPECIFIED COMPONENTS and NEW MULLARD VALVES. We also give the purchaser the choice of two of the best ULTRA-LINEAR OUTPUT TRANSFORMERS made—first the latest by PARMEKO, LTD., and also the latest by PARTRIDGE (£1.6.0 extra). We also supply the PARMEKO MAINS TRANSFORMER, and this has extra power available to supply a Radio Tuning Unit. The Control Unit can easily be detached from the Amplifier Chassis for use in a remote position.

COMPLETE KIT OF PARTS £11.10.0 Alternatively we supply **ASSEMBLED AND TESTED £13.10.0**

H.P. Terms: Dep. £2.10.0 and 12 Monthly Payments of 19 10. Send S.A.E. for ILLUSTRATED LEAFLET or 1/6 for the ASSEMBLY MANUAL.

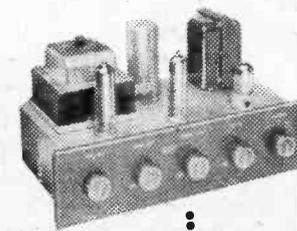
THE IDEAL AMPLIFIER FOR A SMALL HIGH QUALITY INSTALLATION

COMPLETE KIT £7.10.0 Alternatively supplied **ASSEMBLED OF PARTS £8.19.6** and FULLY TESTED (plus 6/6 coverage and insurance)

H.P. Terms: Dep. £2.0.0 and 8 Months of £1.0.0.

Developed from the very popular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to MULLARD'S SPECIFICATION including supply of specified components, Mullard valves and a PARMEKO OUTPUT TRANSFORMER. Send S.A.E. for leaflet or 1/6 for ASSEMBLY MANUAL.

**THE NEW
COMPLETE
MULLARD 3-3**



STERN RADIO LTD.

"MODERNISE YOUR OLD RADIOGRAM"

IT IS CHEAPER AND BETTER VALUE TO REPLACE YOUR OLD CHASSIS AND GRAM UNIT

!! RADIOGRAM CHASSIS !! !! RECORD PLAYERS !!

ARMSTRONG "STEREO TWELVE" £38.17.0

The most complete unit yet produced for Stereo, giving 6 watts high-fidelity push-pull output on each channel, 12 watts for monaural. Full VHF band, medium and long wavebands. Stereo and monaural inputs or records, tape and radio, and a tape output for stereo and monaural tape recording. Comprehensive matching for all types of crystal pick-ups. The perfect basis for a complete monaural reproducing system or for a complete stereophonic system now or later.

ARMSTRONG "JUBILEE" £30.9.0

An AM/FM chassis with nine valves and two diodes and with push-pull output stage providing 6 watts. Full VHF, medium and long wavebands with automatic frequency control on FM and ferrite aerial on AM. Tape record and playback facilities. Can be adapted for stereo at any time by the addition of our compact, easy-to-fit converter amplifier.

ARMSTRONG "PB409" £29.8.0

A nine-valve AM/FM chassis giving 6 watts push-pull output and fitted with attractive piano key selectors. Covers full VHF band, medium, long and short wavebands and an output socket is provided for tape recording from radio and pick-up. Can be adapted for stereo at any time by the addition of our compact easy-to-fit converter amplifier.

DULCI "H4PP" £29.3.10

An eight-valve AM/FM 4 waveband chassis giving 6 watts ultra linear output. Covers short, long, medium wavebands plus the VHF/FM band and has internal aerial on the medium and long wavebands. Tape outlet incorporated and suitable for 3 to 15 ohm loudspeakers.

DULCI "H3" £20.17.0

A 6-valve AM/FM chassis giving 4 watts output. Covers medium and long wavebands, on which an internal aerial operates, plus the VHF/FM band. Full AVC on all wavebands and Tape outlet incorporated.

NEW HIRE PURCHASE TERMS are available on all above. Illustrated leaflets available—send S.A.E.

AM/FM RADIO TUNING UNITS

Containing own Power Supply Units.

ARMSTRONG "S.T.3" £28.7.0

A self-powered high-fidelity tuner covering full VHF, medium, and long wavebands with automatic frequency control on VHF. Excellent in combination with our MULLARD AMPLIFIERS, but the cathode follower stage and variable feedback output control enable this tuner to be used with virtually any amplifier available.

DULCI "H4/T" £24.19.0

A 4 waveband self-powered high-fidelity tuner covering the VHF/FM transmissions plus the long, medium and short wavebands. Excellent performance in combination with our MULLARD AMPLIFIERS and also all high quality designs.

ILLUSTRATED LEAFLET showing recommended HIGH QUALITY LOUDSPEAKERS is available—send S.A.E.

STERN'S FOR STEREO OUR POPULAR MULLARD MAIN AMPLIFIERS ARE RECOMMENDED FOR USE WITH THE DULCI STEREO PRE-AMPLIFIERS

WE OFFER PRE-AMPLIFIER and AMPLIFIER AT SPECIALLY REDUCED PRICES

Send S.A.E. for full details.

OTHER STEREO EQUIPMENT AVAILABLE: GRAM UNITS fitted with Stereo cartridge by ... GARRARD—COLLARO Lenco—B.S.R.

HIRE PURCHASE TERMS ARE AVAILABLE.

A SPECIAL CASH ONLY OFFER !!

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER.

ALL FOR ONLY **£8.7.6** (Plus 7/6 Carr. & Ins.)

The Amplifier consists of a 2-stage design incorporating 3 modern B.V.A. valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Maroon and Grey Rexine.

WE ALSO SUPPLY SEPARATELY—

(a) The 2-stage (plus Rectifier) AMPLIFIER **£4.2.6**

(b) THE PORTABLE CARRYING CASE **£3.17.6**

(c) P.M. SPEAKER.....

Carrage and Insurance 4/- extra.



THE LATEST MODELS ARE IN STOCK MANY AT REDUCED PRICES!!!

SEND S.A.E. FOR ILLUSTRATED LEAFLET A FEW CASH BARGAINS

B.S.R. MONARCH
UA8 4-speed mixer
Autochanger with
Crystal Pick-up



£6.19.6

THE COLLARO "CONQUEST" 4-speed Autochanger, Studio Pick-up **£7.19.6**

The latest COLLARO "CONTINENTAL" 4-speed MIXER Autochanger, Studio "O" Pick-up **£8.19.6**

The COLLARO 4-speed Single Record Player, Studio Pick-up **£6.19.6**

THE NEW B.S.R. Model UA12 is in Stock. A 4 "SPEED" MIXER AUTOCHANGER. **£8.19.6**

UA12 also available incorporating the B.S.R. STEREO Pick-up, plays L.P. and 78 Records **£11.17.6**

B.S.R. MODEL TU9 4-speed Single Record Player, complete with separate Crystal Pick-up **£4.10.0**

(This high output Pick-up is available separately for £1/12/6.) Carriage and Insurance on each above 5/- extra.

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The latest GARRARD TRANSCRIPTION MOTOR "301" with Stroboscopically marked turntable **£28.0.11**

The new GARRARD Model 4HF High-quality Single Record Player fitted with the latest T.P.A.12 Pick-up Arm and C.C.8. Crystal Cartridge **£19.7.10**

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The GARRARD T.P.A.12 TRANSCRIPTION PICK-UP ARM is available separately or with Crystal or Moving Coil Pick-up Heads.

GARRARD RC121/44-speed "Autochanger" **£10.10.0** fitted with latest crystal Pick-up.

Send S.A.E. For Leaflet.

NEW HIRE PURCHASE TERMS ARE AVAILABLE ON ALL EQUIPMENT VALUE £9.0.0 AND OVER.

STERN'S MK. II fidelity F.M. TUNING UNIT

PRICE **£15.0.0**

(Plus 5/- Carr. and Ins.)

HIRE PURCHASE: Deposit £3.0.0 and 12 Monthly Payments of £1.2.0.

Incorporates the latest MULLARD PERMEABILITY TUNING HEART and the corresponding MULLARD VALVE LINE-UP comprising ECC85, 2 type EF85s (or EF89s) EM84 Tuning Indicator, plus 2 type O.A.79s Germanium Diodes. A really first-class tuner, very attractively presented and comparable to many offered at much higher prices. Power consumption is only 1.5 amps at 6.3 volts and 25 ma at 250 volts.

HOME CONSTRUCTORS: YOU CAN BUILD THIS TUNING UNIT FOR ONLY £11.0.0 (Plus 5/- Carr. & Ins.)

Please send S.A.E. for fully descriptive leaflet, or the Assembly Manual is available for 1/6. This contains easily followed PRACTICAL DIAGRAMS together with relative instructions.



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A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS

Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high-quality equipment.

The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" Speakers give really first-class reproduction and are well recommended. Models are also available to accommodate high-quality equipment.

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Telephone: FLEET STREET 5812/3/4

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On 6in. rod, 7/16in. diameter, flying lead connections, 208 pF tuning 12/6

OSCILLATOR COIL—P50/1AC

Medium wave in screening can. For 176 pF tuning condenser 5/4

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470 Kc/s operation with 250 pF tuning in cans. 1 1/16in. diameter by 3/4in. high 5/7

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Last stage transformer to feed diode detector. Size as P50/2 6/-

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Fully enclosed with six connecting tags—case 1 1/16in. square by 1 1/8in. high 17/6

PRINTED CIRCUIT—PCAI

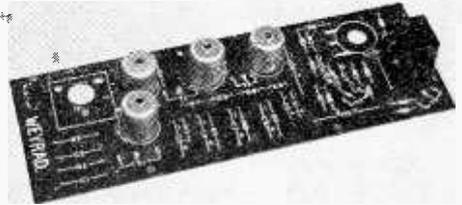
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THESE COMPONENTS ARE APPROVED BY TRANSISTOR MAKERS AND PERFORMANCE IS GUARANTEED.

Constructor's Booklet with full details, 2/-.

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Absolutely No Pre-Cleaning with the VICTOR

Soldering Tool



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The VICTOR is *revolutionary*—it heats the work direct by gripping it with the twin arms of the tool. Simply press the button, the work instantly heats up and the solder runs. *No pre-cleaning—even of oil—is required except where the metal has been oxidised previously.* Operation is from a 6 VOLT supply.

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TRADE ENQUIRIES INVITED.

Price
£2. 2s.

- * Speed in operation.
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		IA29 11/6	6S7 7/6	9003 5/6
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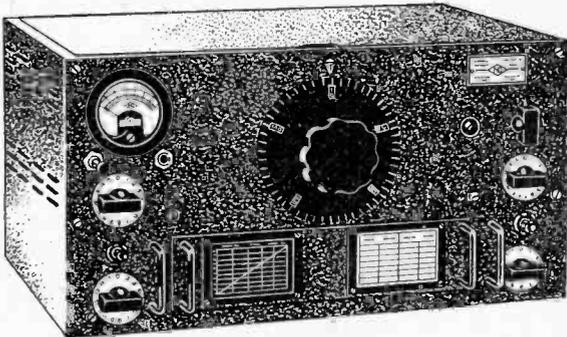
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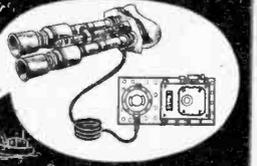


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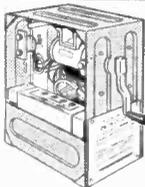
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 300-0-300 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a. 23/9
 350-0-350 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a. 23/9
 350-0-350 v. 100 mA. 6.3 v. 4 a. 4 a. C.T. 0-4-5 v. 3 a. 23/9
 350-0-350 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a. 29/9

CHARGER TRANSFORMERS
 All with 200-230-250 v. 50 c/s Primaries :
 0-9-15 v. 1 a. 11/9 ; 0-9-15 v. 3 a. 16/9 ;
 0-9-15 v. 5 a. 19/9 ; 0-9-15 v. 6 a. 23/9.

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

OUTPUT TRANSFORMERS
 Midget Battery Pentode 66:1 for 6S4 etc. 3/9
 Small Pentode 5,000 Ω to 3 Ω 3/9
 Small Pentode 76,000 Ω to 3 Ω 3/9
 Standard Pentode 5,000 Ω to 3 Ω 4/9
 Standard Pentode 7,800 Ω to 3 Ω 4/9
 10,000 Ω to 3 Ω 4/9
 Push-Pull 10-12 watts 6V6 to 3 Ω or 15 Ω 15/9
 Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω 16/9
 Push-Pull EL84 to 3 or 15 Ω 18/9
 Push-Pull 15-18 watts 6L6, KT66 2B9 Push-Pull for Mullard 510 Linear 29/9
 Push-Pull 20 watts. sectionally wound 6L6, KT66, etc. to 3 to 15 Ω 47/9

ELIMINATOR TRANSFORMERS
 Primaries 200-250 v. 50 c/s.
 12 v. 40 mA. 5-0-5 v. 1 a. 15/9
 90 v. 15 mA. 4-0-4 v. 500 mA. 9/9

FILAMENT TRANSFORMERS
 All with 200-250 v. 50 c/s. primaries 6.3 v. 1.5 a. 5/9 ; 6.3 v. 2 a. 7/9 ; 0-4-6.3 v. 2 a. 7/9 ; 12 v. 1 a. 7/11 ; 6.3 v. 3 a. 8/11 ; 6.3 v. 6 a. 17/6 ; 12 v. 3 a. or 24 v. 1.5 a. 17/6.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 in. 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 v. and 90 v. This includes latest low consumption types. Complete kit with diagrams. 39/9, or ready to use. 46/9.



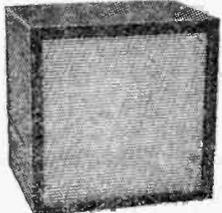
Type BM2. Size 8 x 5 1/2 x 2 1/2 in. Supplies 120 v. 90 v. and 60 v. 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed. Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators. When connected to A.C. mains supply 200-250 v. 50 ccs.

SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator. Complete kit of parts with diagrams and instructions. 49/9, or ready for use. 59/6.

R.S.C. A12 STEREOPHONIC AMPLIFIER KIT

Complete set of parts to construct a 3-watt (each channel) stereo amplifier on ready punched hammer finished chassis. For 200-250 v. 50 c.p.s. A.C. Mains. Ganged controls. Volume and Tone. Preset balance control. Output for 2 matched 3-ohm speakers. Sensitivity 150 m.v. Full instructions and point-to-point wiring diagrams supplied. Only good quality components used. Exceptional value at only **£3.19.6**, carr. 4/6. This remarkable value enables you to introduce stereo to your home at low cost. Details of stereo changers and matching speakers on request.

12in. 10 WATT HIGH QUALITY LOUD-SPEAKERS IN POLISHED WALNUT FINISHED CABINET
 Gauss 12,000 lines. Speech coil 9 ohms or 15 ohms. Only £4.19.6 Carr. 5/-. Terms: Deposit 11/- and 9 monthly payments of 11/-



D.C. SUPPLY KIT. 12 v. 1 a. consisting of partially drilled metal case, mains trans., F.W. Bridge Rectifier. 2 fuse-holders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable Electric Trains, etc. Limited number available at 29/9.

ACOS CRYSTAL 'MIKE' INSERTS. Approx. 1/4 in. square. Fly lead connections. Only 5/11 each. Brand New. Round type approx. 1 1/4 in. diam. Equipment tested. 4/11 each.



LUCAS 8 v. 22 A. H. MOTOR C.V.C.L.E. BATTERY
 B.S. Brand New. Sealed. Limited number available at only 29/9, carr. 4/6.

PORTABLE CABINETS. High Quality Finish. Rexine covered. Attractive design. Inside measurements : 17in. x 12 1/2in. x 8 1/2in. high. Clearance above base-board 5 1/2in. Below 2 1/2in. 69/9 each. Or size 14 1/2in. x 13 1/2in. x 6 1/2in. only 47/9.

SPECIAL OFFER. Above cabinet. LG3 Amplifier. B.S.R. Changer and 6in. P.M. Speaker. 13 GNS. Carr. 10/-.

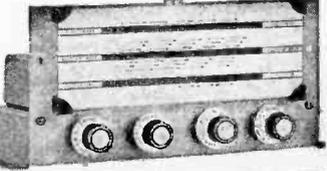
THE SKYFOUR T.R.F. RECEIVER.
 A design of a 3-valve Long and Medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion audio bend detector. Power pentode output. Valve line-up 6K7, SP61, 6V6C. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point-to-Point wiring diagrams, instructions and parts lists. 1/9. Maximum building costs £4.19.6, inc. attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6 1/2 x 5 1/2 in.

14 WATT AMPLIFIERS. Unused and in good order but store soiled. For 200-250 v. A.C. mains input. Outputs for 3 and 15 ohm speaker. Inputs for "mike" and Gram. Limited number complete with valves. Only 6 Gns., carr. 5/-.

EXTENSION SPEAKERS
 Ready for use in walnut veneered cabinet.
 6in. 2-3 ohms. 29/11
 8in. 2-3 ohms. 35/9
 10in. 2-3 ohms. 56/9
 Very limited number



AMFM RADIOGRAM CHASSIS HIGH QUALITY 6-8 WATT PUSH-PULL OUTPUT
 For 200-250 v. Mains. Long wave. Medium. P.M. and Gram. Complete with 8 B.V.A. valves. Guaranteed 12 months. Only 22 GNS. Or Deposit £2.12.0 and 9 monthly payments of £2.12.0.

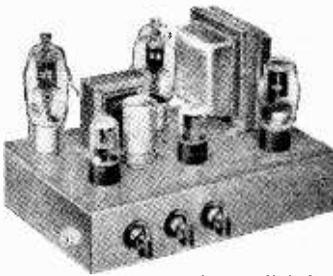


R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High fidelity Push-Pull Amplifier with "Built-in" Tone Control. Pre-amp stages, high sensitivity, includes 5 valves (807 outputs). 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 71 db. down. ONLY 70 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and practically all microphones. Comparable with the very best designs.

For STANDARD or LONG-PLAYING RECORDS, MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. **OUTPUT SOCKET** with plug provides 300 v. 20 mA. and 6.3 v. 1.5a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c/s. Outputs for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value. Carriage 10/-.

If required factory metal cover with 2



£7-15-0

carrying handles can be supplied for 18/9. Additional input sockets, with associate Vol. control so that two different inputs such as Gram and Mike or Tape and Radio can be mixed, can be provided for 13/- extra. Guaranteed 12 months. TERMS on assembled two input model: DEPOSIT 18/9 and 12 monthly payments 18/9. HIGH FIDELITY MICROPHONES and SPEAKERS in stock. Keep cash prices or credit terms if supplied with amplifier.

COLLARO RC54 3-SPEED AUTO-CHANGERS with Studio pick-up. Brand new. For 110 v. 50 c.p.s. A.C. mains. Price with 110 v. 200-250 v. Auto Trans. only 25/19/6. Carr. 5/6.

COLLARO CONQUEST 4-SPEED AUTO-CHANGER with high fidelity Studio pick-up. Latest model. Brand new. Cartoned. For 200-250 v. 50 c.p.s. A.C. mains. Our price 27/19/6. Carr. 5/6.

COLLARO 4-SPEED SINGLE PLAYER with separate pick-up, as fitted RC457. For 200-250 v. A.C. mains. 24/10/0. Post 3/9.

PICK-UP ARMS complete with Hi-Fi turnover crystal head. Acos GP54. Limited number brand new, perfect, at approx. half price. Only 35/9.

EG3 MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with above or any other single or auto-change units. Output for 2-3 ohm speaker. For 200-250 v. 50 c.p.s. A.C. mains. Overall size 61 x 41 x 2 1/2 in. Controls: Vol. and Tone with switch. Guaranteed 12 months. Only 55/9.

SUPERB FEEDER UNIT. Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). Delayed A.V.C. employed. The W.Ch. Sw. incorporates Gram position. Controls are Tuning, W.Ch. and Vol. Only 20 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-5-7in. high. Simple alignment procedure. Point-to-Point wiring diagrams, instructions and priced parts list with illustration. 2/6. Total building cost 24 15/-. For descriptive leaflet send S.A.E.

LINEAR L45 MINIATURE 4/5 WATT QUALITY AMPLIFIER. Suitable for use with Collaro, B.S.R. or any other record playing unit, and most microphones. Negative feedback 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6-5-5 1/2 in. high. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only 25 19/6. Send S.A.E. for illustrated leaflet. Credit Terms: Deposit 22/6 and 6 monthly payments of 2/6.

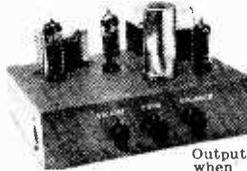
LINEAR 'DIATONIC' 10-14 WATT HIGH FIDELITY PUSH-PULL ULTRA LINEAR AMPLIFIER. For 200-250 v. A.C. mains. Valves ECC83, ECC81, EL184, EL184, EZ91 miniature Mullard. Self-contained Pre-amp. Tone Control stage, and separate Bass and Treble Controls. Independent 'Mike' and Gram input sockets are provided. Output Matches for 3 and 15 ohm speakers. Only 12 GNS. or Deposit 22 3/10 cur and 12 monthly payments of 22 3. Send S.A.E. for leaflet.

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

A highly-sensitive 4-valve quality amplifier for the home, small clubs, 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 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is metal. 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 24 15/-, or assembled ready for use 25/- extra, plus 3 6 car. or Deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.



LINEAR STEREPHONIC L33 3+3 WATT QUALITY AMPLIFIER



with stereo head. For 200-250 v. 50 c.p.s. A.C. mains. Ganged controls, Volume and Tone. Outputs matched by preset balance control. For use with 2 matched 3 ohm speakers. Only requires connecting to Pick-up speakers and mains input. Sensitivity 150 m.v. Supplied with guarantee and instructions. Send S.A.E. for leaflet. Terms available.

7 GNS.

Terms: C.W.O. or C.O.D. No C.O.D. under 21. Post 1/9 extra under 22; 2/9 extra under 25. All goods supplied subject to terms and guarantee as detailed in current catalogue. Open 9 to 6; Weds. until 1 p.m. Catalogue 6d. Trade supplied. S.A.E. with all enquiries.

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 80 output valves. All components are chosen for reliability. Six valves are used, EF86, EF86, ECC83, 807, 807, GZ33. 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 OUTDOOR FUNCTIONS, etc. For use with Electronic ORGAN, GUITAR, STRING BASS, etc. For standard of 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 cover as for A8 can be supplied for 18/9. The amplifier can be supplied, factory built with 12 months' guarantee, for 24 19/6. TERMS: DEPOSIT 24/9 and 12 monthly payments of 24/9.

11 GNS.

Carr. 10/-

LINEAR 50 WATT HIGH FIDELITY AMPLIFIER. Sensitivity 25 millivolts for full output. Suitable for any kind of microphone or pick-up. Output matches for 3 and 15 ohm speakers. Brand New. Guaranteed 12 months. For 200-250 v. A.C. mains. Only 19 gns. Carr. 15/-. Terms available. Twin handled cover available at 25/- Send S.A.E. for leaflet.

LINEAR L745 HIGH QUALITY TAPE DECK AMPLIFIER. With "built in" power pack and output Ready for stage. For Tape Decks USE ONLY with High or Low Impedance. Playback and erase heads, such as Lane, Truvox, Collaro, Brennel. Carr. 7/6

12 GNS.

etc. For A.C. Mains 200-250 v. 50 c/s. Linear frequency response of ± 3 db. 50-11,000 c/s. Negative feedback equalisation. Illustrated leaflet 6d.

SPEAKERS. All 2-3 ohms, suitable for use with LG3, L45, A5 or A7 amplifiers. 5in. Goodmans, 17/9; 7 1/2 in. Elliptical Elec., 19/9; 6in. Goodmans, 17/9; 8in. Rola, 18/9; 10in. R.A., 27/9; 10 x 6in. Elliptical Goodmans, 29/9; 12in. Plessey, 29/11; 10in. W.B. "Stentorian" 3 or 15 ohms type HF1012 10 watts, hi-fidelity type. Recommended for use with our A8 Amplifier 24 10/9; 12in. Plessey 3 ohms 10 watts (12,000 lines), 59/6.

PLESSEY DUAL CONCENTRIC 12in. 15 ohms HIGH FIDELITY SPEAKER (12,000 lines) with built-in tweeter (complete separate elliptical speaker with choke, condensers, etc.), providing extraordinarily realistic reproduction when used with our A8 or similar amplifier. Rated 10 watts. Price only 25/17/6.

ACOS HG-P59 Hi-Fi Crystal Cartridges. (Turnover type with sapphire stylus.) Standard replacement for Garrard and B.S.R. Only 19/9.

R.S.C. 3-4 WATT A7 HIGH-GAIN AMPLIFIER

For 230/250 v. 50 c/s. Mains input. Appearance and Specification, with exception of output wattage, as A5. Complete Kit with diagrams, 23/15/- Assembled 22/6 extra. Carr. 3/6.

Terms: C.W.O. or C.O.D. No C.O.D. under 21. Post 1/9 extra under 22; 2/9 extra under 25. All goods supplied subject to terms and guarantee as detailed in current catalogue. Open 9 to 6; Weds. until 1 p.m. Catalogue 6d. Trade supplied. S.A.E. with all enquiries.

RADIO SUPPLY CO. (LEEDS) LTD. Mail Orders to 29/31 Moorfield Rd., Leeds 12. Callers to 5 and 7 County (Mecca) Arcade, Briggate, Leeds 1.

RECORD PLAYER CABINETS

49/6

Elegant cabinet, cloth covered in grey or red with sunken control panel and speaker fret. Size 13 x 17 x 8in. deep. Takes a B.S.R. Monarch 4-speed Autochanger; 7 x 4in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins. 4/6.



(R.P.6)

79/6

Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours (red & grey). Grilled front controls panel. Size 15 x 19 x 8 3/4 in. deep. Beautifully made—a cabinet you can be really proud of. Takes 4-speed B.S.R. Autochanger; 6 1/2 in. round or elliptical speaker. Room for any amplifier of your own choice. Carr. & Ins. 4/6.



(R.P.4)

69/6

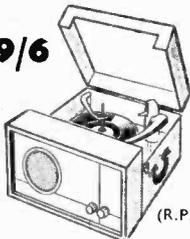
A beautifully styled cabinet. Made by a famous manufacturer. In polka dot cloth with clipped lid and carrying handle. Size 16 x 14 1/2 x 8 1/2 in. deep. Will take B.S.R. Monarch 4-speed Autochanger and 4 x 7 in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins. 4/6.



(R.P.2)

79/6

A delightful looking cabinet 14 1/2 x 17 1/2 x 8 3/4 in. in 2 tone leatherette. Will take a B.S.R. Monarch 4-speed Autochanger and 6 1/2 in. round speaker. Carr. & Ins. 4/6.



(R.P.3)

STEREOPHONIC AMPLIFIER

£7.19.6

12 months' guarantee
Beautifully made for portable stereophonic Record Players. Printed Circuit 3 x 5 1/2 x 9 3/4 in. A.C. only. Mains isolated. Twin amplifiers each side giving 3-4 watts output. Full tone, volume & balance controls. Knobs 3/6 extra. P. & P. 4/6.

*B.S.R. MONARCH 4-SPEED AUTOCHANGER

£6.19.6

12 months' guarantee
Incorporating auto and manual control complete with turnover crystal p.u. and sapphire stylus.

P.P. & Ins. 5/6.

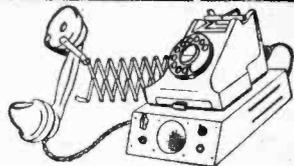
* COLLARO 4-SPEED AUTOCHANGER

£7.19.6.

Incorporating auto and manual control complete with studio crystal p.u. and sapphire stylus. P.P. & Ins. 5/6.



Televox Telephone Amplifier 89/6



Invaluable in a noisy office or workshop. 3 valves: UY41; UF41; UL41. 3in. speaker and a suction type vibration microphone. A.C./D.C. Size of amplifier 7 x 11 x 3in. Fits any type of G.P.O. telephone. P.P. & Ins. 4/6.

EXTENSION SPEAKERS 19/9

Polished oak cabinet of attractive appearance. Fitted with Bin. P.M. Speaker V.B. or Goodmans of the highest quality. Standard matching to any receiver (2-5 Ohms). Switch and flex included. Ins. Carr. 3/6.

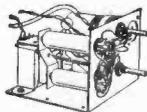


- ★ IDEAL FOR STEREOPHONIC SOUND
Bin. P.M. Speakers 8/9. With O.P. transformer fitted 10/-.
- ★ To suit most Record Players
6 1/2 in. Round Speakers 12/6 : 4 x 7 in. elliptical speakers 19/6. Postage 2/9.

AMPLIFIERS

PORTABLE AMPLIFIERS 12 months' guarantee

- ★ MARK D.1. Brand new. Latest design with printed circuit. Dimensions 7 x 2 1/2 x 5 in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. **59/6**
- ★ MARK D.2. Printed circuit. Latest design. Dimensions 7 x 2 1/2 x 5 in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume & tone controls. Knobs 2/6 extra. P. & P. 3/6. **79/6**
- ★ MARK D.3. De luxe model. Printed circuit. Latest design. Dimensions 7 x 2 1/2 x 5 in. A.C. only. Mains isolated. 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume, treble and bass control. Knobs 3/6 extra. P. & P. 3/6. **89/6**
- ★ MARK D.4. Brand new. By famous manufacturer. Especially built for portable record players. Dimensions 4 1/2 x 3 1/2 x 4 in. A.C. only. 2 valves EL84 as high gain output valve; EZ80 as rectifier. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6. **69/6**



(Mark D.4)



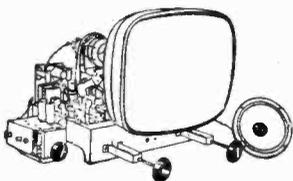
(Mark D.1 & D.2)

DUKE

Dept. D.4, 621/3, ROMFORD ROAD,
SEND FOR FREE CATALOGUE

Open all day Saturday. Closed on Thursday 1 p.m.

17in. T.V. CHASSIS, TUBE & SPEAKER 16 Gns.



17in. Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1-5, or, incorporating Turret Tuner, which can be added as an extra, at our special price to chassis purchasers of 50/- giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6. Chassis size 12 x 14½ x 11in. less valves. Similar chassis are used by well known companies because of their stability and reliability. With Tube & speaker (less valves) 16 guineas. Complete and working with valves and Turret Tuner, 24 guineas. 12 months' guarantee on the Tubes. 3 months' guarantee on the valves and chassis. Ins. carr. (incl. Tube) 25/-.

14in. T.V. CHASSIS, TUBE & SPEAKER 11 Gns.

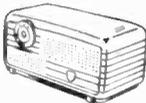
As above, with 14in. Rectangular Tube. 12 months' guarantee on Tube, 3 months' guarantee on chassis and valves. Chassis with Tube and Speaker (less valves) 11 guineas. Complete and working with valves and Turret Tuner 19 guineas. Ins. carr. (incl. Tube) 25/-.

POPULAR 12in. PLESSEY T.V. CHASSIS

This is a real bargain for anyone wanting to make up their own T.V. at a very low cost. I.F.'s 10.5-14 Mc/s. Simply adapted for a 12 Channel Turret Tuner and can be modified to take a larger Tube. A chassis in one unit. Untested. Less valves, tube, speaker & scanning coils (all can be supplied as extras). Circuit diagram available at 3/6, or FREE with order. Carr. & Ins. 10/6.

BAKELITE CABINETS 5/9

Brand new. Colour brown. Attractive design. Size 12 x 7 x 5½in. Ideal for small receivers, converters, etc. P. & P. 3/9.



MIDGET RADIO 5-VALVE SUPERHET 49/6

5-valve superhet. Can be used on 110-250 volt mains. A.C. or D.C. Compact little set using 12K8, 12K7, 12Q7, 35L6 and 35Z4 G.T. valves. 5in. speaker. Cabinet size 17 x 8 x 6in. Carr. & Ins. 3/6.

★ HEATER TRANSFORMERS

HEATER TRANSFORMER, 12/9

12 v. at ½ amp. 0-200-250 volts primary. P. & P. 1/9.

HEATER TRANSFORMER, 3/9

2-1 ratio or 1-2 ratio Auto Transformer; 2 volt at 1.4 amp. primary, 4 volt secondary. P. & P. 1/9.

★ MAINS TRANSFORMERS

DROP THROUGH TYPE, 12/9

350-0-350 volts at 250 mA., 6.3 volt at 4 amp., 6.3 volt at 4 amp., 4 volt at 3 amp., 22 volt at 3 amp., 4 volt centre tapped at 1.5 amp. Primary 200-250 volt 50 cycles. P. & P. 3/9.

DRCP THROUGH TYPE, 12/9

350-0-350 volts at 250 mA., 6.3 volt at 5 amp., 4 volt at 4 amp., 4 volt at 7 amp., 4 volt centre tapped at 1 amp. Primary 200-250 volt 50 cycles. P. & P. 3/9.

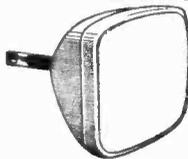
& CO.

MANOR PARK, LONDON, E.12.

★ TERMS AVAILABLE

Tel. ILF 6001/3.

CHASSIS · TUBES · SPEAKERS



12 MONTHS' GUARANTEE

REGETTERED IMPROVED VACUUM T.V. TUBES

17in. Rect. **£7.10.0**
14in. Rect. **£5.10.0**

Our 12 months' guarantee (6 months' full replacement, 6 months' progressive) illustrates our wholehearted confidence in the Tubes we offer. We sell many hundreds a week throughout the

country and have done so for the past 7 years. Many of them go to the Trade, i.e., to Insurance Companies, Renters and Retailers who are thoroughly satisfied with our supplies. Remember, they also hold a 10 days' money back guarantee. 9in., 10in., 14in., 15in. and 16in.

ROUND TUBES. Our special offer of these sizes, £5, 12in. T.V. Tubes, £6. Three months' guarantee on round tubes. Ins. carr. 15/6.

POWER PACK AND AMPLIFIER, 19/6

R.F. E.H.T. Not tested. Amplifier stage 6V6 with O.P. trans., 3 ohms matching. Smoothed H.T. 350 volt at 250 mA., 6.3 volt at 5 amp., 22 volt at 3 amp., 6.3 volt at 4 amp. and 4 volt centre tapped. Less valves. Drawings free. Size 14½ x 8 x 7in. Ins. carr. 5/6.

POWER PACK & AMPLIFIER, 9/9

Output stage PEN45 O.P. trans choke. Smoothed H.T. 325 volt at 250 mA., 4 v. at 5 amp., 6.3 v. at 5 amp., 4 v. at 5 amp. centre tapped. Valve base for rectifier. Octal or 4-pin. Output is taken from standard plugs. Less valves. Ins. carr. 5/6.

POWER PACK & AMPLIFIER, 19/6

Tested. Output stage 6V6 with O.P. trans. 3 ohms choke. Smoothed H.T. 350 v. at 250 mA., 6.3 v. at 5 amp., 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 v. centre tapped. Less valves. Ins. carr. 5/6.

SOLO SOLDERING TOOL

110 v., 6 v., or 12 v. (special adaptor for 200/240 v., 10/- extra)

Automatic solder feed including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post 2/9.



SOUND AND VISION STRIP, 25/6

Plessey. Tested. I.F.s 10.5 Mc/s sound, 14 Mc/s vision. 8 valveholders. Less valves. Size 8½ x 5 x 4½in. Circuit incl. The tuner unit plugs directly into this chassis. P. & P. 2/6.

SOUND AND VISION STRIP, 5/9

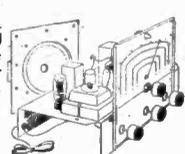
Salvaged Superhet. 8 valveholders. Less valves. I.F.s 7.25 Mc/s sound, 10.75 Mc/s vision. Vision complete from input up to video output. Sound complete from input to A.F. amplifier. P. & P. 2/6.

TIMEBASE, 4/9

Containing scanning coils, focus unit, line transformer, etc. Less valves. Drawings free with order. P. & P. 2/6.

★ SUPER CHASSIS, 99/6

5-valve superhet chassis including 8in. P.M. speaker and valves. Four control knobs (tone, volume, tuning w/change switch). Four w/bands with position for gram p.u. and extension speaker. A.C. Ins. carr. 5/6.



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A 10-WATT HIGH FIDELITY ULTRA LINEAR AMPLIFIER WITH INTEGRAL PRE-AMP

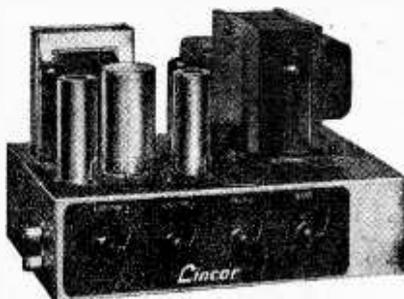
A special feature is the compactness of the unit. Full advantage has been taken of latest component miniaturisation developments to produce a 10-watt Hi-Fi push-pull amplifier incorporating tone control pre-amplifier stages within the measurements of 9 x 7 x 6½ ins.

In addition two high impedance input sockets are provided for microphone and gram, etc. Each input has its associated vol. control, five B.V.A. valves are employed ECC83, ECC83, EL84, EL84, EZ81, H.T. and L.T. power supply point is included for a radio tuner.

L45 MINIATURE 4/5-WATT QUALITY AMPLIFIER

Size only 6 x 5 x 5½ in. high: 12 d.b. Negative Feedback, Sensitivity 30 m.v. for full output. 3 Mullard valves, ECC83 Twin Triode, EL84 Power Output, EZ90 Rectifier. Separate Bass and Treble Controls. Mains switch incorporated in control. For 200-250 v. 50 c.p.s. A.C. Mains. An ideal unit for use with Gram. or 'Mike.' Output matching for 2-3 ohm speakers. Retail Price £5-19-6

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Outputs for 3- and 15-ohm speakers. Chassis finish stoved Blue-Grey hammer.

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MAXIMUM RELIABILITY!
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12 GNS.

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ELECTRON WORKS, ARMLEY, LEEDS.

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In excess of 14 watts.
RATED OUTPUT 10 WATTS.

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Volume (2) 220 millivolts for rated output.

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Continuously variable + 13 d.b. to -18 d.b. at 15 c.p.s.

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HARMONIC DISTORTION

0.19% measured at 6 watts.

NEGATIVE FEEDBACK

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The first One Year course begins on 8th September 1959 and enrolments are now being accepted. Succeeding courses commence in January, April and September of each year.

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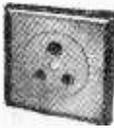


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Latest A V O Testmeter

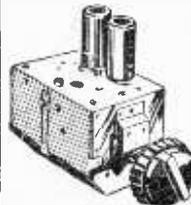


Can be yours for only 10/- deposit and 19 fortnightly payments of 10/-. Like all A V O meters it is a very fine instrument; it has a sensitivity of 10,000 ohms per volt and 19 most useful ranges as follows—

D.C. volts 0-1,000 (seven ranges), A.C. volts 0-1,000 (five ranges), D.C. current 0-1 amp. (5 ranges), resistance 0-2 megs. (2 ranges) (complete with test leads). Immediate delivery. Cash price £9/10/0.

FREE GIFT.—All purchasers will receive Range Extender scale and data which add: capacity 0-1 mfd. in two ranges. Inductance 0-100 henrys, etc., etc.

Latest Type Turret Tuner



Brand new stock, not surplus, with coils for Band I and III complete with valves. Model I I.F. output 3338 Mcs. Series heaters Model 2 I.F. output 16/19 Mc's. Parallel heaters. With instructions and circuit diagram, 79/6. With knobs 3/6 extra, post and insurance 2/6.

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Metal body standard round dolly with on/off indicator and fixing nuts, 1/3, or 12/- dozen.

Break-up Bargain

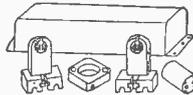
The unit 3515 less valves and I.F. strip. This contains components valued at least £10 as follows:—

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Plus hundreds of miscellaneous items, nuts, bolts, washers, tag strips, I.F. sockets, etc. All for 6/6, plus 5/- carriage up to 50 miles.

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For customers wishing to use fluorescent lighting without metal work, for shop window lighting, etc. We offer complete kits of parts. Five items as illustrated comprising best quality choke ballast, canister starter and white bakelite holders. 40 watt kit, 22/6, 80 watt kit, 26/6, plus 2/- post and insurance.



Infra Red Lamp

● Economical. ● Costs only 1d. per hour (elec'y at 1d. per unit).

● Absolutely safe, no health or fire risk. Fitted over bed as illustrated gives heat and light, ideal reading in bed, fitted over work bench keeps hands warm, etc. Price 23/6, plus 2/6 post.



Fluorescent Lighting



Complete lighting fittings. Built-in ballast and starters—slove enamelled white and ready to work. Ideal kitchen, workshop—anywhere. Twin 20 approximately 7in. long complete with two 20W tubes, 49/6. Single 40 approximately 4ft. long complete with one 40W tube, 39/6. Inductor £0 approximately 5ft. long complete with one 80W tube, 59/6. Carriage r.r.d. insurance up to 150 miles 5/6, up to 250 miles 7/6. 21in. Miniature complete with 13W tube. Ideal for showcase or position where miniature fitting is required, complete with latest 1/2 in. diameter tube, 49/6 each.

Cabinet Snip



This fine cabinet as illustrated but less control knobs is available this month at special snip price of 12/6, plus 3/6 post and insurance. Size is 13 1/2 in. x 9 in. x 4 in. and it is nicely covered in two tone I.C.I. fabric.

Wire Joiner



This is in a bakelite case with trigger switch, works off stop-down transformer, 3/6, plus 9d.

10 Valve 1 1/2 Metre Superhet



Ideal for Commercial T.V. These contain 6 valves type SP61, and one each RL7, RL16, and EA50. Six I.F. transformers, 12 Mc/s band, and hundreds of other useful components. Price 29/6, plus carriage and packing 7/6. These receivers are unused.

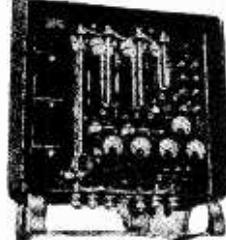
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A.C./D.C. Multimeter Kit

Ranges : D.C. volts 0.5, 0-50, 0-100, 0-500, 0-1000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamms 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries. Measures A.C. D.C. volts. D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector switches, calibrated scale and full instructions. Price 19/6, plus 2/6 post and insurance.



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Offered at about one-twentieth of original cost. This is an ex-Government switchboard. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are original cases. Price £2/15/-, carr. 10/-, 1,200 watt model now available, £3/15/-, carriage 10/-.

For Your Lab.

Resistance substitution boxes are great time savers and you really cannot have too many of them ; here then, is an opportunity to acquire these at a very low rate. Our R.S. kit available for only 8/6, plus 1/6 postage, comprises 50 W. precision variable resistor 0-100 K., six 2-3 watt fixed resistors, one 6-position switch, one pointer knob and one ordinary knob and instructions. This unit when made up will give an infinite variability over the range 100 ohm to 2 meg.

Band III Converters

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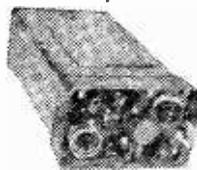
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Complete Walkie-Talkie 25/-

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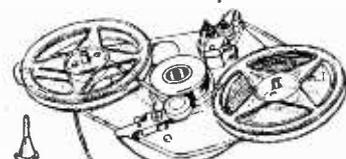
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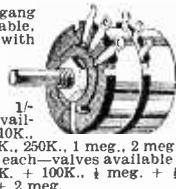
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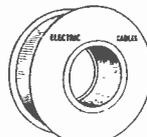
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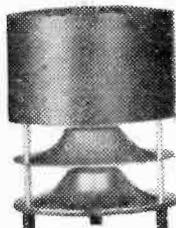
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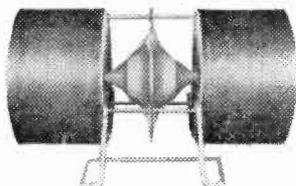


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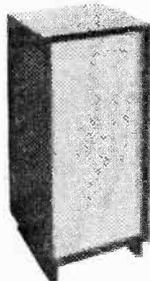
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PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXV, No. 628, APRIL 1959
COMMENTS OF THE MONTH

EDITOR : F. J. CAMM

27th YEAR
OF ISSUE

BY THE EDITOR

OUR CAXTON HALL FILM SHOW

TO use a cliché, a good time was had by all at our Film Show at the Caxton Hall in February. As far as I can trace, there were no absentees, but there were several arrivals without tickets, and we were able to provide standing room for them.

For ourselves, we found the film on the Birth of the Atom extremely interesting. Nearly 600 people were present and we were able to chat to some of our old friends of years ago.

One reader made the suggestion that instead of running the film show we should organise a general get-together when people could wander round and chat about old times. What do you think about that suggestion?

We shall repeat the performance next year, with perhaps a larger hall and a different programme.

WANTED—CHEAPER COMMERCIALS

THE enormous profits now being made by Associated-Rediffusion and other operators have naturally whetted the appetites of the Trade Unions, who are now already negotiating for a bigger bite of the apple. It is our view that considerable reductions in the price of programme time could be made without affecting the programmes in any way. The standard rate of pay for service engineers per 44-hour week is fixed as follows:

(a) Radio and TV engineers who have served a five years' apprenticeship, £11 7s. 6d.

(b) Radio and TV engineers who have served a five years' apprenticeship and who have gained the R.T.E.B. certificate in radio servicing, £12 7s. 6d.

(c) Radio and TV engineers who have served a five years' apprenticeship and gained the R.T.E.B. certificate in television servicing, £13 7s. 6d.

Other employees: semi-skilled persons engaged on general radio and television, installation and maintenance, £9 7s. 6d.

The agreement defines hours of work, overtime, wages during sickness, holidays with pay, tools and equipment, and a note regarding private work to the effect that no engineer shall undertake work in his own time.

A further schedule quotes the following rates of pay for apprentices for a 44-hour week: first year, £3; second year, £4; third year, £5; fourth year, £6; fifth year, £7 10s. In addition, 10s. per week will be paid to apprentices entitled to the R.T.E.B. radio servicing certificate and a further £1 per week to those entitled to the Board's TV servicing certificate.

Although two-thirds of the population now have television, 7½ m. still receive BBC only. There is a general fall off of evening programmes.

THE RADIO SHOW

A NEW company—Radio Exhibitions Ltd.—is to be responsible for promoting future "radio exhibitions." As soon as registration formalities are completed it will get to work on the Radio Show, which this year takes place at Earl's Court from August 26th to September 5th.—F. J. C.

Our next issue, dated May, will be published on April 7th

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PRACTICAL WIRELESS

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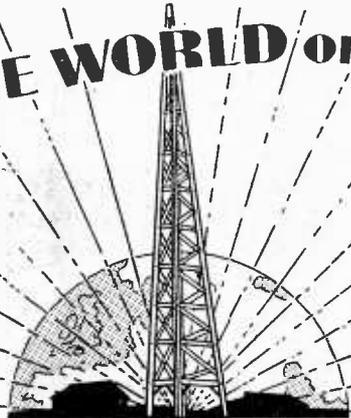
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The Editor will be pleased to consider articles of a practical nature. Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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ROUND THE WORLD OF WIRELESS



Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of December, 1958, in respect of wireless receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include licences issued to blind persons without payment.

Region	Total
London Postal	966,114
Home Counties	950,859
Midland	699,953
North Eastern	852,242
North Western	663,501
South Western	574,875
Wales and Border Counties	358,150
Total England and Wales	5,065,694
Scotland	618,741
Northern Ireland	169,114
Grand Total	5,853,549

By "QUESTOR"

on one side of the card which shows a man walking through the communicating doorway holding a microphone at arm's length. The recording runs for approximately five minutes.

Aids to Landing

A NEW system has been developed by the Blind Landing Experimental Unit of the Royal Aircraft Establishment, Bedford. The modern civil airliner carries equipment which, used in conjunction with ground-based radio beam systems, enables approaches to be made down to a height of about 150ft. above ground level, the automatic pilot being used to fly the aircraft. From this height, the pilot must depend upon visual approach and landing aids for the completion of the landing. The work of the Blind Landing Experimental

more than double the value for 1955 (£5.6m.). Exports of components, which had reached a peak value in 1957, were slightly lower in value while maintaining their volume.

An Experiment in Sound

A POST-CARD recording of an acoustic experiment has been sent to 5,000 architects, builders and specifying authorities by the Building Boards Division of Bowaters. It illustrates dramatically the difference between sounds heard in a room with an ordinary plaster ceiling and similar sounds in a room with a ceiling of Bowater Thermo-Acoustic Panels. In the latter there is a complete absence of speech distortion by reflected sound waves.

Believed to be the first use of a "Sound Card" for such a purpose, this operation combines the curiosity value of a new gramophone record with the personal appeal of the human voice, the printed word and a photograph, all in one. The recording was made in two communicating rooms, and the experiment is illustrated by the photograph

Transistors—To-day and Tomorrow

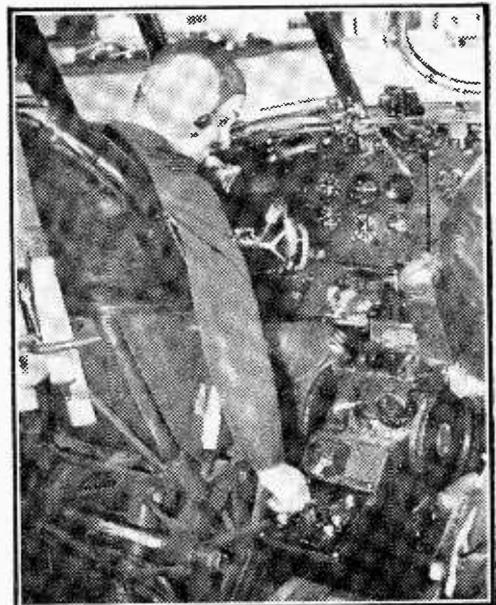
WHAT makes a guided missile tick? Why are the new hearing aids so small?

The answers, and what these contrasting devices have in common, are to be found in transistors, subject of an international scientific Convention and Exhibition at Earls Court from May 21 to May 27, which is to be promoted by The Institution of Electrical Engineers.

Record Radio Exports

A NEW record was reached for exports of British radio equipment of all kinds in 1958, it is announced by the Radio Industry Council. The provisional value, over £45m., was over £1½m. more than that of the previous highest level, 1957, and is nearly four times that for 1948 (£11.9m.).

The highest proportionate rise was for valves and cathode-ray tubes, £5.3 m. or £1.4m. higher than in 1957, and a new record level. Record levels were also reached in the sound reproducing equipment groups, where the total, £11.3m., represented a rise of £1.4m. over 1957 and was



Flt. Lt. Stark switches on the automatic landing pilot in the "Varsity" aircraft.

Unit is mainly concerned with eliminating the final phase of the landing.

New radio guidance systems have been developed which provide the necessary accuracy to enable aircraft to be landed under complete automatic control. Using these new guidance systems in conjunction with a modified automatic pilot and an automatic airspeed control, over 2,000 fully automatic landings have been made.

Oversea Visual Aid Centre

THE OVERSEA VISUAL AIDS CENTRE, which has recently been opened, has been established as a result of a unanimous request of an oversea visual aids conference in 1956, to amass and disseminate "know-how" on all aspects of aural and visual aids overseas, particularly in a tropical or semi-tropical context. The facilities offered by the centre will meet a long-felt need for some central point to which teachers, community development workers, indeed, all who have teaching or training problems from countries both inside and outside the Commonwealth can go to get advice on audio-visual teaching aids from experts with practical experience of their special needs and problems.

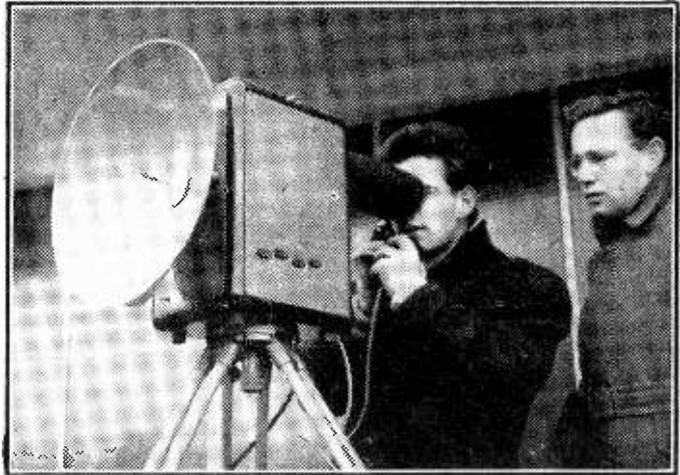
"Tellurometer" Measuring Equipment

A NEW instrument is now available, known as the "Tellurometer," which uses electronic waves as its "tape." This system consists of two units, transmitter and receiver, each operated by one man. The two units are set up even hundreds of miles apart on the site to be surveyed, and aimed at each other by means of radar waves read in strength from an oscilloscope. When they are correctly aligned, radar waves are sent out from the transmitter and timed in micro-milli-seconds on the journey to the receiver and back, and then translated quite simply into miles, feet and inches. The probable error of this system is one part in 300,000 on long stretches, and maximum possible error is 11 inches in 40 miles. The system enables surveying to be carried out in a fraction of the time required for the more conventional methods of hand

measurement, etc., and is being used very extensively in the United States to establish the numerous ground control points necessary to construct the 41,000 mile National Interstate Highway system, and is expected to

officer aboard the Bristol Pilot Boat lying in Barry Roads.

The new station is one of the most up to date of its kind in the world and is designed to improve the service and extend the range of ship-shore radio



The Tellurometer master instrument being operated by a trainee, seen here receiving instruction.

cut millions of dollars off the cost of laying the network.

Copper Etched Wiring Circuits

PRI-N-TED CIRCUITS LTD., of Borehamwood, Herts. one of the pioneer manufacturers of copper etched wiring circuits, who recently became associated with The London Electric Wire Co. & Smiths, Limited, is about to establish an information service in the form of a series of technical bulletins, to provide present and potential users with the latest information on production techniques and recent applications. Those wishing to receive these brochures are asked to write to the address given above stating their interest and copies will be sent immediately on publication.

New Post Office Radio Station

ILFRACOMBE RADIO, the new Post Office Coast Radio Station at Mulacott Cross, North Devon, was opened on January 29th by Mr. T. A. Davies, O.B.E., Inspector of Wireless Telegraphy. He made a radio-telephone call to Commander A. W. R. Adams, D.S.C., R.N. (Retd.), senior

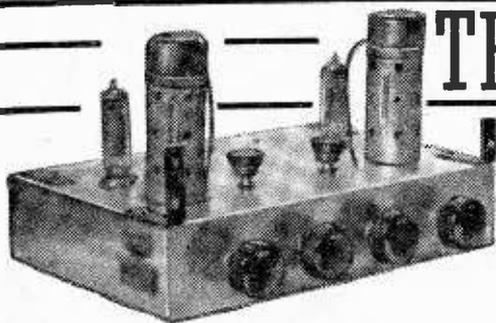
communication in the Bristol Channel area. For the past three years the short-range radio-telephone service for these waters has been operated from a temporary station at Ilfracombe Head Post Office, and this as well as the short-range radio-telegraph service previously given through Burnham Radio will be taken over by Ilfracombe Radio.

SMPTE Appointments

THE Board of Governors of the Society of Motion Picture and Television Engineers has appointed G. Carleton Hunt, General Film Labs., Hollywood, California, as financial vice-president of the organisation. He will complete the unexpired term of SMPTE Executive Vice-President J. W. Services, National Theatre Supply Co., New York.

Also appointed to fill an unexpired term is S. P. Solow, Consolidated Film Industries, Hollywood, who replaces Reid H. Ray, as treasurer. Mr. Ray is now convention vice-president. Barbara D. Skeeter, a former newspaper editor, has replaced Wallace Shapiro as Director of Public Relations.

THE STEREO SEVEN



RADIO PROGRAMMES ARE PROVIDED AS WELL AS GRAMOPHONE RECORD REPRODUCTION

By J. B. Willmott, A.I.P.R.E.

THE main purpose of this radiogram is to provide good quality reproduction from the newly introduced stereophonic records, at a volume suitable for domestic requirements, together with reliable reception of the principal BBC stations and a few of the more powerful Continental broadcasting stations on long and medium wavebands.

Radio Tuner Unit

The receiver is so designed, however, that the radio tuning unit is constructed on a separate chassis, and draws its power supplies from a plug and socket arrangement on the main amplifier chassis, into which the A.F. output is fed by a short length of coaxial cable, also utilising plug and socket connections. The more experienced constructor is therefore at liberty, if he so desires, to substitute a radio tuning unit of another type, for example, a three waveband superhet, or the well-tried "Jason" F.M. tuner. The only proviso is that the power requirements do not exceed approximately 30 mA at 250 v. H.T. and 6.3 v. at 1.2 amps.

The radio tuner unit, constructed on a chassis 7in. X 5½in. X 2in., is a two stage circuit (see Fig. 1), using a 6K7 as R.F. amplifier, in the cathode circuit of which is incorporated a variable gain control which at the maximum setting also provides "reaction" via the aerial coil coupling winding, greatly increasing the sensitivity on weaker transmissions. This control becomes in effect the volume control on radio reception and the main volume control on the stereo amplifier chassis can remain unaltered from its desired setting when playing records.

The Detector

The output from the R.F. amplifier stage is then fed to a 6J5 valve acting as an "infinite impedance detector," of which the distortion-free qualities are well known. Ample filtering is provided in the output from the cathode of this valve, and the resultant audio signal is taken out to the main amplifier as described above. Because in the author's location (Hull), reception of the Light Programme on medium waves is unsatisfactory, dual range coils are used, and the normal type of wavechange switching incorporated. There are thus three controls on the radio tuner unit, volume, tuning and wavechange. An elaborate

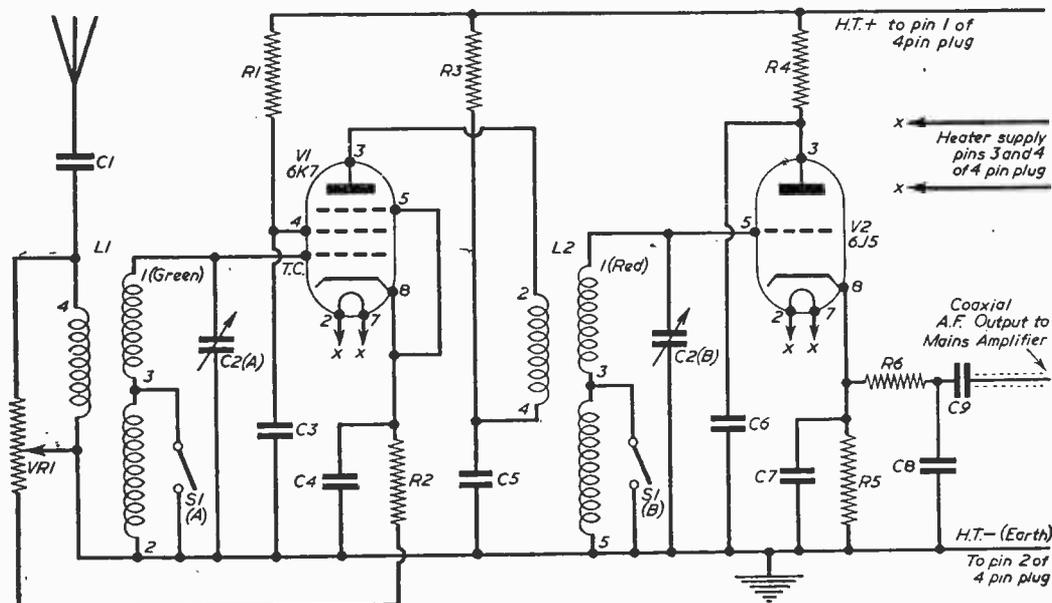


Fig 1.—Circuit of the Radio Tuner Unit.

(and expensive) tuning dial is not necessary with a receiver of this type, and so direct drive to the tuning condenser spindle was adopted.

The radio tuner unit power supplies are fed in from a four-pin miniature plug, a corresponding socket being mounted on the top surface of the main amplifier. The coaxial output lead is terminated in a small two-pin non-reversible plug, a socket for which is mounted on the left-hand side (looking from above) of the main amplifier chassis.

The Main Amplifier

Turning now to the main "stereo" amplifier, this will be seen from the circuit diagram (Fig. 2) to consist of two identical channels comprising an SP61 and EL84 valve in each case. Some readers may question the use of "old" type SP61 valves in the first stage. The reason is they are plentiful and cheap, and perform satisfactorily in this application. No doubt they could be replaced by any suitable triode (or pentode connected as triode) of the B7G and B9A based types.

In addition to the input socket from the radio tuner unit mentioned above, there is a three-pin plug and socket for introduction of the output from the stereo pickup head. Three-way cable is, of course, used for this, the two insulated wires coming from the outer tags on the stereo crystal cartridge, and the outer screening being connected to the centre tag thereon. Similarly, at the input end, the centre socket is earthed to chassis and the outer sockets are fed to the respective amplifier channels.

A two-pole, two-way radio/

gram changeover switch is interposed between these input sockets and the amplifier chains themselves. Switching is so arranged that on "radio," the signal is fed to both amplifiers simultaneously in parallel, whilst on "gram," the input from each of the "live" gram sockets is fed separately to Channel "A" and "B" respectively.

Following the input switching arrangements, there is a pre-set gain control in the grid circuit of the triode-connected SP61 valves. This enables the gain of the two channels to be exactly

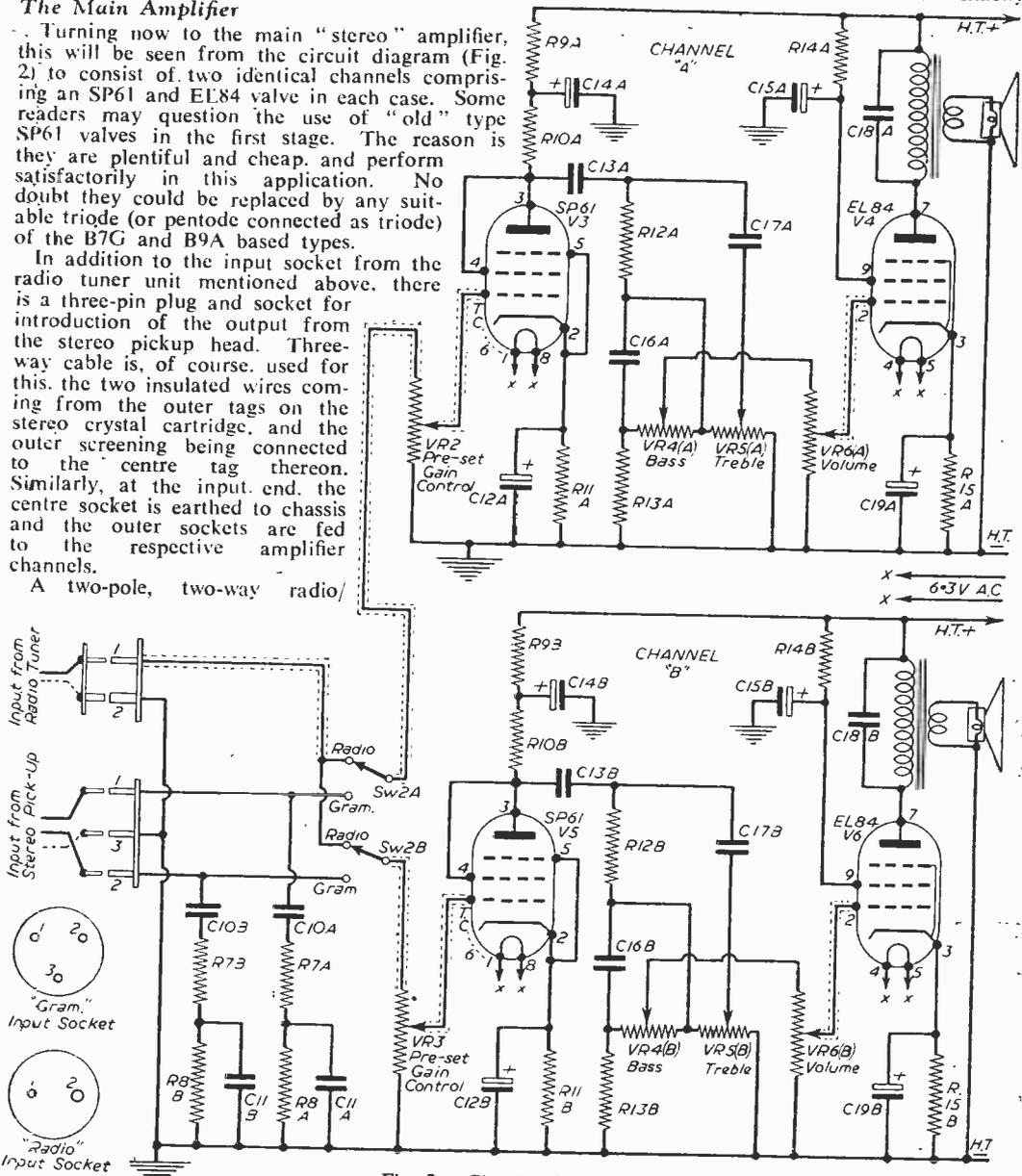
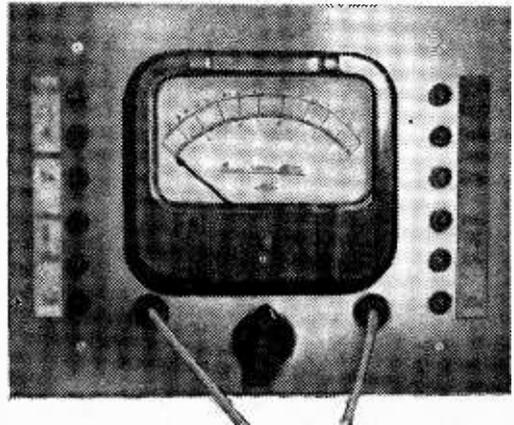


Fig. 2.—Circuit of the Main Amplifier.

A Push-button Multi-range Testmeter

THIS CONCLUDING ARTICLE DEALS WITH THE ASSEMBLY AND WIRING

By Hugh Guy



THE table giving the required lengths of Eureka (Constantan) or copper wire for the three shunts R2, R3 and R4, mentioned last month, is shown on the next page.

The chosen length should be carefully measured out and then neatly wound on a large resistor, say, 1 or 2 watt size, not less than 1,000 ohms in value. The resistor, of course, is used purely as a convenient former for the winding.

Front Panel

The arrangement here depends very much on the meter used in the design. The material of the panel may be metal, when 18 s.w.g. aluminium provides a rigid assembly, or a pleasing appearance can be obtained by using Formica or a similar laminated plastic material.

A typical layout is shown in Fig. 9 to suit a 4½ in. instrument. The panel size will vary with the meter chosen for the job. The press button switch banks are arranged vertically and the function of each button should be neatly engraved or written at one side. The scales will read in the same order as indicated in Fig. 6 if the switches

are mounted the right way up. The centrally located ½ in. diameter hole provides a fixing for the resistance scale zeroing control VRI.

Two terminal fixing holes are provided, although, in the experience of the writer, very often it is more convenient to provide two flying leads as connections to the instrument. These are taken via the two holes shown, which should be bushed by rubber grommets, directly to the appropriate contacts on the switch banks at the rear of the panel. A very convenient and durable form of connector, which can be terminated in a crocodile clip, is provided by ordinary flexible television aerial coaxial cable with the inner conductor and braiding all soldered together.

Assembly and Wiring

The unit is designed to enable all the components to be mounted on the rear of the front panel, with the exception of the battery. The switch banks should be fixed by means of four screws with mounting pillars (or piles of washers) providing stand-offs so that sufficient space exists between the front panel and the switch chassis to accommodate the flange on the bakelite buttons which fit on the switch rods. This arrangement provides a captive fitting to the buttons.

The wiring diagram (Fig. 8) shows the interconnections between the switches and components in pictorial form and if tackled correctly, no extra tag strips or fixings should be necessary. To facilitate this, those interconnecting wires which couple several points in the circuit together should be thick tinned copper single conductors, such as 16 s.w.g. wire, so that they are self-supporting.

The bridge rectifier can be supported in this way, and use can also be made of any unused tags on the various switches. However, not more than one tag on any one set of related contacts should be used for supports to different parts of the circuit because when the switch is made, those parts of the circuit wired in this way would be shorted out. The two leads to the battery can be supplied as flexible connections soldered to the battery. The life of the battery in normal

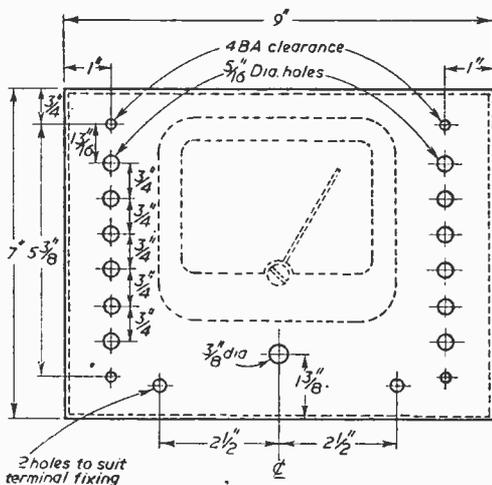


Fig. 9.—General front panel layout.

use is easily in excess of six months and soldering therefore avoids a complicated set of connectors.

Some readers may prefer to use a 1.5 v. low tension battery, as manufactured for portable receivers, as a resistance range source. The battery connections are provided here by a conventional miniature socket and the mating plug can therefore be wired to the battery leads.

In the case of the U2 an electrolytic C-type fixing clip offers a simple and convenient method of mounting the battery, screwed to the wooden box forming the case to the instrument. A hinged port should be provided in the case to allow access to the battery for replacement purposes.

Final Notes

A close study of the circuit of Fig. 6 will show that great care has been taken in the design to offer maximum protection to the meter. This has been achieved by arranging that on each switch one pair of contacts is in series with the meter. Consequently a large number of "on-off" switches appear in series with the meter, each provided by the switch contacts.

In the case of switches which have been lying in store for long periods of time, erratic readings on the meter may result as the contact resistance of all the contacts appears in series with the meter. Contacts should therefore be scrupulously examined when the switches are bought and carefully cleaned before being put into use.

An extra facility which some readers may like

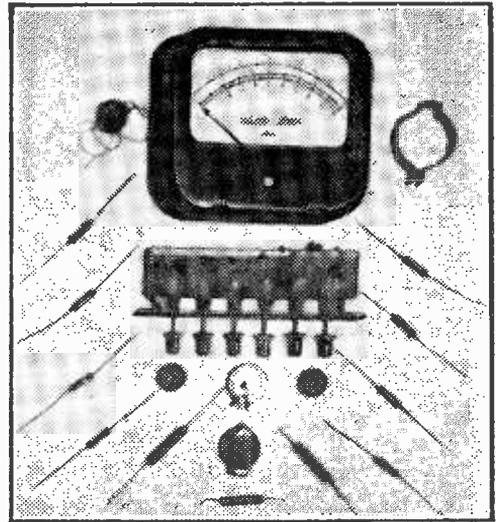


Fig. 10.—The meter and some of the components used in the instrument.

over switch the moving arms of which should be connected to the meter. The input connections should be coupled to two of the poles and looped on to the other two poles crossed over.

TABLE SHOWING ALTERNATIVE WINDING LENGTHS FOR SHUNTS

SWG :	EUREKA			COPPER		
	18	22	26	20	28	40
R2—0.1001Ω	9½ in.	—	—	12ft. 9in.	2ft. 1¼ in.	—
R3—1.01Ω	—	2ft. 9in.	10¾ in.	—	21ft. 8¼ in.	2ft. 3½ in.
R4—11.11Ω	—	30ft. 3in.	9ft. 4¼ in.	—	—	22ft. 10in.

to include is a reversing switch to enable the meter polarity to be changed when the connections are made the wrong way round in testing a circuit. This switch should be connected directly at the meter and consists of a double pole change-

If this switch is included some repositioning of the controls is required on the front panel. A symmetrical arrangement should be made of the resistance zeroing control and the switch making a pleasing lay-out.

Publications Received

New Valve Chart

TAYLOR ELECTRICAL INSTRUMENTS LTD., Montrose Avenue, Slough, have published a completely new valve chart for use with Taylor valve testers, containing 5,000 settings. The price of this manual is 7s. 6d. including postage.

Two-dimensional Measuring Microscope

W. G. PYE & CO., LTD., Granta Works, Cambridge, have sent us a catalogue dealing with their two-dimensional measuring microscope. This instrument is designed for flexibility, simplicity of operation and a high degree of accuracy.

PRACTICAL TELEVISION

March Issue

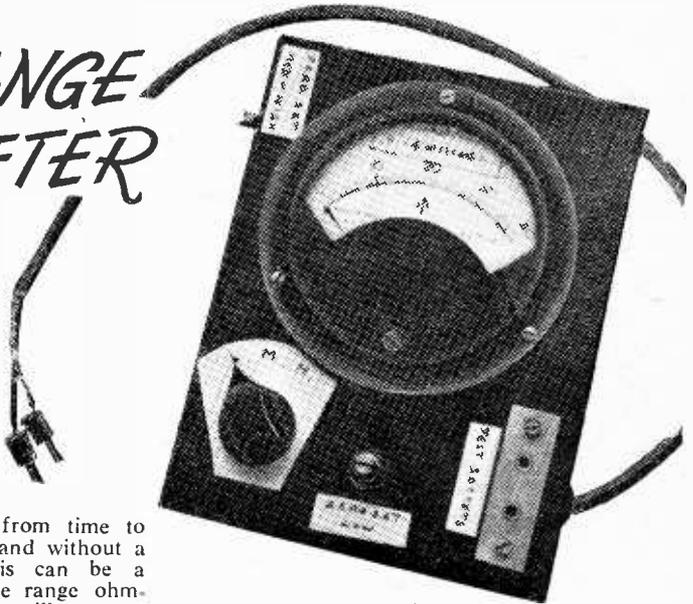
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A THREE RANGE OHM-METER

RESISTANCE MEASUREMENTS
CAN BE MADE FROM ABOUT
0.5 OHMS TO 500 KILOHMS

By D. Collins



THE home constructor needs from time to time to measure resistance, and without a fairly good ohm-meter this can be a difficult task. The following three range ohm-meter, whilst costing little to make, will measure most values of resistance between $\frac{1}{2}$ ohm and 500 kilohms. The circuits incorporated in the final design are discussed separately so that the constructor who does not possess a meter of exactly the same type as that used will be able to adapt the circuit to suit the meter he has available.

The writer obtained for a few shillings an ex-Govt. milliammeter reading to 40 milliamperes and when the internal shunt had been removed

network of R1 and R2. R2 is a variable resistance, and is called the set-zero control, its function is to maintain FSD even when the torch cell voltage falls off with use. The overall value of the required series resistance is given by Ohm's Law, which may be written mathematically as $R = V/I$, where R is the resistance in ohms, V the applied voltage, and I the current in amperes. In this particular case the FSD current is 4 milliamperes, i.e., $4/1,000$ ampere, and the applied voltage is $1\frac{1}{2}$.

$$\text{Therefore } R = \frac{1.5}{4/1,000} = 375 \text{ ohms.}$$

R1 was chosen as 300 ohms and R2 as 100 ohms.

The calibration of the instrument is best done mathematically at first in order to indicate the range of the instrument, and final checks on accuracy may be made by measuring resistances of known value. Consider the circuit shown in Fig. 2, where G represents the resistance of the meter movement (in this case 5 ohms), S represents the resistance to be measured, Ig represents the current through the meter, and Is represents the current through the unknown resistance. Further, it is known that the sum of Is and Ig is 4 milli-

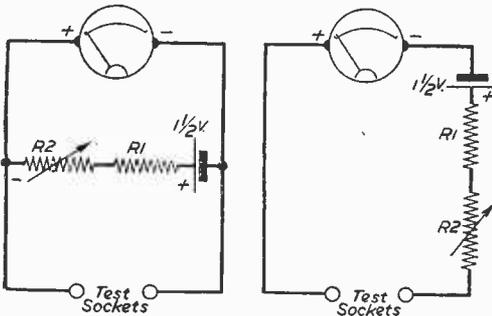


Fig. 1 (Left).—Low-range circuit.

Fig. 3 (Right).—Medium-range circuit.

it was found that the meter had a full-scale deflection (FSD) current of 4 milliamperes and a movement resistance of 5 ohms. This meter proved very suitable for use in the ohm-meter circuit about to be described. It must be stressed here that the meter used is of the moving coil type.

(1) The Low Ohms Range

The circuit of a suitable low ohms meter is given in Fig. 1. The unknown resistance is placed as a shunt across the meter, which is held at FSD by current from a $1\frac{1}{2}$ volt torch cell, the deflection being controlled by the resistance

COMPONENT LIST

- 1 meter. Resistance below 50 ohms. FSD current 5 mA or below.
- 1 300 ohm carbon resistance, $\frac{1}{2}$ watt.
- 1 carbon resistance, 20-35 K., according to high voltage used.
- 1 5 K. wire-wound potentiometer.
- 1 100 ohm wire-wound potentiometer.
- 1 two-pole, three-way wafer switch.
- 1 torch cell, $1\frac{1}{2}$ volts.
- 4 wander plugs, two red, two black.
- 2 crocodile clips (for test leads).
- 1 two-way socket strip.
- 1 pointer knob (for switch).
- 1 metal box or suitable container for the instrument.

amps, so that if one is known the other may be found. Now, from $R = V/I$, $V = IR$. Therefore the voltage dropped across the meter is given both by $I_s S$ and by $I_g G$, i.e., $I_s S = I_g G$, or $S = I_g G / I_s$. At this stage, an example should make the use of this formula clear. Suppose a resistance placed across the meter, already set to FSD by R_2 , caused the reading to fall to 1 milliampere. Then I_g would be 1 milliamp., I_s would be 3 milliamp., and G is known to be 5 ohms. Therefore:

$$S = \frac{1/1,000 \times 5}{3/1,000} = \frac{5}{3} \text{ ohms}$$

or 1.7 ohms correct to one decimal place. A table could be drawn up showing the value of the unknown resistance for each setting of the pointer. The method of using the instrument would then be: (i) Set pointer to full-scale deflection by the operation of R_2 . (ii) Place unknown resistance across the meter, or carry leads to the unknown resistance, and read off the scale. (iii) Consult the table for the value of the resistance. On this range, the writer's instrument gave

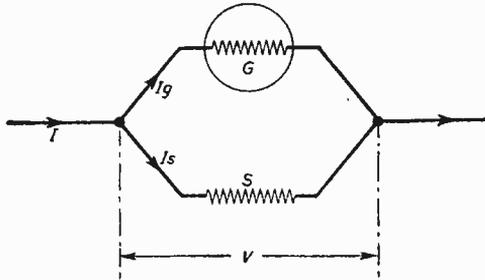


Fig. 2.—Circuit for calibration of the lowest range of the meter.

quite accurate readings from 0.4 ohms to 50 ohms. It must be remembered that the low ohms range depends upon the resistance of the meter in use, and will vary as the resistance of the meter varies.

Note:—The formula used for calibration of this range is an approximate one since its validity depends on the current flowing in the circuit when the unknown resistance S is placed across the meter. If the meter resistance is small compared with that of the series resistance (R_1

or R_2), the formula $S = \frac{I_g G}{I_s}$ will give quite accurate values of S . If the meter resistance is fairly high the more lengthy but more accurate formula to be used for calibration is:

$$S = \frac{I_g R_1 G}{(R + G)(I - I_g)} \text{ ohms.}$$

where I_g = observed reading of meter in mA, R = resistance in series with the meter, G = resistance of meter, I = full-scale deflection current of the meter in mA.

If more accuracy than this is desired it will be necessary to measure the voltage of the torch cell used and then to calculate the value of R , i.e., $(R_1 + R_2)$, from this. In this case S is then calculated from the larger formula above. However, this degree of accuracy is not normally required, and provided the meter resistance is

fairly small, i.e., 5 to 20 ohms, the original calibration will be found sufficiently accurate for most purposes.

(2) *The Medium Ohms Range*

The medium range ohm-meter is shown in Fig. 3. The unknown resistance is placed in series with the instrument. The same components are used as for the low ohms range, but they are switched to a different position. Zero is set by shorting the two test leads and adjusting R_2 for FSD. The two leads are then applied to the unknown resistance, the scale is read, and the value of

Fig. 4.—High range circuit.

the unknown resistance found from another table. The table is made up as follows: suppose a resistance placed in series with the instrument allowed a current of 1.5 milliamp. to flow. Then the effective resistance of the whole circuit would be given by $R = V/I$. In this case:

$$R = \frac{1.5}{1.5/1,000} = 1,000 \text{ ohms.}$$

But 375 ohms (approximately) of this is the sum of R_1 and R_2 . Therefore the value of the unknown resistance is $1,000 - 375$ ohms, i.e., 625 ohms. On the table of readings this would be counted as 650 ohms, since it is always uncertain how much of R_2 is in the circuit. This indicates to some degree the accuracy of the instrument. In practice it was found to be about 8 per cent. in error over a range of from 400 to 8,000 ohms. The general formula to be used for calibration is: R (unknown) = $V/I_g - 375$ ohms.

(3) *The High Ohms Range*

The high ohms range is shown in Fig. 4. This (Continued on page 151)

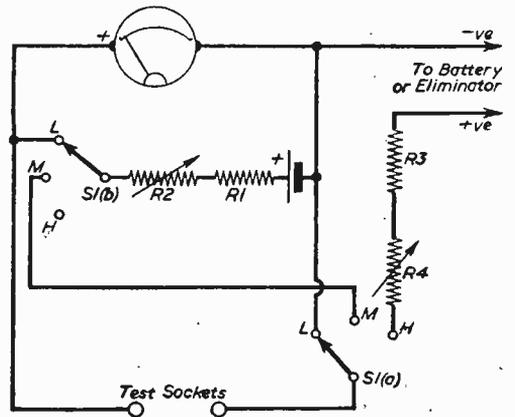
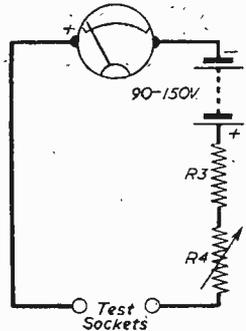
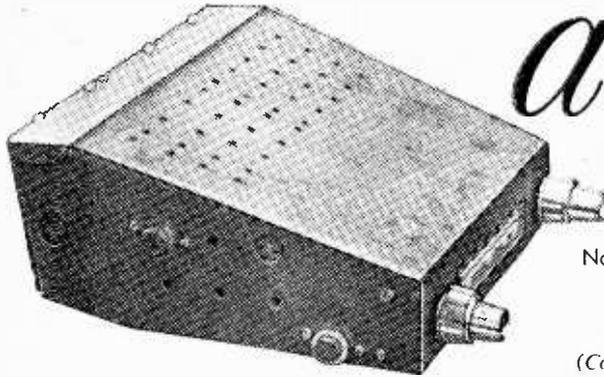


Fig. 5.—The complete circuit of the ohm-meter.

A Six Valve Car Radio



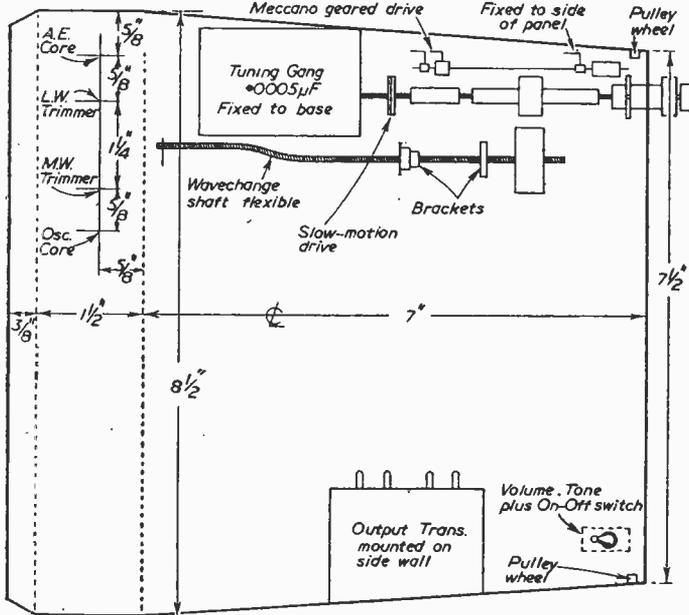
No. 2.—FITTING THE TUNING CONTROL AND WAVECHANGE SWITCH

By T. Murphy

(Continued from page 26 of the March issue)

THE next operation was to fit a gear to the outer shaft as supplied with the knobs. This shaft is about 9/32in. external

The 1/4in. gear boss will now give a dial pointer travel of approximately 4in. which is slightly too great for the type of dial used. The remedy here



is simple. Spin the shaft assembly in a drill and hold a piece of emery cloth over the boss. Grind down in this way until a perfect travel is obtained. It does not take much grinding. The geared drive is now coupled to the "tuning gang" gear via two further "toy" wheels, shaft and bushes, mounted on the side of the case and comfortably meshed so that vibration will not roll the gang or dial pointer around. That completes the tuning arrangement which is very positive with no noticeable backlash.

Wavechange Switch

The wavechange switch shaft is cut off leaving about 5/16in. protruding through the chassis. Then a length of flexible drive is either purchased or can be made up from a broken speedo inner cable. This is done by first cleaning all oil from the cable and then soldering it well, prior to cutting. This will stop fraying and a tendency for the cable to unravel itself. An extension

shaft spindle is then obtained cutting it about 1/4in. behind the grub screws. This shaft must be round

Fig. 6.—Receiver base and side walls, showing layout of major components.

diameter the gear (No. 26 (4 req.)) is bored out to a tight fit on the shaft, fitted with its boss and locking screws facing the dial. Having fitted it on the shaft, take a washer, preferably brass, tin this and slide it up tightly to the gear teeth face and solder in position. Having done this take another washer, similar to the first one; this should be a tight fit on to the gear boss. Solder in position, lock the two grub screws on the shaft and you now have a shaft, complete with gear drive and a flange between the two washers. The washer nearest the gear teeth prevents the shaft from sliding backwards, and together with the front one forms protective collars for the cord drive.

If the two grub screws protrude, file them flat.

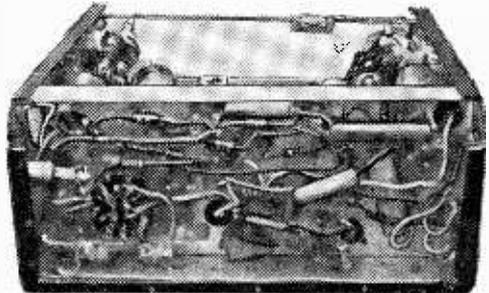


Fig. 7.—Internal layout.

(no flats on). The grub screw end piece is drilled $3/16$ in. bore, and the cable soldered on to it. Length of flexible required approximately 4 in. The other end of the spindle is drilled out $3/16$ in. for about $1/2$ in. depth, the other end of the flexible is then (already well tinned) soldered in position, giving an extension shaft with grub screws for clamping to the wavechange switch. Two brackets are then made, panel bushes fitting to these. The solid end of the flex shaft is slid through and brackets bolted to base. On the extreme end of

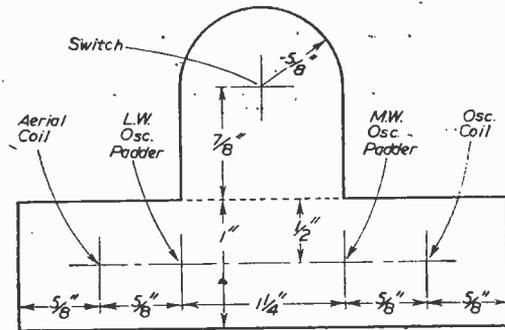


Fig. 8.—Sub-chassis carrying wavechange switch coils and padders.

the shaft is fitted a gear $1\frac{1}{2}$ in. diameter (drilled out to $1/2$ in. diameter). This is meshed with gear No. 26. The latter is drilled out $9/32$ in. and fitted to a piece of outer shaft. This assembly is then held in position and the inner control shaft is pushed in through the tuning shaft assembly, until it is a snug fit in the gear fitted to the reduction drive gear. A mark is then made on the shaft, through the gear locking screw hole, the assembly is then removed and a hole drilled through the shaft and tapped 4 B.A. It is then reassembled, sliding shaft through, offering up wavechange gear and locking latter to inner shaft with 4 B.A. screw. The gear on the flex shaft is then slid on the end, meshed-up and locked on its own shaft with grub screws. Final tightening of the

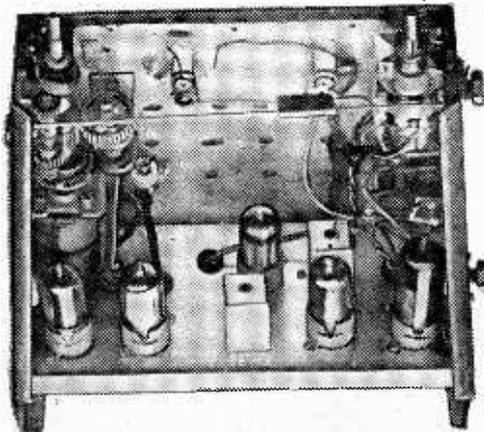


Fig. 9.—Showing tuning-drive arrangement.

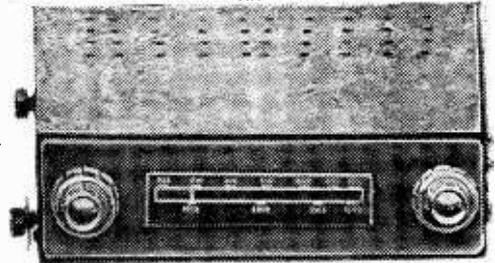


Fig. 10.—The finished version.

brackets is done with the front gear wheels in mesh (very tightly).
The four small pulleys are drilled out to clear 6 B.A. and mounted on four small 90 deg. brackets, two on either side of the case. They

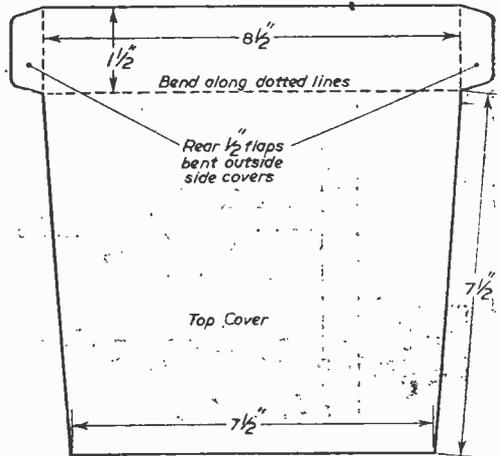


Fig. 11.—Details of the top cover.

are fitted to the brackets with 6 B.A. bolts, locked with two nuts at rear. Nylon drive cord is then fitted as shown, and a pointer fitted to run close to the dial.

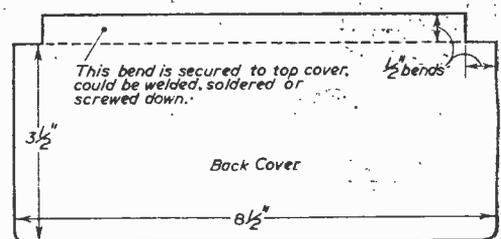


Fig. 12.—Back cover details.

Now having drilled the necessary holes all round, holes may be drilled for ventilation purposes. Brackets will, of course, be made to fit the case to the car concerned. This whole unit must be rigidly constructed.

(To be continued)

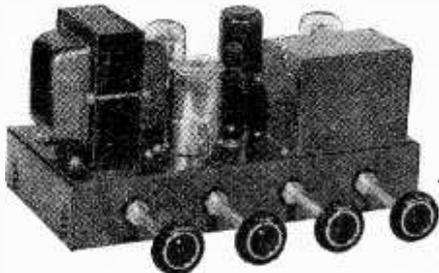
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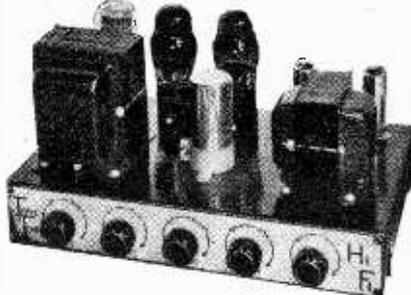
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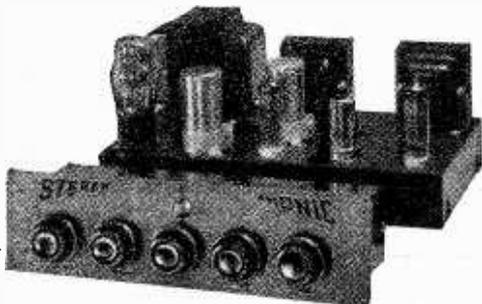
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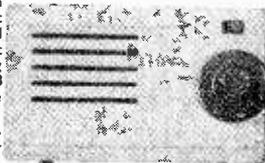


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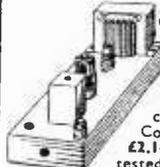


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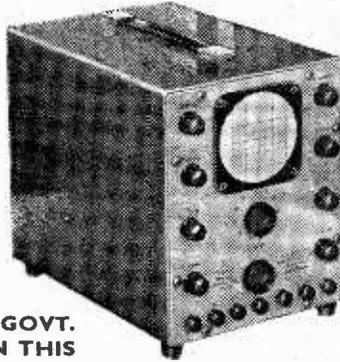


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EF41 15/-	KT36 18/6	PL33 14/-	Z152 8/6	12A77 9/9
EF41 9/6	LZ319 12/6	PL33 14/-	Z152 8/6	12A77 9/9
EF42 12/-	MKT43 12/6	PL33 14/-	Z152 8/6	12A77 9/9
EF50 (A) 4/6	(or 7) 21/6	PL33 14/-	Z152 8/6	12A77 9/9
EF81 8/6	ML4 12/6	PL33 14/-	Z152 8/6	12A77 9/9
	MSP4 15/-	PL33 14/-	Z152 8/6	12A77 9/9
	MU14 10/-	PL33 14/-	Z152 8/6	12A77 9/9
	MK4 15/-	PL33 14/-	Z152 8/6	12A77 9/9
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A SIMPLE SOUND BOOSTER

AN EASY-TO-MAKE, EASY-TO-FIT
ADD-ON UNIT By M. Dunn

THIS small accessory unit can be made and fitted without in any way disturbing the original apparatus. Its purpose is to give an increase of volume where the existing maximum is inadequate, or only just sufficient. It leaves the circuit of the output stage intact, but interposes an extra amplifying stage between the grid connection of the output valve and the grid itself. The unit is built up on a small sub-chassis, which may be mounted anywhere convenient, either inside or outside the cabinet, without any alteration to the set itself or even removing it from its cabinet. It is designed for use with any set employing a single-ended output stage, preferably using a pentode or tetrode. All that has to be done, once the unit is made, is to remove the output valve from its socket in the set and insert it in its new position in the unit. The plug is then put into the vacant valve socket in the set and all is ready for use. It should, however, be stated that it is not intended for flogging a tired output valve (such a procedure would almost certainly result in distortion), but to boost a feeble signal reaching it—as, for instance, from a gramophone pick-up, particularly the L.P. variety.

Theoretical Circuit

Examination of the theoretical circuit shown in Fig. 1 will give a clear idea of the system employed. "Old hands" will not require further instructions, but as this is a good circuit for a comparative beginner to try out, the details given below of step-by-step procedure should not be out of place.

A suitable sub-chassis, preferably of metal, should be made or otherwise obtained. It should have two holes to take the valveholders which must suit the new valve and the original output valve. The two valveholders should be mounted first, and it is suggested that for the most part the components are soldered in from point-to-point so that the wiring is self-supporting. In any case all the "hot" leads, especially grid leads, should be kept as short as possible.

For the choice of first valve almost any triode or a pentode with a straight characteristic can be used. The writer used an SP61 wired as a triode as it was found that as a pentode the gain was terrific and quite unnecessarily so. The reasons for choosing this particular valve were, firstly that it is a very good audio amplifier,

and secondly that it is exceedingly cheap on the surplus market, being obtainable from a shilling upwards. After preparing the chassis and bolting on the valve sockets, a scheme of wiring may be adopted on the following lines:

Wiring

(1) Connect the heater pins of both valves in parallel with twisted flex. (It should here be stated that the extra valve should have the same voltage rating as that of the heaters in the set, otherwise a separate heater transformer will have to be employed.) For a set with 4 v. heaters, the SP41 would provide identical performance to the SP61.

(2) Connect C2 between the anode of V1 and the grid of V2.

(3) Connect R2 and R3 in series between the anode of V1 and the screened grid pin of V2. The latter will be connected direct to H.T.+ in the set and provides the H.T. supply for the unit. If, however, the output valve in the set happens to be a triode, then the H.T.+ point will have to be located in the set. (A likely accessible place would be on the output transformer.)

(4) To the junction of R2 and R3, connect the positive end of C1 and one end of R6 (the latter will not be required if the valve is a triode or a triode-connected pentode).

(5) Connect the negative end of C1 to earth.

(6) Connect the other end of R6 to the screened grid pin of V1 and C3 from there to earth. (Not needed for triode.)

(7) Connect R4 between the cathode pin of V1 and chassis, also a by-pass capacitor (C4) if used.

(8) The grid of V1 (the top cap of an SP61) should be connected either to the slider of a

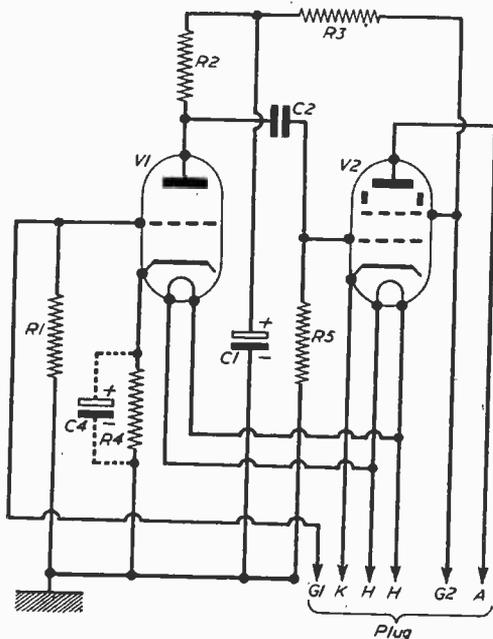


Fig. 1.—Basic circuit employing a triode as V1 and no volume control.

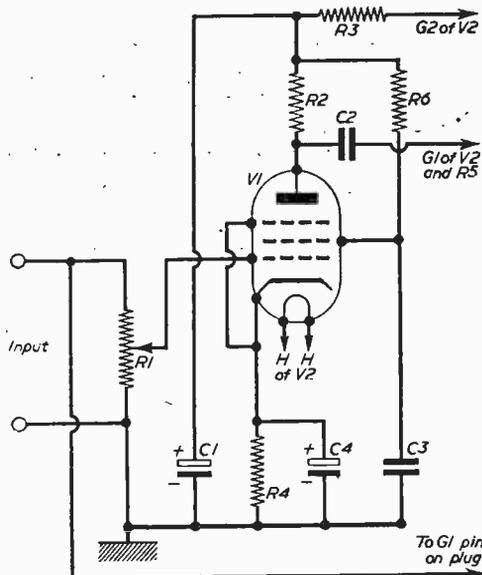


Fig. 2.—Showing the extra connections and components required if V1 is a pentode. In this circuit R1 is a volume control and a gramophone pick-up can be connected across the input terminals.

volume control or to a 1 M Ω grid leak (R1). The lower end of either of these should go to earth.

(9) If not internally connected, join G3 of V1 to the cathode. For triode connection of a pentode, the screened grid should simply be joined to the anode, G3 still being connected to the cathode.

This completes the first stage. It is a good plan to bring all the earth connections to one point on the chassis to avoid hum.

Except for the grid, all connections to the socket of V2 go to the plug. The grid of this valve is already connected to the coupling

capacitor (C2) and it is also necessary to fit a grid leak of 0.25 or 0.5 M Ω to chassis (R5).

The base from an old valve can be used for the plug or a suitable plug bought.

Plug Connections

Ascertain the pin positions on the output valve socket for the heaters, cathode, screened grid and anode and connect the leads to their respective pins on the plug. The grid connection must go to the top end of the volume control, or direct to the grid of V1. For the plug leads it is a good thing to use lengths of different coloured flex, sufficiently long to reach between the new sub-chassis and the socket of the output valve in the set.

Finally, when setting up, remember to bond the two chassis together. It may be found if hum is present that there is an optimum position on the chassis for this lead. One is more likely to have trouble with excessive noise if V1 is a pentode. Triode connection should prove quite adequate and is recommended.

The fitting of a volume control as R1 is strongly recommended also, because this will make the unit all the more useful. It can then be used as a separate amplifier and a pick-up can be connected direct to the input terminals, or a microphone for party games, etc. By using an external loud speaker of better quality than that in the set, reasonably good reproduction of music can be expected. One great advantage is that at any time the unit can be removed at short notice, and the power valve plugged back into the set. Note that the booster cannot be fitted to receivers of the A.C./D.C. variety.

Book Received

PRINCIPLES AND PRACTICE OF RADAR.
by H. E. Penrose and R. S. H. Boulding, O.B.E.,
B.Sc., A.C.G.I., M.I.E.E., F.Inst.P. 803 pp. Published by George Newnes Limited. Price 50s.

This is the sixth edition of this well-known work. Sections have been added dealing with "True Motion Radar Displays" for marine installations, the cosecant squared aerial, and the use of circular polarisation as a means of minimising the effects of rain interference on airfield radar displays. The 24 chapters include: "Fundamental Principles of Measurement of Range, Bearing and Elevation," "Basic Circuit Theory," "Thermionic Tubes, Amplifiers and Oscillators," "The Basic Radar System," "The Cathode Follower," "Radar Testing and Test Gear," etc. Three appendices deal with the theory of transmission lines, waveguides and cavity resonators.

In order that this revised edition shall be as up-to-date as possible, micro-waves and the particular problems met with at these wavelengths are fully considered. Some of the latest developments, such as lenses and slot aerials, have also been included.

Indispensable to radar engineers, this comprehensive work will also be found invaluable to all who are interested in the technique of modern radio communication.

LIST OF COMPONENTS

Resistors

- R1—Grid leak, 1-2 M Ω .
(Potentiometer), 0.5-1 M Ω .
- R2—Anode load, 0.25 M Ω .
- R3—Anode Decoupler, 50 K Ω .
- R4—Cathode Bias, 1 K Ω .
- R5—Grid Leak V2, 0.25-0.5 M Ω .
- R6—Screen resistor, 1 M Ω .

Capacitors

- C1—Anode decoupler, 8 μ F electrolytic.
- C2—Coupling, 0.01-0.05 μ F.
- C3—Screen decoupler, 0.1 μ F.
- C4—Cathode by-pass, 50 μ F, 50 v. Wkg. (optional).

Valves

- V1—Any suitable voltage amplifying pentode or triode.
- SP61—Obtainable very cheaply on surplus market. Other suitable valves which can be easily and cheaply obtained: 6J5 (Triode), EF36, 6J7 (Pentodes). Do not use a variable- μ R.F. pentode.
- V2—The output valve from the set.

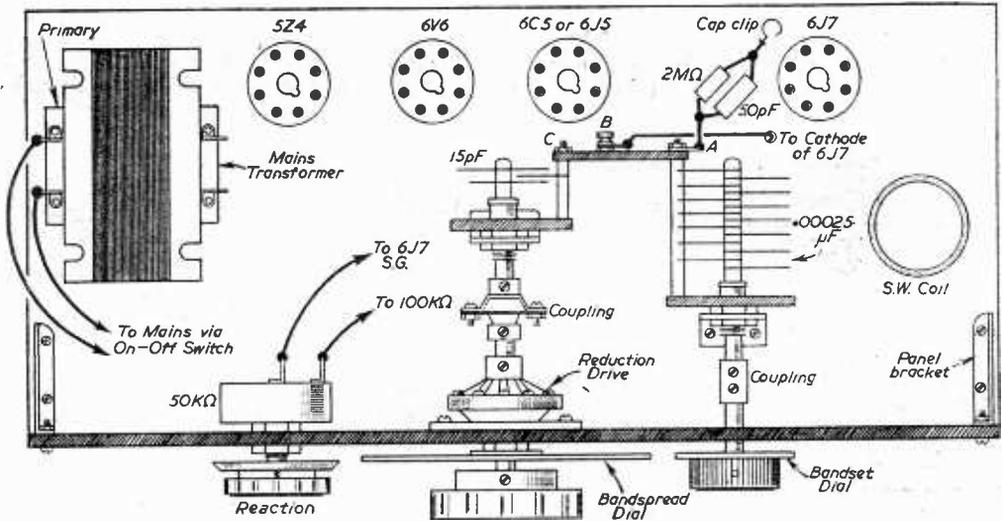


Fig. 2.—Plan view showing chassis layout.

and this is provided for if wiring is as shown. If there is no desire to tune below 9 metres, both condensers can be permanently connected.

Adequate smoothing is required to keep hum down when reaction is advanced. The L.F. amplifier section is perfectly straightforward, a volume control being provided. It is worth noting that the set will give good results with the 6C5 stage omitted, potentiometer slider going to the 6V6 control grid, and this simplification may be considered by anyone looking for the easiest type of mains all-waver to construct. The extra stage is particularly useful for more amplification of short-wave stations.

Chassis Layout

This is shown in Fig. 2, and the chassis itself is 13in. × 6in. × 2½in. deep, with a panel 13in. × 8in. secured to the front runner by means of the fixing bushes of the lower controls. Panel brackets are necessary to make the whole rigid.

Both variable condensers are mounted on brackets to shorten wiring; to allow a reduction drive to be used, and to bring them level to support the coil-mounting strip. It is possible to manipulate the 15 pF condenser with no reduction drive if a large knob is fitted, but

the drive does further simplify tuning. So that stations can be logged, the bandset condenser requires a dial or scale.

Figs. 2 and 3 will make clear the arrangement adopted for coil mounting. A strip of paxolin about 2in. long and 1in. high is fixed permanently between the variable condensers, as shown, the lower corners being drilled to fit the projecting bolts of the condensers. Three 6 B.A. terminals

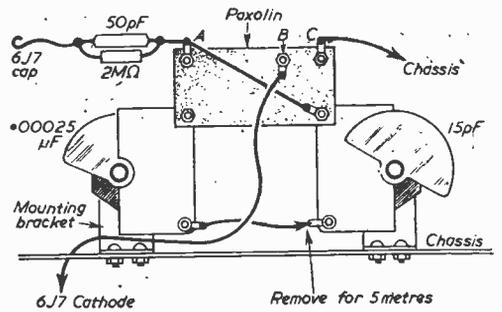
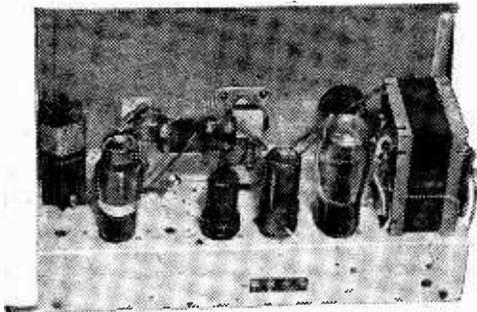


Fig. 3.—The coil mounting arrangement.

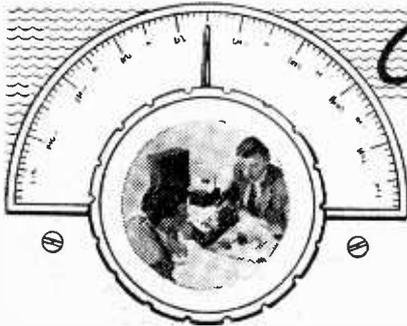
are fitted to the top of this strip, as in Fig. 3. "A" goes to the fixed plates of the 15 pF condenser. A flying lead completes the circuit between .00025 μF and 15 pF condensers, and can be removed from the latter for U.S.W. tuning. If only short, medium and long waves are wanted, then "A" can be wired straight down to the fixed plates of the .00025 μF condenser.

Terminal "B" is wired to the valve cathode by the shortest route. Terminal "C" is wired directly to the moving plates tags of both variable condensers, and to chassis. Stout, short leads are necessary for U.S.W. reception, or tuning will be erratic and noisy.

(To be continued)



View from the rear.



On Your Wavelength

BY THERMION

are 1.8 Mc/s and 3.5 Mc/s. the latter band for C.W. QSO's. On this band he runs 10 watts, but for top band work he can obtain very good results on only 2 watts.

In the photograph, the power supplies are underneath the desk lid in the drawer which also houses the 6J7, ECC82, 6V6G modulator.

More Slanguage

MR. PHILIP J. PLATER, of Streatham, London, S.W.16. has an octogenarian mother who is perpetually annoyed by BBC language. Here is a list of some of her pet annoyances: Woolitch, Fay Cumpton, The sevening (Woolwich, Fay Compton, This evening).

You are, of course, bound to find irritations of this sort when you start looking for them, but there is no excuse for slovenly English. The *Graf Spec*, during the war, was announced as

'Flu

AT the present time of writing, I am assailed by the redundant 'flu which seems to be attacking everybody without warning.

Last night, however, I could not get to sleep, so I took out an early receiver and started turning round to short waves. In the course of an hour, I felt very much better!

Re-processed C.R. Tubes

THOSE good old friends of constructors, Mullard Ltd., have announced that from February 2nd they have introduced a television tubes re-processing service for the trade. It will operate through B.V.A. wholesalers, to whom all retailers' enquiries should be made. This service will be under the general name of "Re-Life" and for the present only 17in. tubes will be handled.

All re-processed Mullard tubes will have been re-screened and remetalised and a new heater-cathode assembly fitted, and will also be individually examined and tested to rigorous factory specifications. All types of Mullard tubes, except projection, 9in. and metal cone types, will eventually be eligible for re-processing under these conditions, but to begin with only the 17in. tubes will be covered by the service.

Such tubes will not be liable to purchase tax because they will retain their identity throughout the process. They will be called Re-Life television tubes to distinguish them from the new Mullard Radiant Screen tubes.



Twelve-year-old John Bell with his receiver.

"the packet bottle ship *Graf Spec*," and there was that howler. "This is the Foam and Horses Programme."

The other day, I was rewarded with "this rarely word herk" for "this rarely heard work." Mrs. Dale's Diary was introduced as Mrs. Dial's Dairy!

The Juniors

A LARGE number of my correspondents who send me photographs are juniors from the age of 12 on, but they are simply bursting with enthusiasm. Take the first photograph, above, that of John D. G. Bell, who is 12 years of age and who tells me that he received a Christmas card from Radio Warsaw in return for a letter he wrote about one of their programmes nine months before. The other photograph is of Mr. R. J. Weaving (G3NBN). Although he has been interested in S.W.L. for many years, it is only recently that he has obtained his ticket. The rig shown in the photograph consists of an H.R.O. Senior receiver, the TX, a 6AG7, 6AG7, TT11 (V.F.O., B.A., P.A.). The bands he operates on



Mr. R. J. Weaving of Stockport in his den.

Meter Shunts & Multipliers



HOW TO CALCULATE THEIR VALUES

end of the scale. For example, if the meter needle moves from its zero position to its full-scale position when one milliamper (1 mA) is passing through it, then the FSD of the meter is said to be 1 mA.

Measuring Current

Now if a meter has an FSD of 1 mA and a larger current is passed through it, the meter is liable to be damaged since the needle will attempt to move off the upper end of the scale perhaps with such a force as to bend it and ruin the meter. Thus it is impossible to use a meter as it stands to measure currents greater than the FSD of the meter. If the meter has an FSD of 10 mA then only currents less than or equal to 10 mA can be measured.

OUR team of experts who answer readers' technical queries tell us that they are receiving many letters requesting information on how to use one moving-coil meter for several ranges of current and potential difference. It is impossible to answer such requests completely in a short letter and this article was therefore written.

Basically a moving-coil meter consists of a coil of wire, usually of copper, suspended in a magnetic field. The two ends of the coil are connected to terminals on the meter case. When

But suppose that if we wanted to measure a large current we selected a fraction of this current and measured that on our meter. A shunt across the meter enables us to do this. In Fig. 2 the meter of Fig. 1 is shown with a resistance R_s ohms connected across its movement. Now R_s and R_m are in parallel and if R_s is made less than R_m then more current will flow through R_s than through R_m . Thus if the meter has an FSD of 10 mA and we wish to measure up to 100 mA then we arrange that with 100 mA

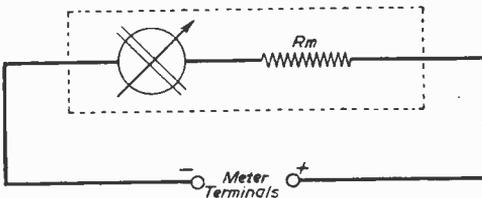


Fig. 1.—The effective circuit of a basic moving-coil meter.

a current is passed through the coil it rotates and this movement is used to make a pointer travel over a scale. The more current passes through the coil, the more movement takes place. The moving part of the meter is known as the "movement."

In Fig. 1 the effective circuit of a meter is shown. The meter movement has been shown as having no resistance and its actual resistance R_m ohms (Ω) is shown as wired in series with this resistance-less movement. The dotted line box is to indicate that the movement and its resistance are really only separable on paper.

Two characteristics of any meter are generally given on the scale: one is the resistance of the movement (R_m in Fig. 1) and the other is the "full-scale deflection" ("FSD"). These characteristics of the meter must be known before shunts and multipliers can be made. The FSD is the current required to deflect the pointer of the meter from its zero position to the other

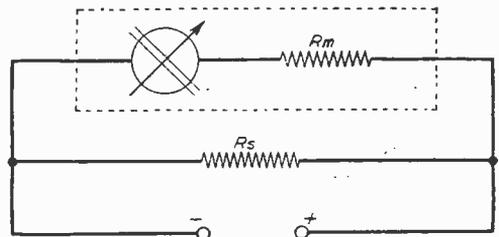


Fig. 2.—A shunt of resistance R_s ohms connected across the meter enables higher currents than its F.S.D. to be measured.

flowing in the external circuit, 10 mA flows through the meter and 90 mA through the shunt. If the meter has an FSD of 11 amps. and if the maximum current we require to measure is 12 amps. then (12 - 11) amps. must be made to pass through the meter shunt. Note that 11 and 12 are in amps. This is to simplify the

(Continued on page 133)

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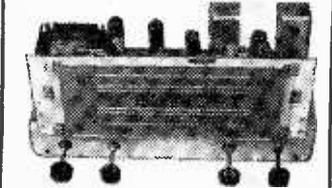
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6BE6	7/6	6Z4T7	9/6	EP41	10/6
6BE8	10/6	6Z4U7	9/6	EP59	10/6
6BW6	10/6	6Z4X7	9/6	EP80	10/6
6H5	7/6	12DE6	10/6	EP91	8/6
6F6	7/6	12AF6	10/6	EP92	8/6
6H6	3/6	12J27	8/6	EL32	5/6
6J5	6/8	35L8	9/6	EL84	10/6
6K7	7/6	35Z4	9/6	EM81	12/6
6L7	8/6	80	10/6	ET20	10/6
6K9	6/6	95A1	11/6	ET80	9/6
6K7	5/6	EA50	11/6	EL113	1/6

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4/450v. 2/3	250 25v. 2/6	32/350v. 4/..	
8/450v. 2/3	500 12v. 4/6	100/270v. 4/6	
8/500v. 2/9	8+8 450v. 4/..	1,500/3v. 4/..	
16/450v. 3/6	8+8 500v. 5/..	6,000/5v. 4/..	
16/500v. 4/..	8+8 16 500v. 5/..	32+32/250v. 4/6	
32/450v. 5/6	4+16 500v. 5/6	4+50/50v. 5/6	
50/25v. 1/9	16+16 450v. 5/6	64+120 270v. 7/8	
50/25v. 2/..	32+32 500v. 4/6	64+120 350v. 11/6	
50/50v. 2/..	32+32 500v. 7/6	100+200/350v. 12/6	
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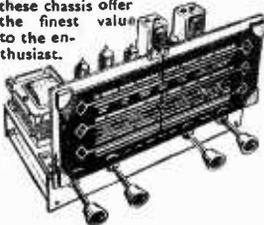
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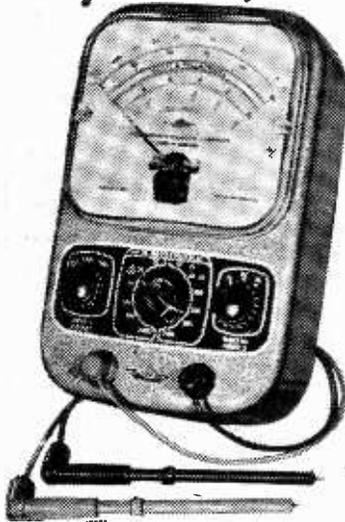
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expressions in the calculations which follow.

Suppose that, when the above conditions obtain, the potential difference (loosely known as voltage) between the meter terminals is V_1 volts. The circuit of Fig. 2 is shown in Fig. 3 with these values of current and P.D. indicated. Now R_m , I_1 and the current through R_s are all known. By Ohm's Law $V_1 = I_1 \times R_m = I_1 R_m$. Also $V_1 = R_s (I_2 - I_1)$; therefore $I_1 R_m = R_s (I_2 - I_1)$ and $R_s = I_1 R_m / (I_2 - I_1)$.

Thus we have obtained a formula which will

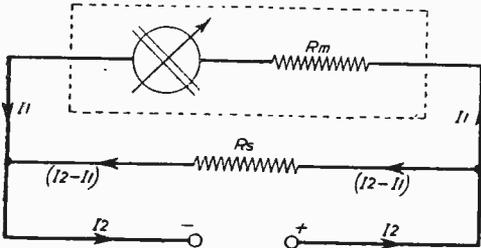


Fig. 3.—The circuit of Fig. 2, with values of current used in calculating R_s inserted.

enable us to determine the value of shunts to extend the range of a meter if the resistance of its movement and its FSD are known.

Calculating Shunts

For an example, suppose we have a meter with a resistance of 100 Ω and an FSD of 1 mA and we wish to make it read up to 1 A by means of a shunt. Then in the formula given above I_1 is 1/1000 A; $I_2 - I_1$ is $(1 - 1/1000)$ or 999/1,000 A; and R_m is 100 Ω . Substituting these values; $R_s = (100/1,000) \div (999/1,000)$; hence $R_s = 100/999 \Omega$. Since 999 is nearly 1,000 R_s is just over 1/10 or 0.1 Ω . In practice, 0.1 Ω would be a sufficiently accurate value of resistance for the shunt.

Having dealt with the measurement of current, we will proceed to the measurement of potential difference (P.D.) which, as stated earlier is often loosely termed voltage.

When there is a potential difference across a

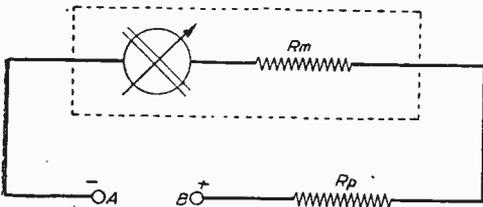


Fig. 4.—A multiplier of resistance R_p ohms connected in series with the meter enables high P.D.'s to be measured.

meter, a current will flow through it and the magnitude of this current depends on (i) R_m , the resistance of the meter and (ii) the P.D. The resistance of the meter is a constant so far as we are concerned and therefore the current through the meter depends on the P.D. across it. The current through the meter is registered by the pointer and the larger the current, the farther the pointer is deflected. Therefore, the larger

the P.D. across the meter the greater is the movement of the needle. Thus we can use a meter to measure P.D.

Suppose the meter is the one referred to above; the one with a resistance of 100 Ω and an F.S.D. of 1 mA. If the P.D. we wish to measure is about, say, 1/100 of a volt, the current reading on the meter will be $(1/100)/100$ A or 1/10 mA, i.e., the meter will read 0.1 mA. If the P.D. were 1/10 of a volt the meter would read exactly 1 mA and if the P.D. increased any more the needle would move off the scale.

Multipliers

If the P.D. we require to measure is V_x volts; the resistance of the meter is R_m as before and the FSD of the meter is I_d amps., then when $V_x = I_d R_m$ the meter will read its FSD. With any basic meter movement then, there is a limit to the magnitude of P.D. which can be measured. But suppose that instead of writing R_m in the expression for V_x we write $(R_m + R_p)$ where R_p is the value of an extra resistance which has been included in the circuit. Then $V_x = I_d (R_m + R_p)$.

If we increase R_p , V_x increases and therefore, we can read higher values of P.D. with a meter if we increase the resistance of its circuit. R_m could be increased during the manufacture of the meter, but this would involve winding more turns of finer wire on the moving-coil—making it more difficult to construct—and would make the coil larger and heavier. So the way adopted is to insert a resistance in series with

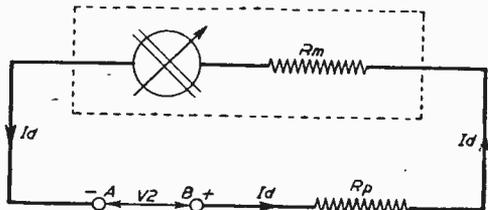


Fig. 5.—The circuit of Fig. 4 with values of current and P.D. used in calculating R_p inserted.

the movement as shown in Fig. 4. Such a resistor is known as a "multiplier." Let the resistance of this multiplier be R_p ohms.

If the maximum P.D. we require to measure is V_2 volts; the resistance of the meter is R_m ohms; and the FSD of the meter is I_d amps.; then we require that when the P.D. across the terminals A and B in Fig. 4 is V_2 volts the meter shall read full-scale, i.e., the current through the meter shall be I_d . In Fig. 5 the circuit of Fig. 4 is shown with these values inserted. Since R_p is in series with the meter, the current through R_p is also I_d .

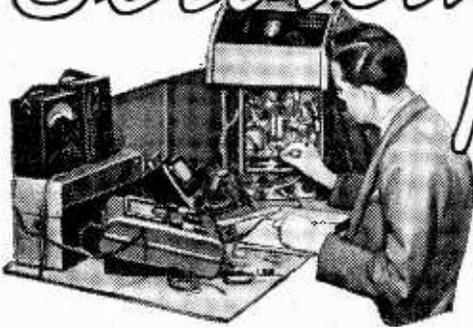
By Ohm's Law, $V_2 = I_d (R_p + R_m)$ and therefore $I_d R_p = V_2 - I_d R_m$ or $R_p = (V_2 - I_d R_m) / I_d$.

Thus if we know the resistance and FSD of a meter we can use it to read several ranges of P.D.

For an example, take the meter with a resistance of 100 Ω and an F.S.D. of 1 mA. If we wish to make it read up to say 100 volts, we must add a multiplier in series with it of R_p ohms. Here V_2 is 100; I_d is 1/1,000; and R_m is 100.

(Continued on page 143)

Servicing Radio Receivers



G.E.C. MODELS BC5842, BC9442 AND BC9640

By Gordon J. King, A.M.I.P.R.E.

THESE three models use a common chassis. Model BC5842 is a table receiver, while models BC9442 and BC9640 are radio-gramophones. The chassis uses eight valves in an A.M./F.M. circuit, in addition to which two

germanium crystal diodes form the F.M. ratio detector stage. The wavebands are as follows: V.H.F. F.M. 87.2-100.3 Mc/s; L.W. 1,100-1,950 metres; M.W. 186-549 metres. The waveband is selected by a four-position rotary switch, which also provides the "gram" position on all models.

On the table radio reproduction is by way of an 8in. X 5in. elliptical loudspeaker unit, while the grams utilise a 10in. unit. In all cases the speech coil impedance is 3 ohms at 400 c/s, and terminals are available for the connection of an extension loudspeaker of similar impedance.

All models are suitable only for use on A.C. power supplies but can be adjusted to suit the voltage range 190-250 v. 40-100 c/s. The approximate power consumption of the table model is 55 watts, but the record player increases the total loading of the grams to 70 watts.

In areas of fairly strong signal, the M.W. and L.W. frame aerials provide good signal pick-up without the need of an external

aerial, and the same applies to the V.H.F. F.M. service, but here pick-up is by way of a plate aerial on the back of the receiver.

Sockets are provided, however, for the connection of external aerials in areas where the signal-to-interference ratio is low, and in the case of the V.H.F. section, the circuit is designed for

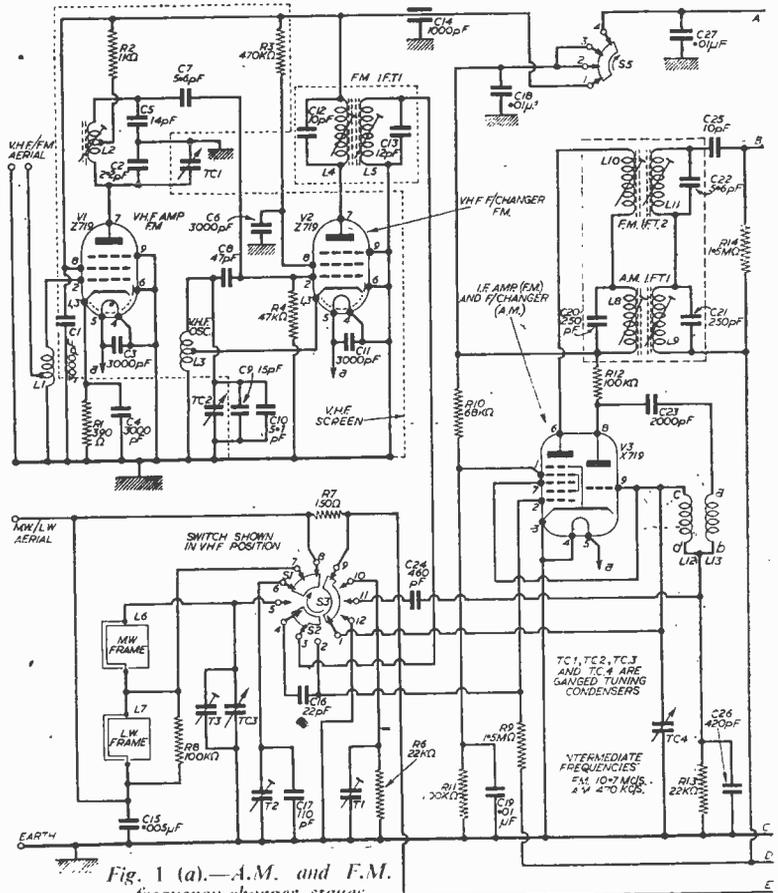


Fig. 1 (a).—A.M. and F.M. frequency-changer stages.

a balanced feeder of 80 ohms impedance. A good earth connection is always desirable and often reduces interference.

Valve Line-up and I.F.s

The circuit is designed around G.E.C. or Osram type valves, and the line up is: V1: Z77; V.H.F. amplifier; V2: Z77; V.H.F. frequency changer; V3: X719; A.M. frequency changer; V4: W719; I.F. amplifier; V5: DH77; signal detector (A.M.). A.G.C. rectifier and A.F. amplifier; V6: N709; output pentode; V7: EM80; tuning indicator; V8: U78; H.T. rectifier. The I.F.s conform to convention, 470 kc/s for the A.M. section and 10.7 Mc/s for the F.M. section.

The Circuit

The complete circuit is given in Figs. 1(a) and 1(b). It will be seen that the V.H.F. section is virtually isolated from the rest of the circuit. This is usual practice, as will be recalled from other articles in this series. The aerial tuned circuit relating to V1 is flatly tuned and responds without variable tuning over the whole of Band II (the F.M. band). The R.F. circuits in the anode of V1 along with the oscillator circuit (L5 and C8) adopt variable permeability tuning, the dust-

iron cores of both circuits being ganged and controlled by the tuning knob which is common also to the A.M. tuning.

A feature which is not very common in V.H.F. tuners is the use of Z77 pentodes for the R.F. and frequency-changer stages, but in the G.E.C. chassis they would appear to do these jobs admirably.

The F.M. I.F. signals are developed across the tuner I.F. transformer windings, L7 and L8, and when the set is switched to "F.M.," the signals are fed to the signal grid of V3 heptode by way of S3. The heptode in this case is employed as the first I.F. amplifier, the local oscillator triode section being muted by the 150 ohm resistor (R9) introduced in parallel with the tuned circuit via S3.

The F.M. I.F. signal is thus amplified by V3 and is developed in amplified form across the F.M. I.F. transformer, L13/L14. The 47 pF capacitor, C30, serves to by-pass the A.M. transformer owing to the relatively high 10.7 Mc/s I.F.

From L14, the F.M. I.F. signals are conveyed to the signal grid of the final I.F. amplifier valve, V4, from which they pass to the ratio detector formed by the two germanium diodes across the ratio detector transformer, L17, L18 and L19.

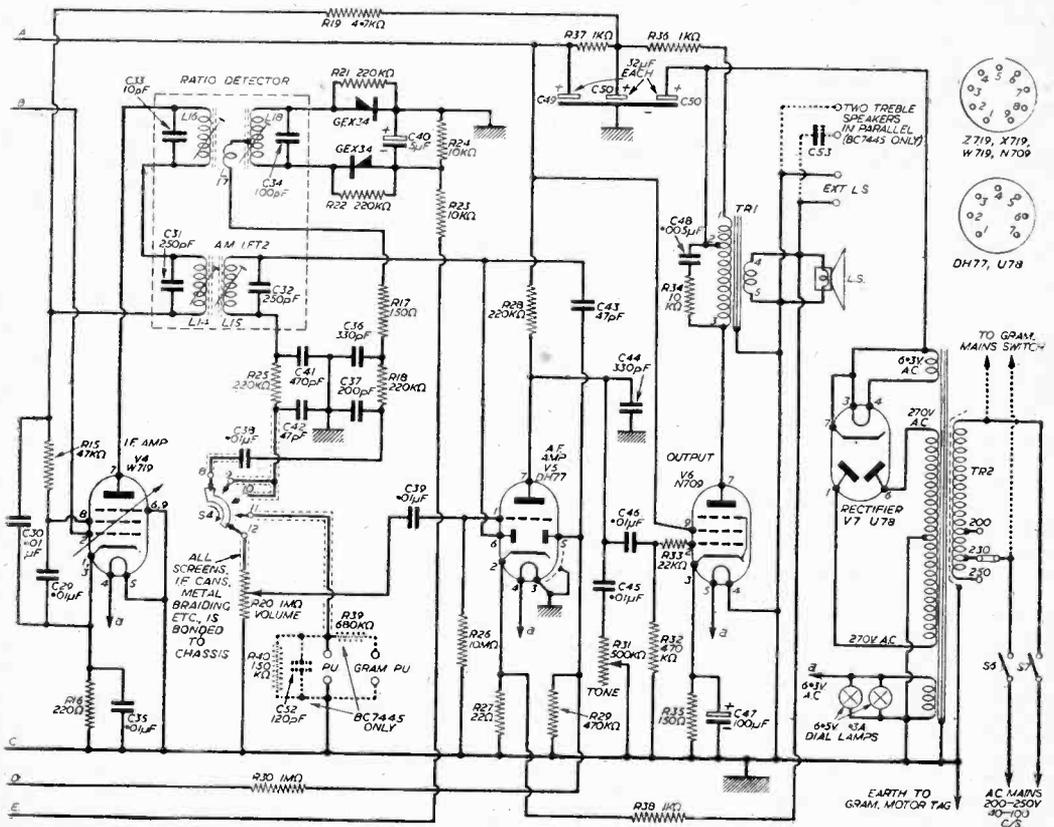


Fig. 1 (b).—I.F., audio amplifier and output stages.

Obtaining A.V.C.

Resistor R28 and capacitor C43 (10 μ F electrolytic) comprise the detector D.C. load and stabiliser. The voltage developed across R28 when the detector is receiving a signal is negative with respect to chassis, and this voltage is applied across the potential divider, R1 and R27. The voltage across the R1 element is adopted as an A.G.C. bias for the V.H.F. amplifier valve, V1, it being applied to the signal grid through R2. The tuning indicator is also activated by this bias on "F.M.," receiving the full voltage through R23 and S4.

The audio derived from the F.M. signal is

by C50 and the tone control (treble) R36 is also connected in the anode of the A.F. amplifier stage, while in the gram chassis a bass control network is given by R47 and C58. Negative voltage feedback is applied by feeding back to the cathode circuit of V5 a portion of the A.F. signal voltage across the secondary of the output transformer TR1. It will be noted that the bass control of the gram chassis is connected in this circuit.

H.T. Supply

A fairly conventional rectifier system is adopted, a full-wave valve and a completely isolated transformer being desirable features of the design. Smoothing is provided by the electrolytic capacitors C56 and C57, and the hum-bucking winding on the output transformer.

When the receiver is switched to "A.M." the V.H.F. tuner is switched off by S5 and the A.M. oscillator is brought into operation. V3 then serving as an ordinary frequency-changer stage, accepting its signals from the frame aerial windings, L9 and L10, or from the external aerial. Aerial tuning is performed by TC1 section of the tuning gang, while the oscillator is tuned over the bands by TC2 section of the gang.

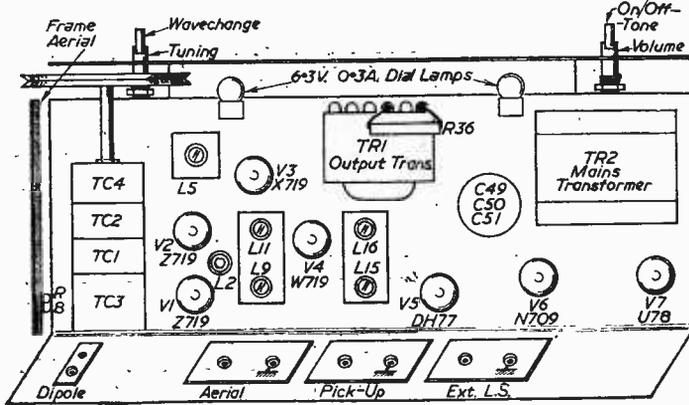


Fig. 2.—Top view of the chassis.

developed across C41, and a degree of de-emphasis is given by the filter C40 and R22. The audio signal is coupled to the volume control, R24, by way of C32 and S4, and from the control slider is conveyed to the grid of the A.F. amplifier triode in V5 through C42. The amplified A.F. across the load R33 is coupled to the output valve via C52 and R38, and the output stage operates in the usual manner.

A variable low-pass (top-cut) filter formed

The 470 kc/s I.F. signal is thus developed across the first A.M. I.F. transformer, L15 and L16, and this is conveyed to the I.F. valve V4. The signal across the second A.M. I.F. transformer is applied to the signal diode in V5 (on pin 6). In this case, the detector load is formed by the volume control in series with R29. I.F. filtering being accomplished by C44 and C46. From here the circuit operates as already described.

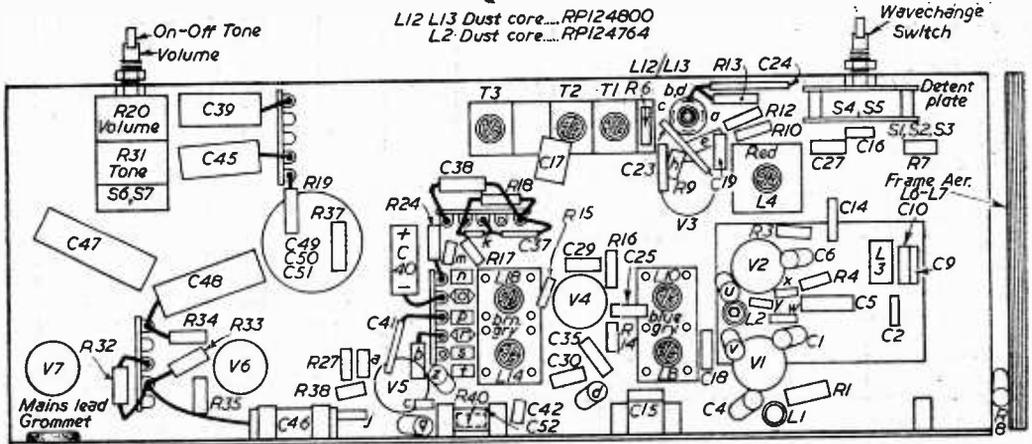


Fig. 3.—Positioning of components underneath the chassis.

The A.G.C. diode in V5 (on pin 5) is energised from the signal across L21 through C45. The A.G.C. load is R34, and the negative voltage, whose level is determined by the strength of the signal, is applied to the signal grids of V3 and V4. The tuning indicator on this service is operated by the D.C. voltage across the volume control (detector load).

Servicing Notes

The top view of the chassis is shown in Fig. 2 and the under-side view in Fig. 3. In the table model the chassis is simply withdrawn from the cabinet by first extracting the five screws which hold the back panel, pulling off the control knobs (they are held on by springs), removing the four chassis fixing screws and disconnecting the loud-speaker leads.

On the grams the back panel is secured by six screws, and in addition to the four knobs of the table model, there is a knob at the side of the cabinet which must also be removed in the way described. The aerial panel must next be removed, this being held in position by three nuts and screws—(do not lose the washers!) The loudspeaker and pick-up leads should then be disconnected, as also should the record changer mains lead at the chassis terminal block. After removing the two chassis fixing screws, the chassis should be carefully lowered and extracted from the cabinet.

The record changer can be removed by taking off the nuts and washers at the three suspensions.

Wiring Colour Code

Characteristic of G.E.C. models is the wiring colour code, a knowledge of which assists greatly with servicing exercises. It is as follows: Orange—unsmoothed H.T. positive; Red—smoothed H.T. positive; Blue—screen grids and mains; Green—grids and oscillator coils; White—aerial and

Tuning capacitor plates fully meshed. To gain access to the drive remove the two dial lampholders, the register paper and backplate.

Start at 'A' and finish at 'I', placing the spring in any hole which makes the drive sufficiently taut.

Length of cord required is 45" (A to H' is 40½")

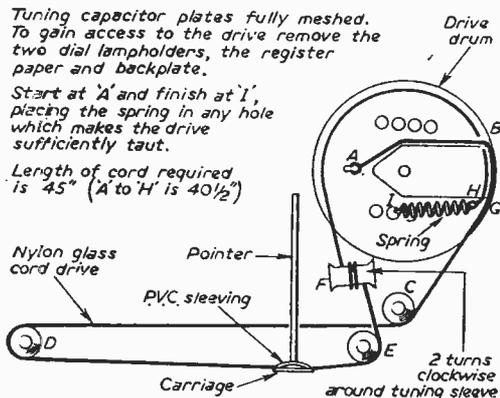


Fig. 4.—The tuning cord-drive.

loudspeaker; Brown—heaters and dial lamps; Black—chassis points; Yellow—anode and general purpose. It should be noted that all sleeving is coded yellow.

Record Changer

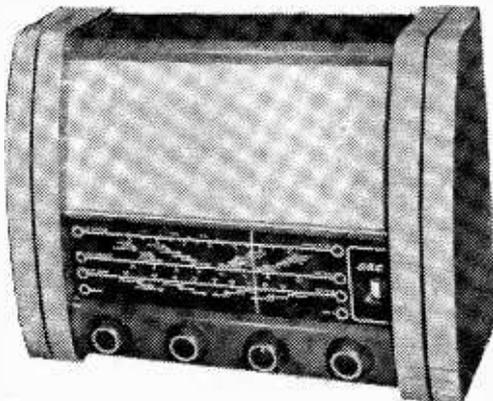
The grams feature a Collaro type RC54 changer.

This will play up to eight records of mixed size at any one of the three turntable speeds.

The tone arm is fitted with a turnover type Studio "O" cartridge, which takes a type 5304/L stylus for microgroove discs and a type 5304/N stylus for standard (78 r.p.m.) discs. The styli are easily replaced by undoing the small machine screw which holds them (one for each stylus) to the cartridge.

It often helps to know that a muting switch is connected across the pick-up, and this shorts the pick-up signal except when the tone arm is in the playing position.

An induction type gram motor having a winding resistance of approximately 700 ohms is featured. This drives the turntable through a



The Regentone "Double Two."

pulley chain. The pulley can be changed if required so that the turntable speed will be correct at mains frequencies other than 50 c/s.

The turntable is removed by extracting the circlip and bright metal washer from the turntable centre. A slight to and fro rotary movement should be given to the turntable as it is being lifted from the spindle.

Tuning Drive

In Fig. 4 is shown the tuning drive arrangement with the gang fully meshed. The total length of the nylon cord, from A to E is 51in. Access to the drive mechanism is achieved by removing the two pilot bulb holders, the tuning indicator from its clip and the backplate from the scale.

Microphony on F.M.

This effect may be caused by microphony of the V.H.F. frequency-changer valve, V2. It should be noted that this may appear to have no defect on test, and for this reason a substitution test of the suspect valve is required.

PRACTICAL WIRELESS CIRCUITS

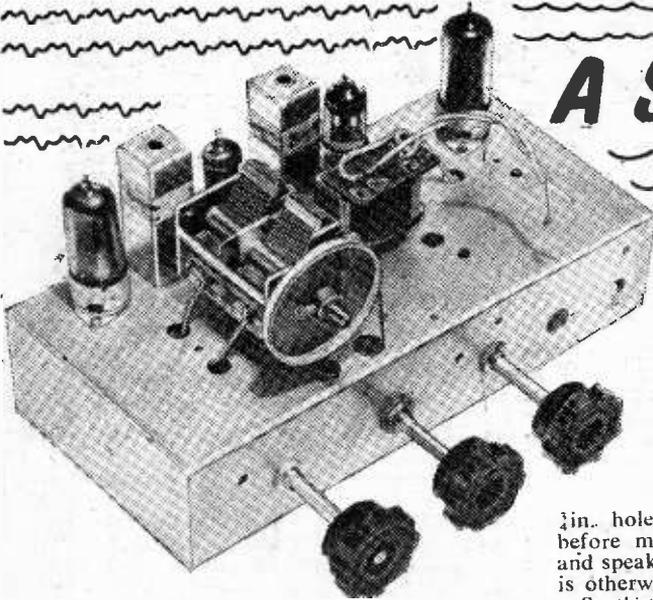
17th Edition

By F.J. CAMM 17/6, by post 18/7

From

GEORGE NEWNES, LTD.,

Tower House, Southampton Street, Strand, W.C.2.



A Shipping Ba

THIS SET ALSO COVERS MEDIUM

trouble from tunable hum, and the general hum level of the receiver is low.

A 4½ in. × 9 in. chassis permits a good sized tuning dial and 5 in. diameter speaker to be accommodated. The chassis is 2 in. deep, and the positions of the I.F. transformers and valveholders will be seen in Fig. 2. The B7G valveholders require ½ in. diameter holes, and the 9-pin holders ¾ in. holes. All large holes should be drilled before mounting any components, and the dial and speaker should not be fitted until construction is otherwise complete.

IN many receivers the waveband from about 70 to 200 metres is often omitted though there is much of interest to be heard on these wavelengths. In coastal areas a good deal of activity is sometimes heard on the shipping bands, and with a reasonable aerial many of these transmissions can be heard inland. These wavelengths also give good reception of amateurs, especially later in the day. For these reasons this band is included on the receiver described here, in addition to the usual long and medium wavebands. The set is of compact design, with a separate power pack. It can thus be run from A.C. mains or from a vehicle or boat accumulator at will. Plugging in the appropriate power supply permits operation from 200-250 v., 6 v., 24 v., or 12 v., the same standard of efficiency being retained. As no changes are required in the receiver when using any of these supply voltages, its field of usefulness is very great.

So that the wiring plan can be followed easily, the valveholders should be positioned to bring the pins into approximately the positions shown. The two I.F. transformers must also be placed correctly, or connections will be wrong.

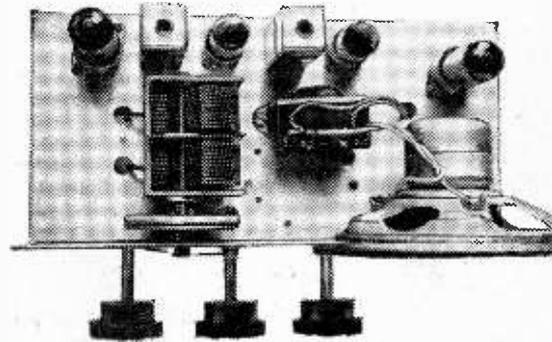
Circuit Description

The circuit employs miniature valves to permit a compact layout, and is shown in Fig. 1. Wiring-up is considerably simplified by using a self-contained coil-pack. This item has three pairs of coils, with trimmers and padders, ready connected to an integral switch, and it avoids the possibility of errors which might otherwise occur in this section of the receiver. As seen from Fig. 1, only five leads are connected to the coil-pack (in addition to the return to chassis via the fixing bush).

The complete circuit is perfectly straightforward, but the valve types used permit a very good degree of sensitivity, with ample volume from many stations. The use of a modulation-hum aerial filter is very effective in eliminating

Tuning Drive

The gang condenser is raised slightly by spacing bushes or extra nuts or washers, so that its spindle is level with the dial hole. The cord



View of the receiver from above.

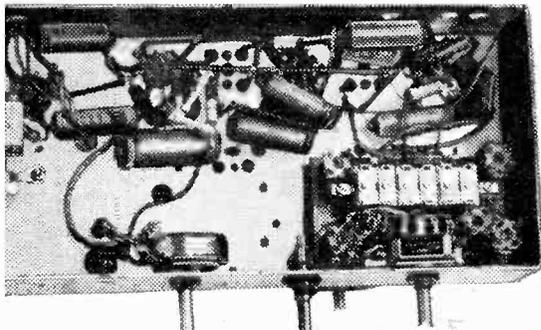
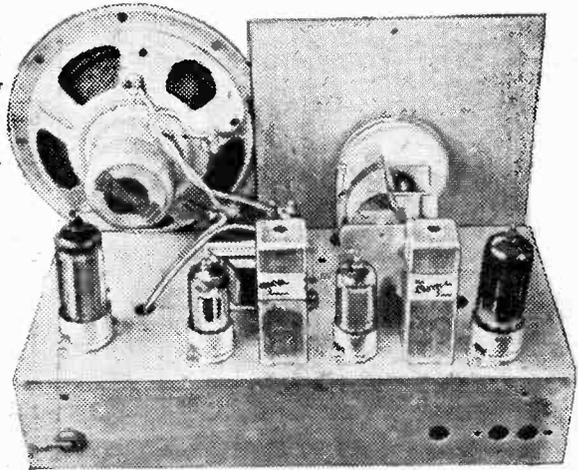
drive is arranged as shown in Fig. 4, a complete turn being given round the driving spindle to secure a good grip. Tension is provided by the spring, and the drum is so positioned on the spindle as to allow full movement of the condenser in each direction. The cord, drum and spindle must be kept well forward, so that the cord can pass between chassis and coil-pack, as in Fig. 3. To assist this, the mounting bracket of the pack can be eased slightly forward, and

and Four-Valver

AND LONG WAVES By R. Morgan

washers placed between it and the chassis.

All connections are shown in Fig. 3. As wiring progresses, the photograph of the underside of the chassis should be noted, because in Fig. 3 components have been given a little extra space to clarify the diagram. For example, some resistors, condensers, valveholder tags and other wiring points slightly overlap each other. However, the exact positions of leads and such small parts are not important, pro-



The underchassis wiring.

vided all wiring is reasonably short and direct.

With the first I.F. transformer, the markings indicate anode, H.T. positive line, Automatic Volume Control (A.V.C.) line, and grid. With the second transformer, the primary is similarly wired, but the secondary is taken to the diode load components and the 6AT6 diode.

Flexible leads pass from pins 7 and 8 of the 6BW6 holder to the primary of the speaker transformer. The secondary is later wired to the speaker, as in Fig. 2. Wrong connections here can prevent the set working, but the secondary leads are of quite thick single-strand enamelled wire, and can be easily identified.

A screened lead is used to tag 1 of the 6AT6 the braiding being wired to chassis. All other points marked "M.C." are soldered to tags tightly bolted to the chassis. In most cases the bolts can also secure valveholders or other parts.

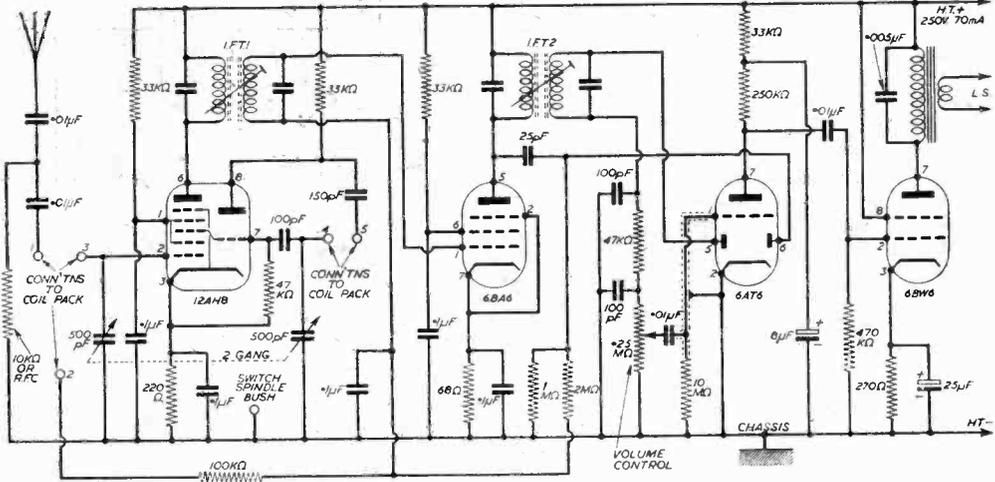


Fig. 1. Circuit diagram of the receiver.

The 8 μ F and 25 μ F condensers must have their negative tags or leads taken to the chassis.

The coil-pack can be inserted when most of the wiring is complete, to avoid possible damage. Coil-packs must always be gently handled. The two leads shown in Fig. 2 should be taken from the gang condenser to the appropriate tags on the pack.

If wiring is carefully checked, the receiver should be expected to work well as soon as completed providing the coil-pack and I.F. transformers are pre-aligned. Apart from avoidable wiring errors, a watch should be kept that no joints touch each other, or the chassis. Valve-holder tags and leads must also be clear of each other, and the chassis. Cored solder and a clean, hot iron will assure that neat, sound joints can be made easily.

Aerial Filter

Modulation hum can be identified because it increases in volume as a station is tuned in. It may be troublesome on some wavelengths but not on others. It is particularly likely with a poorly insulated aerial, or one running near mains or other power wiring.

The modulation hum aerial filter is shown in Fig. 4. The value of the condensers is not important. Mica condensers are most suitable under adverse conditions. If to hand, a screened H.F. choke of the all-wave type may replace the 10 k resistor with advantage. With a short, well-insulated aerial, in favourable circumstances, modulation hum may not be experienced. The filter is then unnecessary.

Heater Circuit

As shown in Fig. 3, the heaters are wired in parallel, and will require 1.35 A at 6.3 v. This may be derived from a mains transformer with 6.3 v. heater winding, or from a 6 v. accumulator. With 12 v. or a higher voltage, from accumulators, a dropping resistance can be used, or a rotary

COMPONENT LIST	
Fixed Condensers	Resistors ($\frac{1}{2}$ watt)
1—25 pF.	1—68 ohms.
3—100 pF.	1—220 ohms.
1—150 pF.	1—10 K.
1—.005 μ F. (5,000 pF)	4—33 K.
4—.01 μ F.	2—47 K.
5—.1 μ F.	1—100 K.
1—8 μ F. 350 v.	1—250 K.
1—25 μ F. 25 v.	1—470 K.
	1—270 ohms. 1 watt.
	1—250 K potentiometer.
	1—1M Ω
	1—2M Ω
	1—10M Ω
2-gang 500 pF. tuning condenser.	
Drum, drive, spring and cord. } or complete traverse	
Metal dial. } dial assembly	
Brass pointer. } (Osmor).	
1 Coilpack for trawler, M. & L. w/bands (Osmor).	
2—465 kc/s I.F. transformers.	
5in. overall P.M. speaker with 45:1 transformer (Osmor) for mains tetrode.	
2—B7G v/holders. 2—B9A v/holders.	
Mains transformer (Osmor).	
Smoother choke (Osmor).	
Valves	
12AH8, 6BA6, 6AT6 and 6BW6.	
Chassis	
4 $\frac{1}{2}$ in. x 9 $\frac{1}{2}$ in. x 2in.	

transformer with a low-voltage secondary in addition to the H.T. secondary.

The method best employed depends upon the operating voltages to be used. For A.C. mains only, the 6.3 v. transformer will be employed. No changes are required for 6 v. accumulator running.

If the receiver is to be operated from a 12 v. accumulator only, the heaters can be wired in series, in pairs. The 12AH8 and 6BA6 in series will then take .3A. The 6AT6 and 6BW6 are similarly wired in series, but a resistor of 42 ohms, 1-watt, rating, must be wired in parallel with the 6AT6 heater. This pair then takes .45A.

(To be continued)

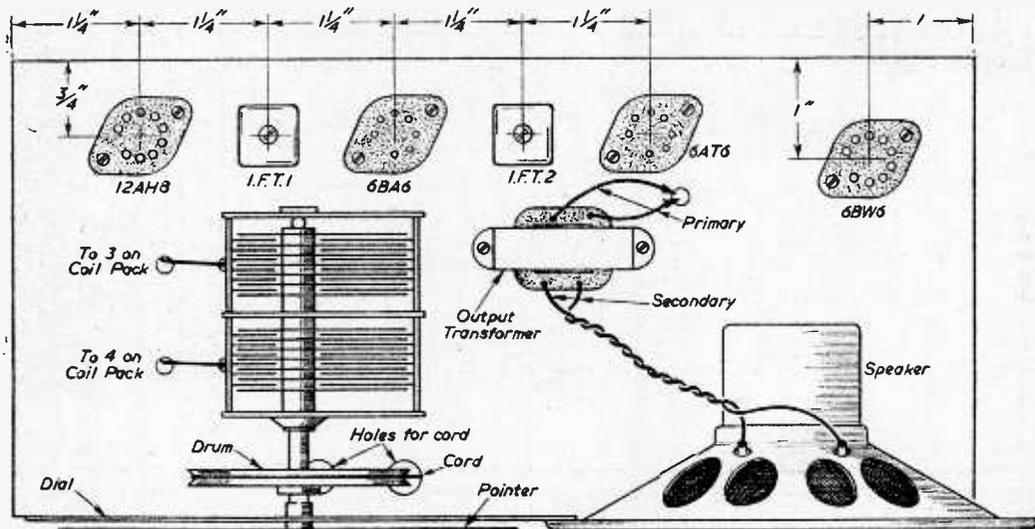


Fig. 2.—Layout of the components on the chassis.

PRINTED CIRCUITS

MANUFACTURE OF PRINTED BOARD

By W. G. F. Roberts

IN the first two articles of this series, we have seen how a printed circuit should be designed, and have converted the circuit into a master drawing. Methods of manufacture divide themselves into two main categories. In the first, and most important, the base laminate is completely covered with copper, as described in Part 1, and the copper is then removed where not required. In the second, the required conducting pattern is applied to an insulating base.

In the first category, we can distinguish two classes, those in which the metal is etched away, by far the most common method, and those in

lactic acid solution. This removes the coating except where exposed to the lamp, thus leaving a resist where required. This method is capable of considerable precision. It is expensive owing to the time involved, but, as it needs only the photographic negative, it is always used for small quantities (Fig. 13).

2. Litho-offset Resist

In this method, a lithographic printing plate is made from the original master in the usual way. It is mounted on a flat-bed press, and the circuit pattern printed on the laminate using a special resist ink. The method is accurate and cheap (Fig. 14).

3. Stencil Resist

This method has several variants. Usually, the resist is stencilled on by screen printing. The screen is a fine mesh, which may be of silk or of metal wire such as Monel, bronze, or stainless steel. The screen is prepared by blocking up the mesh except where the circuit pattern is to be. This is done by a

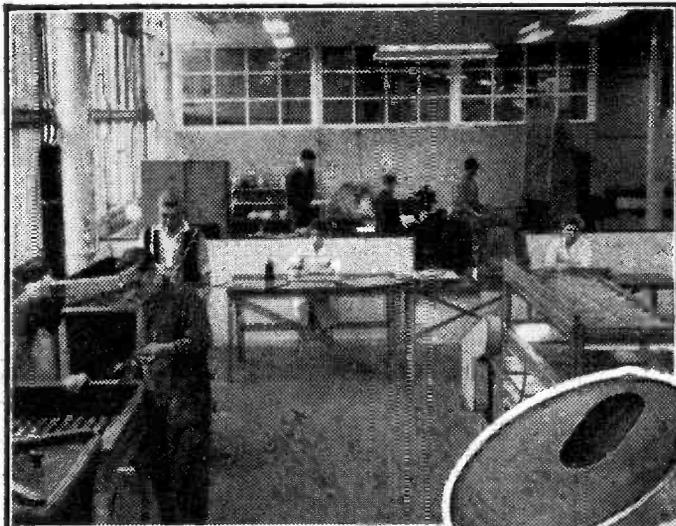


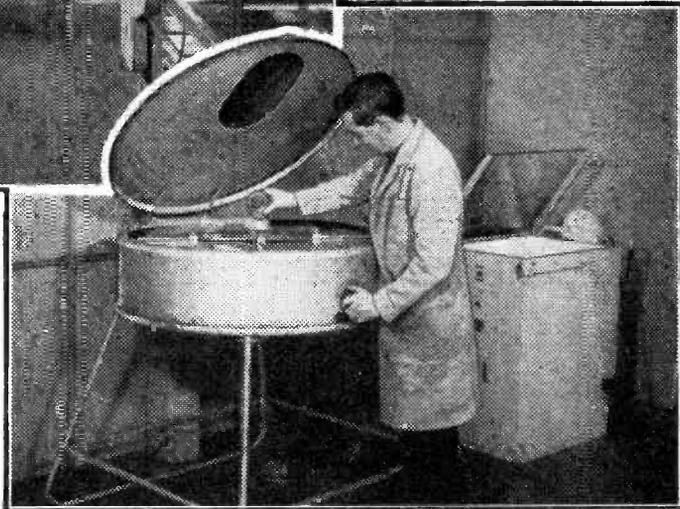
Fig. 12.—(Above) Part of a printed circuit factory.

Fig. 13.—(Right) A photo-etch unit,

which it is removed by machining. As the first step in the etch method, the metal foil to remain must be protected during etching by what is technically known as a resist. There are various methods of applying this resist, as follows:

1. Photo Resist

The copper clad sheet is covered with a sensitized coating solution, usually a bichromated albumen, in a thin smooth layer, usually on a whirling table. After drying, a photographic negative of the circuit is laid on top, and kept in contact in a vacuum frame. It is then exposed to an arc lamp for about six minutes. Development is by swabbing with a calcium chloride/



photographic process. A special resist ink is then forced through the clear parts of the screen by a squeegee, on to the copper clad laminate. The ink is blended so that it flows slightly to fill in the mesh pattern. Less accurate than the first two methods, it is cheap and adequate for most purposes (Fig. 15).

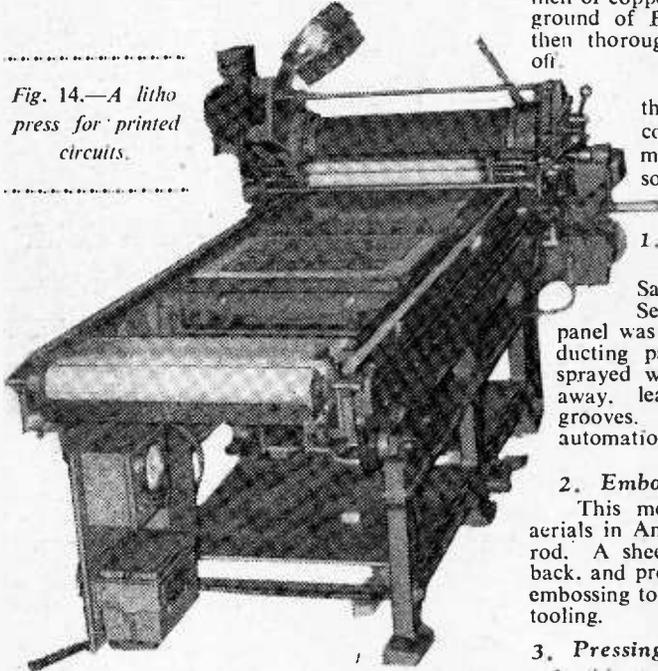
In rare cases, the resist can be applied by

spray or brush through an ordinary metal or plastic stencil. This is clearly restricted by "bridges" to hold the stencil together, which would then have to be painted in by hand. With very simple patterns, such as silvered mica capacitors, this difficulty does not arise.

4. Transfer Resist

The readers of this article, like the writer, will probably remember the boyhood pleasure of buying colourful sheets of transfers, cutting them up.

Fig. 14.—A litho press for printed circuits.



and thus applying a picture of flowers, Red Indians, etc., to the back of one's hand. This process is applied extensively to decoration in the pottery industry, under the strange name of Decalcomania. If these transfers could be made cheaply in the appropriate quantities, and, of course, they form a resist, they may enable cheap production with little equipment. However, indications are that the process may not be economic.

On the other hand, there are other transfer processes where a die cuts the stencil and presses it on to the plate at the same time. The die is usually heated. The method is suitable for long runs of the same small circuit. With this limitation, the method compares favourably in cost with the others.

5. Painted Resist

In this case, the resist is painted on by hand. It is clearly limited in its field, but it is used to produce the giant printed circuits sometimes seen at exhibitions. A sign-writer is usually called in for the job. The method is, however, a useful technique for the amateur, and this will be dealt with later.

However the resist has been applied, the next step is to examine it and correct any defects. The circuit is then put in an etching machine. The etchant is usually iron perchloride, though sometimes nitric acid is used. The latter, however, is a dangerous substance, and poisonous vapours are emitted during etching. If the circuit is laid in the etchant, it will take a long time to etch, but by splashing the etchant against the surface, much quicker results are obtained. It takes about six minutes to etch away $1\frac{1}{2}$ thousandths of an inch of copper. The etchers are shown in the foreground of Fig. 12. Afterwards, the circuit is then thoroughly washed, and the resist cleaned off.

We next consider the methods where the circuit metal, almost always copper, is removed by mechanical means. We can consider three methods sometimes used.

1. Machine Base

This is the method used by Sargrove in 1947 for his Automatic Set Making Machine. A bakelite panel was milled and routed to leave the conducting pattern inset. The whole was then sprayed with copper, and the surface milled away, leaving conducting copper in the grooves. This was a remarkable piece of automation.

2. Embossing

This method was used for making frame aerials in America, before the days of the ferrite rod. A sheet of foil was laid over the cabinet back, and pressed into the required pattern by an embossing tool. This, of course, meant expensive tooling.

3. Pressing

In this case, ordinary copper clad laminate is used, and the desired pattern pressed in the surface is then skimmed over, leaving the copper in the indentation. This is a practical method for making small printed circuits without fine definition, in quantity.

4. Transfer

A metal foil is covered with an adhesive, and this is cut and transferred to the circuit base by a heated die. This method is in early stages of development.

It may seem wasteful to etch away copper rather than putting it on the base laminate as required. However, copper is an unusually difficult metal to stick down, and thus alternative methods have been successful using silver. This is not allowed for military use on bakelite laminate, owing to the unfortunate tendency of silver to ionic migration. In other words, if two silver conductors are printed on bakelite, with a potential across them, and the assembly is subject to damp conditions such as a sea mist or industrial fog, "trees" of silver will start to bridge the conductors. However, the methods will be described as applicable to, for example, unglazed ceramic. There follows a classification of the more usual methods.

1. Direct Stencil

A silver solution is applied by any of the common methods, such as stencil, silk screen, or litho offset. It is then stoved on. Alternatively, a metal may be sprayed on.

2. Stencil and Plate

The first method is expensive in silver, and it is therefore worth considering whether to put a thin layer of silver down and plate up with a cheaper metal. This restricts the pattern, as all points must be electrically connected.

3. Metal Resist and Plate

In this method, the whole of the laminate surface is metallised, usually by chemical deposition. An insulating resist is then applied to the non-conducting part of the metal pattern, and the conductors are thus plated, joined together by the metal under the resist. As a final operation, the resist is removed, and the metal between the conductors dissolved away. Several variations of this method have been proposed.



Fig. 15.—Silk screen stencilling.

	Photo Etch	Screen	Litho
Accuracy ...	0.0005in.	0.003in.	0.001in.
Tool Cost ... (approx.)	£3	£8	£10
Cost per sq. in. on standard 1/16" laminate (approx.)	1.5d.	0.75d.	0.68d.

4. Transfer Method

The required metal is plated on to a conducting surface to which it does not adhere, over such parts not protected by a resist, thus forming the required surface in reverse. The plate is then pressed on to the laminate or other base with a suitable adhesive, and the original plate removed, leaving the printed circuit required. This method need not use silver.

The most common method is, undoubtedly, the

resist and etch process, using photo-etch; litho, or screen resist. Final operations on the printed circuit before it passes to machining firstly comprise any protective finishes that may be required, as copper soon oxidises and becomes difficult to solder. These finishes may be a thin layer of gold, deposited chemically, or a varnish which also acts as a flux. Plug contacts are best plated, with rhodium or palladium. For this purpose the contacts are linked on the master drawing to enable electrical connections to be made, the link being subsequently cropped off. An example is shown in Fig. 5, in Part 2 of this series.

The three common methods of making circuits are compared in the table above.

In the next article, the transistor amplifier for which the master circuit was designed in Part 2, will be converted into a photo-etch circuit.

(To be continued)

METER SHUNTS AND MULTIPLIERS

(Concluded from page 133)

Therefore, $R_p = (100 - 100/1,000)/(1/1,000)$; or $99.9 \times 1,000 = 99,900 \Omega$. Thus R_p is $99,900 \Omega$; a value of $100,000 \Omega$ would be sufficiently near this value for practical purposes and resistors which are nominally $100,000 \Omega$ ($100 K\Omega$) are readily obtainable.

The Meter

The F.S.D. of a meter to be used with multipliers should be as low as possible. Then the meter will take very little current from the circuit under test. If the meter takes a large current

then the P.D. to be measured may be considerably lower when the meter is in circuit and inaccurate readings will be obtained.

We now summarise the results obtained for easy reference.

Shunts.— $R_s = I_1 R_m / (I_2 - I_1)$ where R_s ohms is the required resistance of the shunt; R_m ohms is the resistance of the meter movement; I_1 amps. is the F.S.D. of the meter and I_2 amps is the maximum current we require to measure.

Multipliers.— $R_p = (V_2 - I_d R_m) / I_d$ where R_p ohms is the required resistance of the multiplier; R_m ohms is the resistance of the meter movement; I_d amps is the F.S.D. of the meter and V_2 volts is the highest P.D. we require to measure.

New Method for Stereo Radio

A SINGLE TRANSMITTER IS USED TO PROVIDE A COMPATIBLE SYSTEM

FURTHER details have now been released of E.M.I.'s new Percival System of compatible single channel stereo radio, briefly announced last year.

Stereophonic reproduction with tape as the recording medium has now been available for several years. With improvements in recording and reproducing technique it is now possible, using the principle of the complex cut originally proposed by the late A. D. Blumlein in 1931, to record on disc with a reduction in price and consequent increase in the number of listeners. The next step is to transmit stereophonic sound by radio.

Experiments have been carried out by the BBC and in the U.S.A. in which the signal intended for the left speaker is transmitted from one station, while that intended for the right speaker is transmitted from another station. While valuable information can be obtained from such experiments, the system is uneconomical and is incompatible in so far as listeners with only a single standard receiver could receive only the left or the right signal.

In the U.S.A., a single F.M. transmitter has been employed to transmit the sum of the left and right signals in place of the ordinary audio signal, together with the difference of the two signals on a subcarrier. This must involve a loss of range equivalent to a power loss of the order of 6 dB.

Compatibility

In an ideal system the listener with a standard receiver would be unaware that stereo sound was being transmitted, while the listener with the necessary equipment would enjoy stereo reproduction over the same transmission range as the ordinary listener.

The transition from ordinary to stereo reproduction involves the transmission of additional information as to direction. It can be shown that the quantity of additional information is small compared with that necessary for the audio content. Hence, if the directional information could be separated and transmitted as an independent signal, the extra power and bandwidth required would be very small. Moreover, only the single normal audio signal would be required, so that the system would be completely compatible.

The Percival System

If there were only a single moving source it would be sufficient to transmit an auxiliary signal indicating the position of the source at any instant. In practice it is necessary to deal with a number of independent sources and it might appear that a separate signal would be required for each; however, it has been found that this is not necessary.

In the earliest experiments the directional

information was given by a voltage depending on the ratio of the envelopes of the normal left and right signals. This voltage was employed to control the relative gains of the amplifiers supplying the left and right speakers. The optimum bandwidth for the control signal was found to be about 100 c/s. Some true stereo effects were obtained but, as would be expected, were inadequate.

Nevertheless, the results showed that successive sounds emanating from different directions were interleaving in such a way as to give the impression of separate simultaneous sources.

Further development involved a recognition of the fact that the ears are able to determine the directions of certain types or parts of sounds more readily than the directions of others. Indeed, experiments showed that some sounds could completely mask the directions of certain other sounds. Accordingly, it was necessary to process the original left and right signals in such a way that the directional information was weighted in accordance with the ability of the ears to detect the directions of the various sounds. In other words, an attempt was made to match the channel carrying the directional information to the channel constituted by the ears and the brains.

The additional processing required to form the directional signal naturally involved some complications at the transmitter end. However, it involved no modifications to the radio transmitter itself and, very fortunately, it required no changes whatever in the very simple process of decoding in the receiver.

Signal Transmission

To test the system over radio, the low-power R.F. amplifier of a prototype BBC Band II F.M. transmitter was utilised to transmit the signal over a distance of about a quarter of a mile with a power of the order of one watt.

The left and right audio signals were derived from standard commercial stereo tape, the two signals being combined to give a single compatible audio signal together with a control voltage which was modulated on to a subcarrier at a frequency above the audio band. The audio and directional signals were then added and caused to frequency modulate the main carrier, the transmitter itself being unaltered. The reduction in level of the audio signal required to accommodate the subcarrier would have caused a reduction of range equivalent to a loss of power of about 2 dB. However, it is hoped to do better than this.

A high-class F.M. receiver was employed for reception, an adaptor being incorporated for the purpose of decoding the directional signal. In addition, a similar standard F.M. receiver was provided in order to demonstrate the compatibility of the system.

With this equipment, a successful demonstration
(Continued on page 155)

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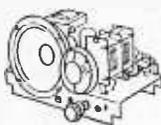
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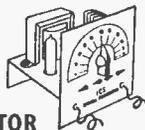
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A Comprehensive Valve Tester

CORRECT ELECTRODE VOLTAGES ARE APPLIED DURING TESTS

By F. Walker

A VALVE TESTER is very useful to have in the workshop. This tester is one which tests valves under proper operating conditions and does not test by applying an A.C. voltage to the anode and using the self-rectification of the valve under test. Although many of the cheaper testers use this method, it is not a good one for the following reasons: (a) it does not test valves under normal conditions; (b) special lists are required of every valve likely to be tested, as valve data books give only a set of D.C. conditions; (c) the pulses of anode current in the A.C. method may bring up the emission of a "low" valve.

Circuit Description

From the circuit diagram of the tester (Fig. 1) it can be seen that H.T. for the valves is obtained from the mains via a metal rectifier and an electrolytic reservoir capacitor. Heater voltage is obtained from a multi-tapped heater transformer, and is

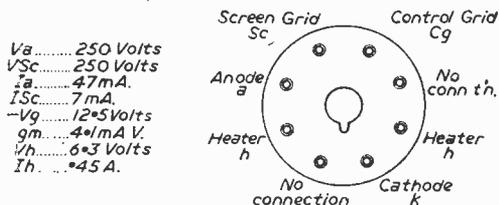
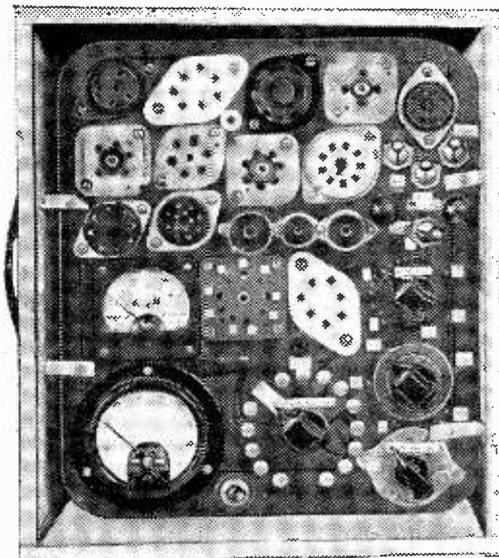


Fig. 2.—Test data for a 6V6.

selected by a one-pole, 15-way switch. Both the transformer and the switch can be made by the constructor quite easily. The ranges of heater voltages are: 0-1.4 v.—2 v.—4 v.—5 v.—6.3 v.—7.5 v.—13 v.—15 v.—20 v.—25 v.—30 v.—35 v.—40 v.—50 v. The range of anode voltages is 0-300, depending on the mains voltage. With mains of 240 v. A.C., 300 v. D.C. is available. The anode voltage can be varied in steps of approximately 25 v.

The output of the rectifier is applied to a chain of eleven 470 ohm resistors, and a 12-way Yaxley-type switch is used to tap off the required anode voltage. This selected anode voltage can be observed on a 300 v. meter. Suppressor grids are connected to the cathode if they are not already so connected inside the valve. Screen grids are fed from a fully variable potentiometer across the H.T. supply. Any screen voltage from 0-300 can be obtained. Control grids are fed by an EA50 (VR91) connected to the 13 v. tap on the heater transformer. The output is smoothed by a

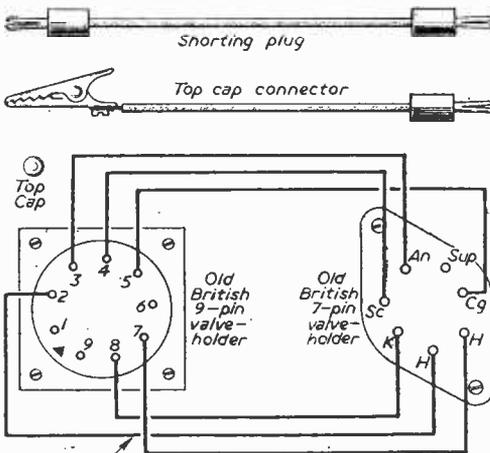


50 + 50 μ F. 50 v. working electrolytic capacitor, and is developed across another potentiometer. A "gas" resistor and shorting switch are included in this circuit.

Another useful feature of this tester is that batteries may be charged: 12 v. at 2 amps. is available. Voltages for the charging rectifier in steps of 0-1.4 v.—2 v.—4 v.—5 v.—6.3 v.—7.5 v.—13 v. can be obtained from the heater switch. Thus batteries can be charged without a rheostat. Care must be taken to see that the charging switch is off when testing valves with heaters above 13 v.

Operation

In operation, all the correct electrode voltages are applied to the valve, and the anode current is measured by a meter which may be set to read



These connecting lines represent the shorting plugs. Fig. 3.—Two valve bases are used with shorting plug to make the required connections for testing.

10 mA or 100 mA F.S.D. This is an emission test, and it shows whether the valve is "low" or not. If gm is to be measured, the control grid voltage is raised (made more negative) by one volt, and the change in anode current observed. If sufficient change cannot be registered, i.e., if the valve has a low gm, the control grid voltage may be raised by 2 volts, and the change in anode current divided by two. However, 1 volt change is usually enough, especially with short grid base valves. A change of 2 v. may be tried if the grid bias is more than about -6 volts.

To test for gassy or soft valves, a grid leak of 100 kΩ is inverted by opening the "gas" switch, to see if the anode current varies. Sometimes gassy valves glow blue, but not always.

The method of connecting electrodes is simple. Rows and rows of switches are not required. There are 14 different types of bases commonly used in radio receivers; these range from British 5 and 7 pin, side contact, UX4, 5, 6, and 7 pin, Octal, Mazda Octal, B9G (EF50 base), loctal, B8A, B7G, to B9A. Each pin is joined up, i.e., all the pin 1's and all the pin 2's, etc., on the valveholders. Each pin connection is connected to the appropriate pin socket on an old British 9-pin valve base. There are seven leads from the supply to the electrodes, i.e., heater, heater, cathode, con-

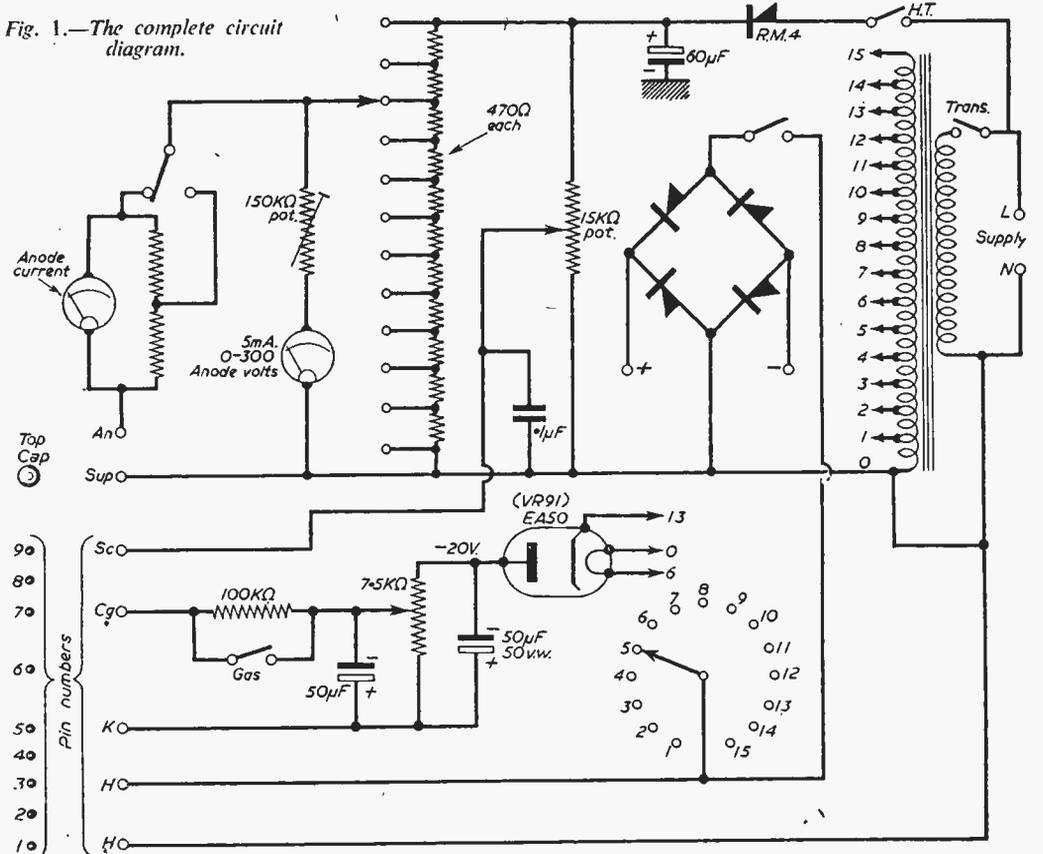
trol grid, screen grid, suppressor grid and anode. These supplies are connected to an old British 7-pin valve. To connect any electrode, a piece of insulated wire with a wander plug on each end is plugged from one base to the other. Seven of these and one T.C. connector are needed (see Fig. 3). For instance, take a 6V6. This valve is an output beam tetrode. The valve book shows the data given in Fig. 2. Thus the tester would be set to all the voltages, and if the valve were good, the appropriate anode current would be registered.

Construction

Many constructors have their own ideas on building equipment, and the tester may be made to the constructor's own manner of layout. However, the prototype is described for those who require something from which to work. A precaution which must be taken is to see that ventilation is allowed for the chain of 470 ohm resistors, as they dissipate a certain amount of heat. For this reason a hole was cut in the cabinet base to allow air to enter, and the front panel was suspended in such a manner as to leave a gap of about 1/4 in. all the way round between panel and cabinet.

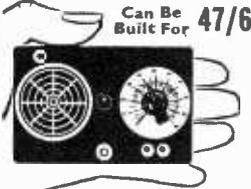
The front panel was made from Perspex, and
(Continued on page 151)

Fig. 1.—The complete circuit diagram.



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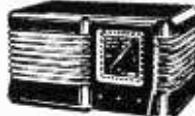


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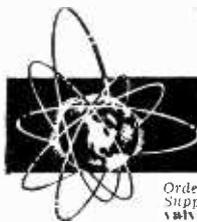
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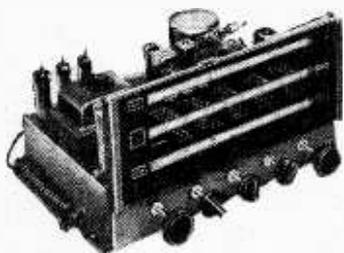


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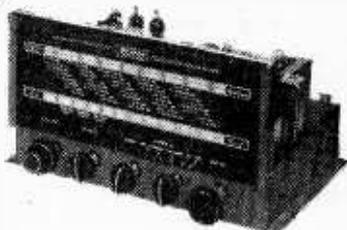
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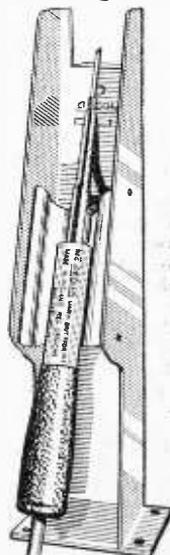
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it measured 10½ in. X 9 in. approximately. The thickness was 3/16 in.

Winding the Transformer

Stampings were bought to make up a 1 in. square cross-sectional area of core. Seven turns per volt were allowed, and the transformer assumed to be 80 per cent. efficient, which is a reasonable approximation for a transformer of this type.

When winding the transformer, the leads were brought to the sides of the cheeks and not under the core. All the leads from the secondary were marked, and when the transformer was finished a tag board was fastened to the top and the leads soldered to it (Fig. 4).

The Heater Switch

Fifteen split rivets were purchased from the local leather shop, and these were used as studs. Fig. 6 (in the next article) shows how the wiper was made. As will be seen, the basis was an old V/C. A piece of brass strip was soldered on to the spindle, and the strip used to wipe over the split rivets.

The Shunt for the Meter

In the prototype the movement was of 5 mA F.S.D. (see Fig. 7). It is important to understand that there is no switch in series with the shunts. If there was, any spurious resistive contacts, even if as low as (say) .1 of an ohm, would make the needle flicker erratically. When the switch is up, both the shunts are in series across the meter, and the 10 mA shunt is arranged so that the meter reads 10 mA F.S.D. Incidentally, when making the shunts, a multimeter is required. It is also required to calibrate the potentiometers. An Avo Multiminor, with a sensitivity of 10,000 ohms/volt, was used to calibrate the prototype. With this

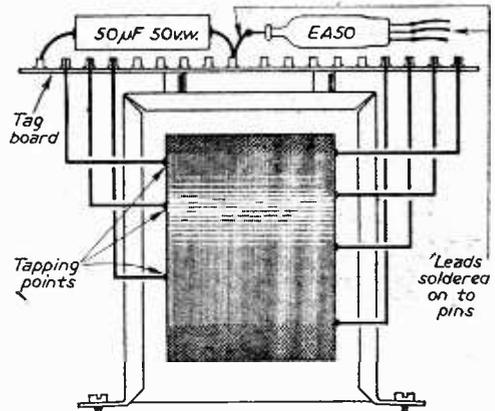


Fig. 4.—The transformer and tag-board.

TRANSFORMER WINDING DETAILS			
Mains primary. 7 X 240—1,680 turns. (That is for mains voltages of 240 volts.)			
<i>Secondary:</i>			
0 v. tap at	0 turns	13 v. tap at	109 turns
1.4 v. "	9 "	15 v. "	126 "
2.0 v. "	17 "	20 v. "	170 "
2.5 v. "	21 "	25 v. "	210 "
4.0 v. "	34 "	30 v. "	252 "
5.0 v. "	42 "	35 v. "	294 "
6.3 v. "	53 "	40 v. "	340 "
7.5 v. "	63 "	50 v. "	420 "
		Wire gauges:	
		Prim.—36 s.w.g.	
		Sec. up to 13 v.	
		20 s.w.g.:	
		from 13 to 50 v.	
		26 s.w.g.	

meter the potentiometers can be left, once calibrated, but with a meter of lower sensitivity, a resistor, equal to the resistance presented by the meter, must be connected between slider and the bottom end of each of the potentiometers where measurements are taken to preserve accuracy.

(To be continued)

A THREE-RANGE OHM-METER

(Concluded from page 120)

circuit is basically the same as for the medium ohms' range except that a higher voltage is used. This voltage may be anything from 90 to 150 volts (D.C.). The writer used an old eliminator as a source of voltage, and this proved very reliable. Connections to the eliminator were made by a two-way cable carrying wander plugs, one red, one black. The values of the components are determined by the voltage to be employed, and hence general instructions are given so that the constructor may calculate his component value to suit the voltage he uses. The sum of R3 and R4 is given by:

$$(R3 + R4) = \frac{V}{I} \quad (I = 4/1,000 \text{ amp.})$$

Suppose the voltage to be used is 150. Then

$$R3 + R4 = \frac{150}{4/1,000} = 37,500 \text{ ohms.}$$

In this case R3 would be 33 k (33,000 ohms), and R4 would be 5 k. Similarly, if the voltage is 90, R3 + R4 = 22,500 ohms. R3 would be 20 k, and R4 would be 5 k. In fact R4 could be 5 k

for all voltages between 90 and 150. The calibration table is made up in exactly the same way as with the medium ohms range. The problem now is to arrange to switch these circuits into use one after the other according to the range the user wishes to employ. The final circuit chosen is shown in Fig. 5, where S1 is a two-pole, three-way wafer switch.

In the heading photograph the medium range set-zero control is the same as the high range set-zero control. This is because the writer used a slightly different circuit for the prototype. The final design chosen incorporates the medium set-zero control in the low set-zero control, and this control (R2) should be labelled accordingly.

A word of warning. Do not use an eliminator designed for D.C. or for A.C./D.C. mains as the source of high voltage, because it would then be possible for the whole instrument to assume mains potential. Use only an eliminator designed for A.C. mains, and even then only if the eliminator incorporates a mains isolating transformer. If the mains in your locality is D.C. you would be well advised to use a 90 to 150 volt battery.

Basic Theory for the Constructor

No. 3.—THE POTENTIAL DIVIDER IN PRACTICE

By G. Palmer

SO far we have contributed the basic features of the potential divider, but in practice there are one or two other factors to be taken into account. For example, the potential or the voltage of the supply has obviously been divided for some definite purpose, possibly to energise a secondary circuit section which needs a smaller voltage than that given by the supply.

This means that the secondary circuit itself will take its current by way of the divider resistors, which considerably modifies the open-circuit voltage distribution in the network. Moreover, a potential divider may be required to supply more than one voltage tap.

The circuit in Fig. 1 gives a more realistic representation of what will be discovered in practice. Here the supply voltage is 100, and two outputs are required, one at 50 v. and the other at 20 v., the former at 20 mA and the latter at 10 mA.

A study of this circuit will reveal that R1 will pass the total current of the two outputs, which

We start with R3, and since we know the voltage across it and the current through it, it is a simple matter to determine its value by using the Ohm's law formula. $R3 = E/I$ or $20/0.03$, which gives about 667 ohms. A resistor of 660 or 680 ohms (a "preferred" value) would be used in practice.

Next R2; the voltage across this resistor can be found by subtracting the voltage across R3, which is 20, from the voltage across R2 and R3 in series, which is 50, giving an answer of 30. The current in R2 is 40 mA, which means that $R2 = 30/0.04$, or 750 ohms.

Finally R1; the voltage across this resistor is the difference between the supply voltage E_s (100 v.) and the voltage across R2 and R3 in series, which, as we have already discovered, is 50. Thus, the voltage across R1 is also 50, but the current is 60 mA, so $R1 = 50/0.06$, or about 833 ohms—a practical value being 830 ohms.

Clearly, the calculation of such a divider, assuming that the various currents and voltages are known, simply resolves to the application of Ohm's law. The power dissipated by the resistors can be found by using the $W = I^2 R$ formula.

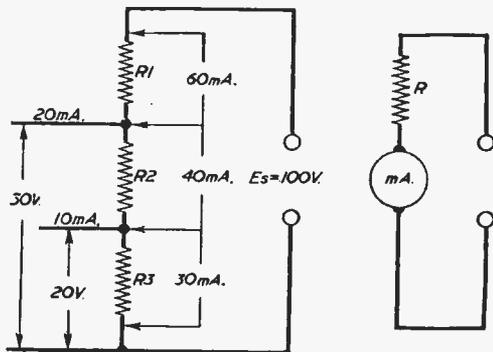


Fig. 1 (Left).—The type of potential divider that will be found in practice.

Fig. 2 (Right).—A voltmeter is no more than a current meter connected in series with a resistor of suitable value to give the required range of voltage indication.

is 30 mA, plus the current through the series-connected resistors across E_s . This is usually known as the *bleeder current*, and is the current in R3, which in this case is 30 mA. Thus, we can see that the current in the supply circuit and in R1 is 60 mA.

The current in R2 is equal to the bleeder current (30 mA) plus the current taken by the 20 v. tap (10 mA), which, as will be seen, totals 40 mA. The problem is, of course, to find the value of each resistor to satisfy the conditions outlined.

Voltmeter Loading Effect

It often surprises the experimenter to find that the voltage as indicated on a voltmeter connected to a resistive network differs considerably from the voltage expected at the point of connection. In some cases the meter needle may barely move, although it is obvious that the voltage at the test point is far in excess of that indicated.

The reason for this apparently curious effect is that the voltmeter itself "looks" to the circuit like an extra resistance, and the voltage distribution is modified accordingly. It can be looked upon in a different way: power is required to deflect the meter needle, and this can be obtained only by way of the resistive elements in the test circuit.

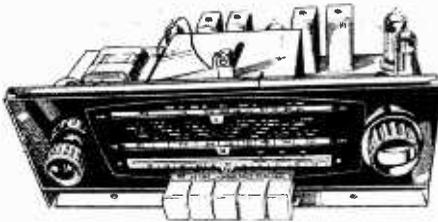
Sometimes the experimenter is completely bewildered when he finds that the meter deflection remains substantially constant, even when the voltage-range switch on a multi-meter is reduced to a low volts value. In some cases, the voltage indication may even reduce when a lower voltage setting is used!

Voltmeter Sensitivity

A voltmeter is no more than a current meter connected in series with a resistor of suitable value to give it the required range of voltage indication. This is shown in Fig. 2. If the current meter has a full-scale deflection of 1 mA, and if the scale is calibrated in terms of volts up

(Continued on page 155)

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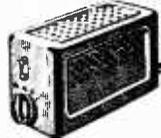
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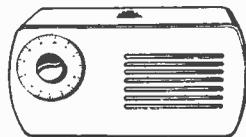
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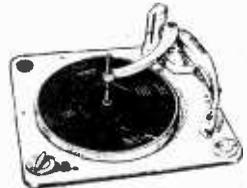
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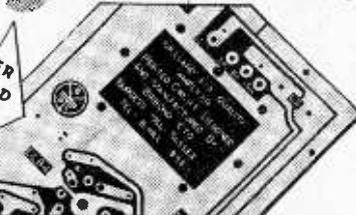
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to a maximum (full-scale deflection) of 6 v., for example, then for the meter to indicate 6 volts the test circuit will have to give up 1 mA.

The resistance of the voltmeter circuit, made up of R and the resistance of the current meter itself, to suit the condition given above will have to equal the applied voltage required for full-scale deflection divided by the full-scale deflection current of the meter movement, which is 6/0.001, or 6,000 ohms.

The sensitivity in terms of ohms per volt is equal to the total resistance of the voltmeter circuit divided by the full-scale deflection voltage, which, in the case under discussion, is 6,000/6, or 1,000 ohms per volt.

It will be realised, of course, that the sensitivity is governed solely by the meter movement: the inherent sensitivity of the voltmeter is not improved when R is adjusted to give a full-scale deflection of, say, 200 v., even though the loading imposed by the voltmeter on the test circuit at that setting would be less. The sensitivity will remain at 1,000 ohms per volt. However, an 0.1 mA full-scale deflection meter would endow the voltmeter with a sensitivity of 10,000 ohms per volt, but a 10 mA meter would give a sensitivity of only 100 ohms per volt.

Effect on Circuit

Let us examine the simple potential-divider circuit in Fig. 3. Here we have two 6 k resistors, and by calculation in previous articles we have proved that in such a circuit 6 v. (half the applied voltage E_s) will be developed across each resistor. This network is not supplying current at its tap as in Fig. 1 for example, but may well be used in a radio set to give bias to a valve.

Now, if we attempt to measure the voltage across, say, R2 with a 1,000 ohms per volt voltmeter set to the 6 v. range, we immediately connect in parallel with R2 the 6 k resistance of the voltmeter circuit. Two 6 k resistors in parallel total 3 k, so the resistance distribution

of the circuit is altered according to Fig. 4.

We can now work out the voltage across the modified R2, which, as we discovered earlier in the series, is equal to $(E_s \times R_2)/(R_1 + R_2)$. This works out to 4 v., and is the voltage that would be shown by a 1,000 ohms per volt voltmeter.

The error between the true voltage and the indicated voltage would be made less by using a meter of the same sensitivity set to a higher volt-

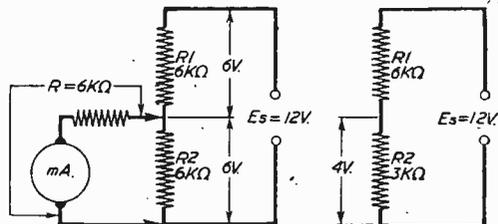


Fig. 3 (Left).—With the voltmeter disconnected 6 v. will be developed across the resistors R1 and R2 of the potential divider, but with the voltmeter connected the resistance distribution of the circuit is altered in accordance with Fig. 4.

Fig. 4 (Right).—The potential difference across the modified R2, owing to the connection of the voltmeter (1,000 ohms per volt adjusted for 6 v. full-scale deflection) is now 2 v. below the true open-circuit voltage.

age range (since then the overall resistance would be higher), or by the use of a voltmeter of greater sensitivity.

In some cases, an additional error may occur as the result of the supply E_s having to cater for the extra current required by the voltmeter. This would happen if the supply voltage itself was derived from a high resistance circuit, but the low internal resistance of a battery in good condition would have negligible effect.

New Method for Stereo Radio

(Continued from page 144)

was given to representatives of the BBC, as a result of which it was agreed that the BBC and Electric & Musical Industries Ltd. (E.M.I.) should co-operate in studying the system with a view to arranging experimental transmissions from one of the BBC transmitters.

From experience gained to date, the following points are clear:

(i) It is possible to obtain true stereo reproduction by separating the directional information from the audio information and transmitting the former on a subcarrier.

(ii) The bandwidth and the power required for the directional signal are small compared with that employed for the single audio signal.

(iii) The system is entirely compatible for F.M. transmitters and could in principle be adapted to A.M. transmitters with the aid of a filter in existing monaural receivers to remove the sub-carrier.

(iv) No modification to the transmitter is

required, a special encoding unit representing the only addition to the broadcasting equipment.

(v) The only addition required to the receiver is a relatively simple decoding unit together with a second amplifier and loudspeaker.

(vi) In order to facilitate transmission over land lines, the subcarrier frequency can be reduced to a convenient value and then increased again to the standardised frequency required for broadcasting. No accurate phase or delay adjustments are required for the subcarrier signal.

(vii) The effectiveness of the system depends on the processing of the directional information.

(viii) It is believed that this is the only fully compatible single channel stereo system which does not involve either modifications to the transmitter or appreciable loss of range.

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MODIFYING THE R.1155

MASTER AND A.V.C./OMNI SWITCHES

By R. H. Ince

THIS modification is intended primarily for those who have undertaken the one suggested in the September and October, 1956, issues of PRACTICAL WIRELESS (which are now out of print) concerning the removal of the M.F./D.F. circuits. It involves the removal of the

(see Fig. 2(a)) should be carefully unsoldered and reconnected as shown in Fig. 2(b) either mounted on a tag board and bolted across the switch wafer spacers or on the switch wafer X in the coil pack, a common lead being taken to the aerial socket. In the original circuit the wafers B.F. and D.F. were used to cut out the trailing and fixed aerials fitted to the aircraft and allow the loop aerial to be brought into circuit via wafer E in the three D.F. positions, namely: balance, visual and infinity.

The wafers B.R. altered the bias potential by placing a 1.2 kilohm resistor across the chassis and H.T. negative, C placed H.T. positive on the aerial switching valves, and A.R. connected in the meter switching valve circuit. All wiring connected to these may be removed, since they were only operative in some or all of the D.F. positions. The wafer A.F. now contains the only connections necessary to the receiver proper, and it was decided to replace it with a smaller switch. The meter deflection switch may be utilised after the two missing contacts have been replaced, these may be obtained by carefully removing

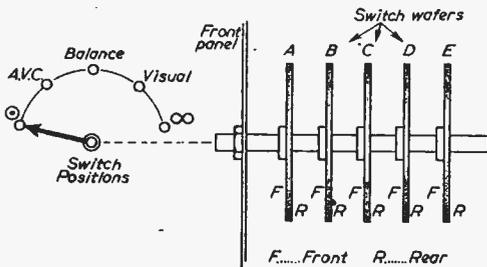


Fig. 1.—The switch positions and wafers.

master switch and the substitution of a smaller A.V.C./omni switch. Note that no provision has been made for the inclusion of the loop aerial

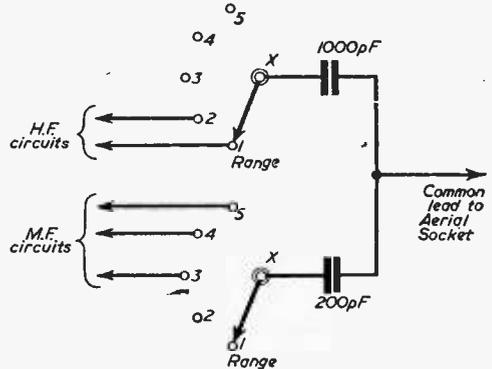
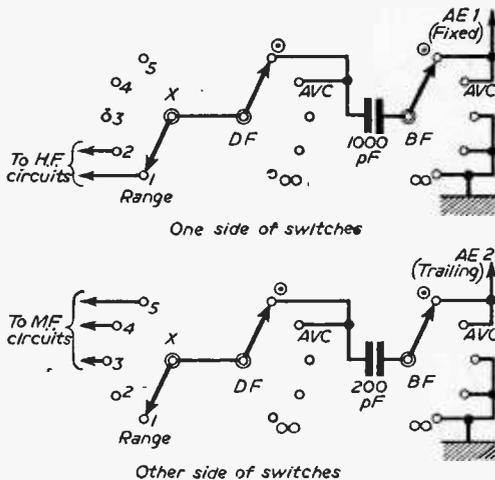


Fig. 2 (a) left and Fig. 2 (b) above show the wafers D.F. and X, in the original and modified layout.

and its associated circuit, and it will, in fact, be removed during the modification, since it was found to be of little value when used on any of the five frequency ranges. The five switch wafers have been lettered, for convenience, from A to E, the sides facing the front panel F, and the opposite sides R (see Fig. 1).

Commence by removing the loop aerial switching wafer E, including the 200 pF condenser. All the leads may be cut and traced to source. Two will be found to terminate at a coil which may be removed from the coil pack together with the 100 pF condenser.

The two 1000 pF and 200 pF condensers connected respectively in the H.F. and M.F. aerial circuit mounted across the wafers B.F. and D.F.

two contacts and rivets from one of the spare wafers. A new switch could, of course, be purchased and should be of the 2-pole, 2-way type. The position of the new switch is a matter for personal choice, but it might be placed either between the volume control and handle or in

(Continued on page 159)

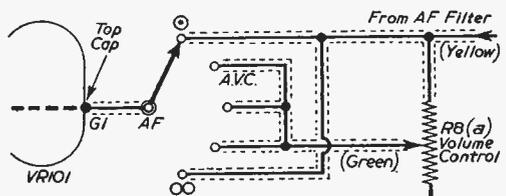


Fig. 3.—Original circuit of wafer A.F.

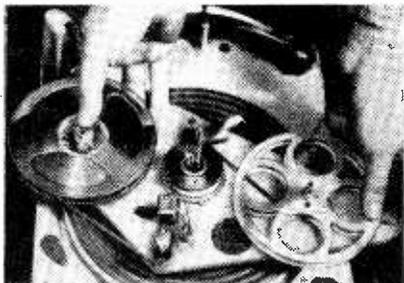
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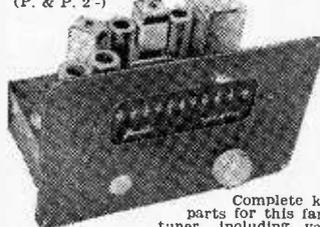
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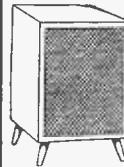
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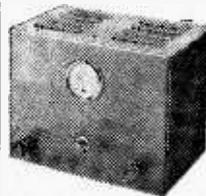
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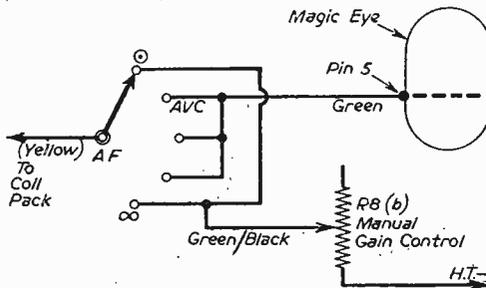


Fig. 4.—Reverse side of wafer A.F.

the space previously occupied by the meter balance control.

On one side of the wafer A.F. there are three leads, i.e., a screened yellow lead which is connected to the volume control R8(a); a screened green lead which is connected to the centre tag of R8(a), and a common lead connected to the pole of the switch wafer, which passes underneath the chassis to a tag board and then to the grid cap of the Det. and A.F. Amp. VR101 (see Fig. 3). All these leads should be shortened as required and connected to the new switch as shown in Fig. 5.

On the other side of the wafer A.F. there are three other leads, i.e., a green lead which is connected to a tag board below the chassis and pin 5 of the magic eye. This lead should be unsoldered from the eye, taken through the

chassis at a convenient point from the tag board and connected to the new switch. Another lead should be soldered between the switch and the eye. A common yellow lead connected to a tag board in the coil pack, should be lengthened and re-routed to reach the switch. A green-black wire passes above the tuning dial to the centre tag of R8(b) (see Fig. 4). Again this wire should be shortened and wired to the switch as shown in Fig. 5.

The remaining space may be used to accommodate an "S" meter, R.F. gain control, aerial trimmer, etc. The author has utilised all the available space in his R.1155-B. A third I.F. amplifier has been mounted in the space behind the B.F.O. can, a crash limiter, R.F. gain control, and a small speaker above the tuning condenser.

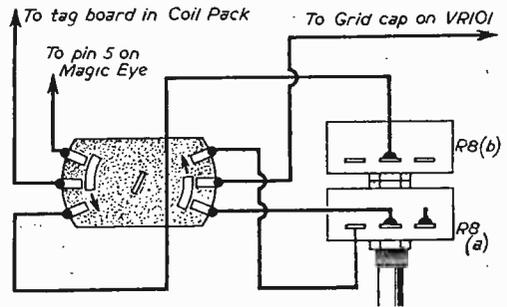


Fig. 5.—Wiring of new switch, R8(a) and R8(b).

E.M.I. Data Processing System for Harwell

A NOVEL transistorised data recording and analysing system has been developed by E.M.I. Electronics Ltd., in conjunction with the U.K. Atomic Energy Authority scientists and engineers, to assist in handling the enormous quantities of statistical data nowadays required for nuclear experiments at the Atomic Energy Research Establishment at Harwell.

Continuous monitoring of nuclear experiments for periods of up to 24 hours' duration is often necessary, and the quantity of data required may involve many millions of separate measurements to accuracies of 0.1 per cent. or less. The new system has been designed to meet this need, and is made up of a number of self-contained recording units and a central high-speed analyser. The recording units, situated near the experimental rig, take the measured quantities—for example, the neutron time of flight, and scintillation counter identity—and convert them into binary coded digital form. The coded data at a typical resolution of 0.2 per cent. is then recorded on magnetic tape in parallel form on 16 channels on 1 in. wide tape.

At the end of the recording run, the tapes are removed from the recording units for high-speed processing on the central analyser. Both the experimental rig—which may well involve a nuclear pile, together with a host of auxiliary

apparatus—and the recording units are immediately freed for another experimental run.

The analyser handles the tapes at speeds of up to 100 inches per second, and the digital information is read off the tape at high speed and automatically sorted into ordered array on a ferrite core store. As the information is now in ordered form in this store it is a simple matter to read it out at speed, and in a sequence suited to any further data processing required.

The core store contents can, for example, be transferred on to punched paper tape for direct input to a digital computer, and further calculations on the statistical data carried out. Punched card or graphical output from the core store can also be provided.

The system is being applied initially to neutron spectrometry measurements, but because of the versatility of the logical design of the system, it is readily adapted to any instrumentation problem where data has to be acquired over a long time, making magnetic tape storage an attractive feature.

When data is arriving at fast rates the magnetic recording stage can be by-passed, and after the data has been converted into digital form by the circuits contained in the recording units it can be directly sorted into the core store of the analyser.

The use of a limited range of plug-in printed circuit transistor "cards" leads to flexibility of logical design, along with extreme of maintenance.



THE BRITISH INSTITUTION OF RADIO ENGINEERS

THE following Institution meetings will be held during March:

Wednesday, March 11th.—6.30 p.m. (South Wales Section). "Applications of Photo-electric Cells," by F. A. Benson, B.Sc., D.Eng., at Cardiff College of Advanced Technology.

Wednesday, March 11th.—7.15 p.m. (West Midlands Section). "The Development of High Frequency Tape Recording," by P. J. Guy, at the Wolverhampton and Staffordshire College of Technology, Wulfruna Street, Wolverhampton.

Wednesday, March 11th.—6 p.m. (North Eastern Section). "Microwave Strip-line Circuits for Radar Equipment," by K. Foster, M.A., at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne.

Thursday, March 19th.—6.30 p.m. (London Section). "Instrumentation in Field Physiology," by Dr. H. Wolff, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

Thursday, March 19th.—7 p.m. (Scottish Section). "Application of Magnetic Amplifiers to Electrical Switching," by J. A. Purdie, at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow.

Friday, March 20th.—7 p.m. (Scottish Section). Repeat of previous lecture, but held at Department of Natural Philosophy, The University, Drummond Street, Edinburgh.

Tuesday, March 24th.—7 p.m. (South Western Section). "Recent Advance in Travelling Wave Tubes," by P. F. C. Burke, B.A., at the School of Management Studies, Unity Street, Bristol, 1.

Wednesday, March 25th.—3.30 p.m. (London Section). Papers on "Radio Telemetry," including "Engineering Aspects of a 24-channel FM-AM Telemetry System," by W. M. Rae and others, and "A Six-channel High-frequency Telemetry System," by T. C. R. S. Fowler, B.Sc., at 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

BRITISH SOUND RECORDING ASSOCIATION

Hon. Sec.: Douglas Winget, 68, All Souls Avenue, London, N.W.10.

AN Extraordinary General Meeting of the Association was held on Monday, February 23rd, at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, for the purpose of considering, and, if approved, adopting, a new constitution.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec.: A. Noakes (G2FTK), 4, Barons Field Road, Coventry.

THE following is a list of the club's forthcoming meetings. All meetings will be held in the clubroom at 9, Queen's Road, Coventry at 7.45 p.m. Visitors are welcome.

March 9th.—"Contest Operating," by H. Chater (G2LU).

March 16th.—Quiz.

March 23rd.—"Two Metres" by W. H. Allen (G2UJ).

BURY RADIO SOCIETY

Hon. Sec.: Mrs. Jean Hodgkins (G3J2P), 24, Beryl Avenue, Tottington, nr. Bury, Lancs.

MEETINGS at 8 p.m., at the George Hotel, Kay Gardens, Bury.

March 10th.—"The Jodrell Bank Research Station."

April 14th.—Talk by H. Whalley (G2HW).

DERBY & DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: F. C. Ward (G2CVV), 5, Uplands Avenue, Littleover, Derby.

HEADQUARTERS and club rooms: Sub-basement, College of Art, Green Lane, Derby.

Some future events are listed below, to which visitors are welcome.

March 7th, 8th.—R.S.G.B. 144 Mc/s open contest.

March 11th.—Discussion on National Field Day, 1959.

March 18th.—Open night.

March 25th.—Talk by G. Smith, of Kingston, Jamaica:

"The British West Indies" (Film).

April 1st.—Surplus sale.

April 8th.—"My Stay in Iraq" (with colour transparencies) by Brian Dare (G3JFT).

April 15th.—Open evening—proposed visit.

PORTSMOUTH & DISTRICT RADIO SOCIETY

(affiliated to the Radio Society of Great Britain)
Hon. Sec.: A. Cake (G3CNO), 7, Wheatstone Road, Southsea.

THE above society holds weekly meetings on Tuesdays at 7.30 p.m. at Albert Road, Southsea (above Scars, drapers), March 10th.—Lecture by S. Howard.

March 17th.—Discussion on Radio Amateur's Examination.

March 24th.—Construction night—Junk Sale.

All interested in radio are cordially invited to attend. Morse lessons are given before meetings, by arrangement.

THE TEES-SIDE AMATEUR RADIO CLUB

Hon. Sec.: A. L. Taylor (G3JMO), 12, Endsleigh Drive, Acklam, Middlesbrough, Yorks.

THE club met on January 23rd, when L. M. Arrowsmith, of the West Hartlepool club, gave a lecture on the oscilloscope, which was accompanied by a demonstration of his Corsor 'scope built from a kit. This oscilloscope was seen to be very well behaved, and apparently also a truthful portrayal of circuit conditions—some of the obvious faults known to oscilloscope builders were pleasingly absent. Other equipment included two oscillators and a Haas modulator, from "The Oscilloscope at Work," by Hallows and a transistor multivibrator made on a small scrap of paxolin. We observed all the waveforms plus a quite unintentional fat spark!

The club meets on March 20th at 8 p.m. at Settlement House, Newport Road, Middlesbrough.

ROTHERHAM RADIO CLUB

Hon. Sec.: J. Barnes, 2, Mappins Road, Catcliffe, Rotherham, Yorkshire.

THE A.G.M. was held on January 7th, and the following officers elected. President, E. Davies, G2LG; Chairman, P. Laughton, G3LBO; Secretary, J. Barnes; Treasurer, R. Palmer, G4BD.

Meetings are held the first three Wednesdays in each month at the Crofts, Rotherham, commencing 7.30 p.m. A full and interesting programme is being planned including training for the R.A.E. A club net is held on 80 metres phone every Sunday morning around 12 noon.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: G. Western (G3LFL), 118, Salisbury Avenue, Barton, Torquay.

F. D. CAWLEY (G2GM, chairman) told 30 members the annual dinner would be at the Abbey Lawn Hotel on March 7th, tickets 11s. 6d. Invitations are being extended to Exeter and Cornwall amateurs.

Club headquarters are nearing completion. Reg. Barrett gave new timber for the work bench, which is finished; Roy Ashby gave a power pack for the 1155 Rx, and David White a 30ft. wood mast for the far end of the garden, just 66ft. away. Within the next two months a club call will be applied for.

Membership approaches the 50 mark with applications coming in from local technical and grammar school pupils in pleasing numbers.

Bill Jones (G3BBF), on leave from R.A.F., El Adem, Libya, was a visitor who has now returned. With Dick Loveday, of Ashford, Kent, Bill is operating all bands using the call 5A2CV. Frequencies 14,020, 28,075 cw, and 14,120, 28,150 phone. Hours as duties permit, 1800-2200 G.M.T. daily. Sundays 0600-1000 G.M.T. Further operations envisaged include possibly two metres May-September, and 160 S.S.B. may be used later. Bill guarantees activity for two years using an Explorer.

WELLINGBOROUGH AND DISTRICT RADIO AND TELEVISION SOCIETY

Hon. Sec.: D. Trusler, 87, Irchester Road, Rushden, Northants.

THE A.G.M. was held on Thursday, January 8th, under the chairmanship of Mr. G. A. Wilford. In his report Mr. Wilford said that the society have had another good year and that an excellent winter programme was well under way. He also noted that over £50 had been handed to charity when the society had organised sideshows at local fetes. The retiring treasurer, Mr. N. M. Seabrook, reported a turnover of £24 during the year, with a slight deficit of £1, but noted that items of equipment had been purchased.

The following officers were elected: Mr. G. A. Wilford, Chairman; Mr. D. Trusler, Secretary; Mr. R. Bonham, Treasurer; Mr. R. Tiley (G3KSC), Mr. J. Wagstaff, Mr. P. Butler and Mr. R. Britton, Committee.

The society continues to meet every Thursday evening at the clubroom above the W.I.C.S. fruit shop in Silver Street, where the programme is as follows:

March 12th: "The Construction of Calder Hall." Film.

March 19th: "Solar Radiation." F. W. Tyler (G3CGO).

April 2nd: "The Romance of the Radio Star." G. C. Woodridge, M.B.A.A. Visitors and new members are always welcome.

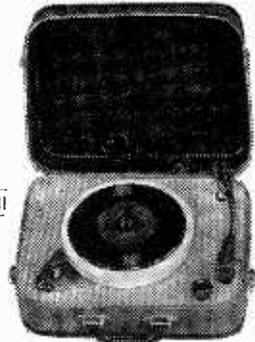
...another TRS Winner

TRS

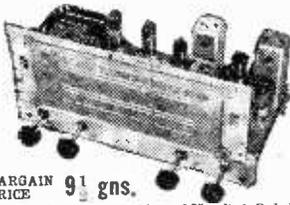
- Latest 4-sp. BSR Player Unit and P.U. ... £4.12.6 carr. 3/6
- 2 v. Amplifier wired complete with speaker, etc., on Mounting Board ... £3. 5.0 carr. 2/6
- Contemporary styled lightweight case in Maroon and Grey. 14 1/2 in. x 11 1/2 in. x 6 in. ... £1. 7.6 carr. 2/6

SPECIAL OFFER

all 3 units
only £9 carr. 4/6



ALL-WAVE RADIOGRAM CHASSIS 3 WAVEBANDS 5 VALVES



S.W. 16 mU—50 m. LATEST MIDGET
M.W. 200 m—500 m. BVA
L.V. 800 m—2,000 m. SERIES

Brand new and guar. A.C. 200-250 v., 3 pos. W.G. sw. Short-Medium-Long-Gram. P.A. socket. High Q dust core coils. Latest circuit technique, delayed AVC and neg. feedback O.P. 4 valve. Chassis size 13 1/2 x 9 1/2 in. Dial 10 in. x 4 1/2 in. Hor. or Vert. station names. Walnut or ivory knobs to choice. Aligned and calibrated ready for use. Sensitivity and Quality at Low Cost. Carr. and ins. 4/6.

7 Valve De Luxe, push-pull EL41 version. 7 watt output. With H.Duty Output Transformer, £12.10.0 Carr. & ins. 2/6.

BARGAIN 9 1/2 gns. PRICE

for 10 in. speakers to match. £0. and 25/- P. & P. 1/6

CONVERTER ACCESSORIES

Band 1-Band 3 Cross-over Unit. 7.6. Var. Attenuators 6db-50db., 7.6. B.C. Pattern Filter. 8.6. Band 2 Aerials—outside Single Dipole with 3 yds. coax., etc., 13/9. 3 Element Beam. 25/-, 5 Element. 32/6.

VOLUME CONTROLS

10,000 ohms—2 Mecohms. All long spindles. Monocrite Midset type 4 1/2 in. diameter. Guar. 1 year. Log. or Lin. Ratios. Less Sw. 3/-. D.P. Sw. 4/-. Carr. & ins. 2/6.

RECORD PLAYER CABINETS

Contemporary Cabinet style. rexine Price covered cabinet £3.3.0. in fawn and brown with cream ins. 3 p. interior. Size 18 1/2 x 12 x 14 1/2 in., fitted with all accessories, including tattle board and anodised metal feet. Space available for all modern amplifiers and autochangers, etc. 1 recent record player mounting board 14 x 13 in. supplied.



2-VALVE AMPLIFIER Mk. 2

Latest developed circuit giving the highest fidelity response and greater output (2-3 watts) using twin stage valve ECL82 and neg. feedback Tone Control. Complete with knobs wired and tested with 6in. speaker, etc., ready to fit in above cabinet. Only £3.18.6. Carr. 2/6.

RECORD PLAYER BARGAINS

New Reduced Prices!

SINGLE PLAYERS 4-speed BSR (TU9). 92/6; 4-speed COLLARO JUNIOR, 90/-; 4-speed GARRARD (4 S.P.). £7.15.0. GARRARD (TA Mk. 11). £9.5.0. Carr. and Ins. 3/6.

AUTOCHANGERS 4-speed BSR (UAR), £2.18.6; 4-speed COLLARO, £7.18.6; GARRARD (RC12) D Mk. 11) Plug-in head, stereo adapted, 10 gns. BSR UA12 latest stereo model, 10 gns. Carr. and Ins. 4/6. All above units are latest 4-speed models, fitted lightweight crystal pick-up and twin supplee styl. Complete and ready to use.
***FINEST SELECTION AVAILABLE— ALL BRAND NEW AND GUAR.**

G.R.T. Heater Isolation Transformers

New Improved types—mains prim. 200/250 v., tapped.

All isolation Transformers now supplied with alternative no boost plus 25%, and plus 50% boost taps, at no extra charge.

2V.	2A type 12/6 (P. & P. 1/6)
0.8V.	.6A " 12/6 "
10.0V.	.7A " 12/6 "
13V.	.8A " 12/6 "

Other voltages in course of production. Small size and tag terminated for easy fitting.

JASON P.M. TUNER UNIT 87-105 Mc/s.

Designer Approved Kit of parts to build this modern highly successful unit, drilled chassis and modern type dial. Coils, caps, and all quality components, etc., for only 5 gns., post free. Set of 4 spec. EF81s or equiv. valves, 30/-, post free. Illustrated handbook with full details, 2/- post free. FREE WIRE KIT, 48 hr. alignment service, 7/6 plus 2/- P. & P.

NEW BOXED VALVES GUARANTEED

135, 1T4 7/6	8J 2/4	10/6	PCF82 10/6
185, 184 7/6	DK96 9/6	10/6	PC182 12/6
384, 3V4 8/6	0L96 9/6	14/6	PL81 14/6
4Z4 9/6	6SL6 10/6	8/6	PL82 10/6
6AT6 8/6	EABCS0 9/6	10/6	PL83 11/6
6K7 6/6	EB91 6/6	11/6	PY80 9/6
6K8 8/6	EC81 10/6	11/6	PY81 9/6
6K7 8/6	ECC83 9/6	12/6	PV82 8/6
6N7 8/6	ECC84 12/6	14/6	PY83 10/6
6X6 7/6	ECC80 12/6	8/6	U22 8/6
6X4 7/6	ECP2 12/6	8/6	U25 15/6
6X5 7/6	ECH42 10/6	8/6	UCH42 10/6
759 9/6	ECH81 10/6	9/6	UF41 10/6
7Y4 8/6	ECL80 12/6	10/6	UL14 10/6
DAF96 9/6	ECL82 12/6	10/6	UY41 8/6

SPECIAL PRICE PER SET

1R5, 1T4, 385, 184 or 384	97/6
DK96, DPF6, DAF96, DL96	35/-
0K8, 6K7, 0Q7, 0V6, 5Z4 or 0X5	35/-

RE-GUNNED TV TUBES

GENUINE OFFER

New Heater, Cathode and Gun Assembly can now be fitted to your old Tube—Reconditioned virtually as new. Fully guaranteed to highest standards—as used by our own Service Dept.

Reare only Mullard and Mazda types at present. Delivery approx. 7 days. Carr. & ins. 12/6.

ELECTROLYTICS ALL TYPES NEW STOCK

25/25 v. 50 12 v. 1 1/2	Can Types, Clips 3d. ea.	3-
25/50 v. T.C.C.	2 1/2	8/500 v. Duh. 3-
50/50 v. 4,500 v.	2	8-8/450 v. T.C.C. 4-
100/25 v. 2,450 v.	2 1/2	8-16/450 v. Hunts. 5-6
8/450 v. T.C.C.	2 1/2	16-16/450 v. T.C.C. 5-
8 1/4 8/450 v. B.E.C.	4	32/350 v. B.E.C. 4/6
8 1/4 16/450 v. T.C.C.	5	32/275 v. Hunts 4-
16/450 v. B.E.C.	3	32/450 v. T.C.C. 6-
16/500 v. Duh.	4	120/350 v. B.E.C. 8/6
16-16/450 v. T.C.C.	5	60/350 v. T.C.C. 8/6
32/350 v. B.E.C.	4	60-100/350 v. B.E.C. 11/6
32/500 v. Duh.	5	60-8-250/275 v. B.E.C. 12/6
50-4-50, 350 v. B.E.C.	6	60/100-4-200/275 v. B.E.C. 12/6

MULLARD 2-3 QUALITY AMPLIFIER.—A

first-class Hi-Fi Companion Unit to the Jason Tuner. Hi/Duty Mains Trans. allows for H.T. and L.T. Power supply. Mullards latest circuit, 3 valve, 3 watt. Freq. response 40 c/s-25 Kc/s + or — 1db with special sectionalised Output Trans., Punched Chassis, all components, valves, etc. Only £8.18.6. Ready wired and tested, 8 gns. Carr. and ins. 4/6.

SENTERCAL RECTIFIERS. E.H.T. Type Flyback Voltage. K3/25 2 kV, 5/-; K3/40 3.2 kV, 6/9; K3/45 3.6 kV, 7/3; K3/50 4 kV, 7/9; K3/100 8 kV, 13/6. MAINS TYPES.—RM1, 125 v. 60 mA., 4/8; RM2 125 v. 100 mA., 5/6; RM3 325 v. 120 mA., 7/6; RM4 250 v. 250 mA., 16/6; RM4B type 270 mA., 17/6; RM5, 250 v. 200 mA., 21/6.

SPEAKER FRET—Expanded Bronze anodised metal 8 x 8 in., 2/3; 12 x 8 in., 3/6; 12 x 12 in., 4/6; 12 x 18 in., 6/6; 24 x 12 in., 9/6, etc.

TYGON FRET (Murphy patent) 12 x 12 in., 2/-; 12 x 18 in., 3/6; 12 x 24 in., 4/6, etc.

SPEAKERS P.M. 3 ohm 2 1/2 in. Elac, 10/8. 3 1/2 in. Goodmans, 18/6. 5 1/2 in. B. & A., 17/6. 6 in. Celestion, 18/6. 7 x 4 in. Goodmans, 18/6. 8 in. Rola, 20/8. 8 in. Special Cone 4mans, 21/6. 10 in. B. & A., 25/-.

EMITAPE Recording Tape ALL NEW & BOXED, Type 88 (Stand), Type 99 (Long Play).
3in. ... 175/-, 7/-
5in. ... 600/-, 18/-
7in. ... 850/-, 24/6
12in. ... 1,200/-, 31/6
14in. ... 1,800/-, 45/6
Spare Reels (Unboxed) 7in. metal, 1/6; 7in. plastic (EMD), 2/6.

RECORDING TAPE.—1,500 ft. on 7 in. Plastic reel, 88 type. Hi Quality Product. Each boxed, 22/6.

NEW REDUCED PRICES! 80 OHM CO-AX CABLE

Semi-airspaced, low-loss, high quality 80 ohm co-axial. Stranded conductor, standard 1/2 in. dia. Famous make. ONLY 8d. per yard. See what you save by ordering:
20 yds. ... 12/6
40 yds. ... 20/-
Carr. 1/6, Carr. 2/-

TRANSFORMER & COIL WINDING CAPACITY

FOR PROTOTYPES & SMALL RUNS

Listed above are only a few items from our very large stock. Send 3d. stamp today for Complete Bargain List.

Terms: C.W.O. or C.O.D. Kindly make cheques, P.O.s, etc., payable to T.E.B. Post/Packing up to 10 7d., 31b. 1. 31b. 1/6, 64b. 2/-, 102b. 2/9. Hours: 9 a.m.-6 p.m. 1 p.m. Wed. Open all day Saturday.

TRS

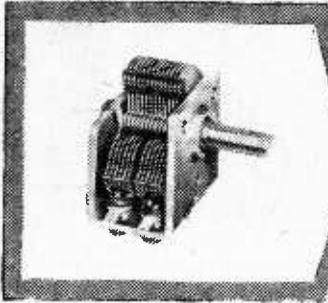
RADIO COMPONENT SPECIALISTS (Est. 1946)

70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY (THO 2188)

50 yards Thornton Heath Station.

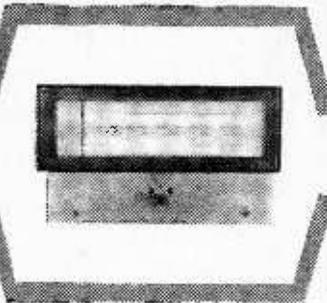
Buses: 130A, 133, 159, 166 and 193

Fully Guaranteed Components



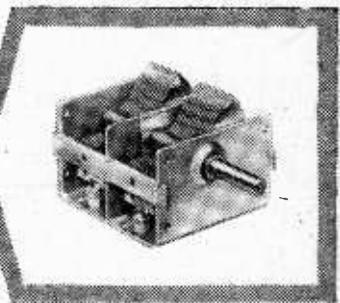
"00" TWIN CONDENSER

Designed for use in miniature transistor receivers. The front (aerial) section is 208 pf. to provide coverage, for medium waves, and the rear section is 176 pf., which may be padded to match the oscillator—very robust yet light weight. Front area 1 1/4 in. x 1 1/4 in. x 1 1/4 in. deep, price 9s. 6d.



S.L. 16 DRIVE

A general purpose slide rule Drive for F.M./V.H.F. Units, short-wave converters, etc. Printed in two colours on aluminium, with a 0-100 scale and provision is made for individual calibrations. Complete with bronze escutcheon and glass. Price 13s. 9d.



F. GANG CONDENSER

A good general purpose gang Robust but small in size. "E" law to match our S.L.8 Full Vision, Square Plane and Air Plane Drives. Size 2 1/4 in. x 1 21/32 in. x 2 9/16 in. long (3 gang 3 11/16 in.). Price for 2 Gang, 13s. 3d. 3 Gang, 17s. 6d. Complete with trimmers.

JACKSON BROS.
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PRECISION BUILT COMPONENTS
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SOLDERING EQUIPMENT

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PRECISION SOLDERING INSTRUMENTS for the ELECTRONICS INDUSTRY

- Comprehensive range
- Robust & Reliable
- Light weight
- Rapid heating
- Bit sizes 3/32in. to 3/8in.
- 'Permabit' or Copper bits
- All voltage ranges 6/7v. to 230/250 v.
- Prices from 19/6

Illustrated is the 25w. 3/16in. replaceable bit model with safety shield.

British and Foreign Patents. Registered designs. Suppliers to H.M. and Foreign Governments. Agents throughout the world.

Brochure No. S.10 sent free on request.

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CIRCUITS FOR AUDIO AMPLIFIERS

A MULLARD PUBLICATION

8/6 + 6d. POSTAGE

In all, twelve circuits are described in the book: four power amplifiers (20W, 10W, 7W and 3W circuits); three pre-amplifiers (2- and 3-valve circuits and an input mixer); two tape circuits (improved versions of the Mullard Type A and Type C circuits); and the three stereophonic circuits.

TRANSISTORS. Yell./Gr. Spot (A.F.), 10.-; Yell./Red Spot (R.F.), 15.-; Mullard OC70, 21.-; OC71, 24.-; OC72, 30.-; OC44, 40.-; OC45, 35.-; Ediswan XA104, 18.-; XA103, 15.-; XB102, 10.-; XB104, 10.-.

GARRARD TA Mk. 2 4-speed Single Record Unit with GC Pick-up	£9 15 8
GARRARD RC121/4D Mk. II 4-speed Auto-changer with GC8 Pick-up	£13 13 10
GARRARD 4 H.F. 4-speed Single Record Unit with TPA12 Transcription Arm and GC8 Pick-up	£19 7 10
GARRARD GCS10 Stereo Head for the above Units	£2 1 1

Send 9d. for 56 page illustrated list.

L. F. HANNEY

(DEPT. P)

77 LOWER BRISTOL ROAD, BATH

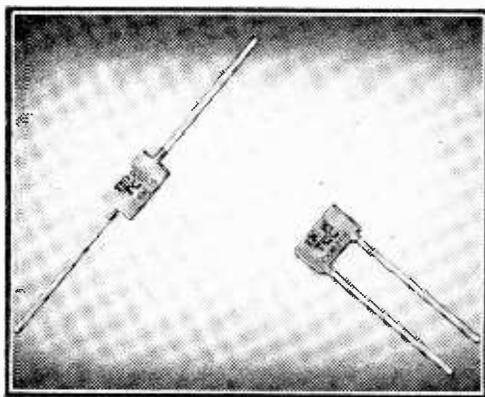
NEWS FROM THE TRADE

LATEST DEVELOPMENTS
IN RECEIVERS AND
COMPONENTS

MINIATURE PROTECTED SILVERED MICA CON- DENSERS

THE demands of recent circuitry being that the miniaturisation of components is of prime importance, The Telegraph Condenser Co., Ltd. (Radio Division), North Acton, W.3. have introduced 10 pF to 220 pF ranges of high stability, low-loss and close tolerance mica condensers. The very small size has been achieved by using carefully selected quality controlled materials and advanced manufacturing technique.

Two methods of assembly terminations are offered, axial, type CSM15, for in-line wiring and

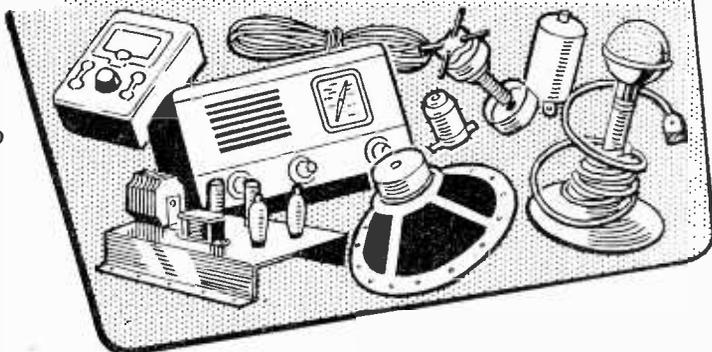


Miniature protected silvered mica condensers.

side mounting, type CSM15s, making them suitable for incorporation into printed circuit panels, transistor, hearing-aid and sub-miniature assemblies. The finish is of insulated, special non-cracking, heat-resisting, thermo-setting compound providing electrical insulation and good protection against the ingress of moisture at temperatures up to + 100 deg. C.

NEW HEATHKIT OSCILLOSCOPE KIT, MODEL O-12U

THE main features of this kit are:—5in. flat face tube, gold-plated circuit boards and preformed cable harness, "Y" bandwidth 3 c/s to 5 Mc/s, "Y" sensitivity 10 mV per cm., "X" bandwidth 1 c/s to 400 kc/s, "X" input impedance 30 megohms shunted by 31 pF, timebase range from 10 c/s to 500 kc/s and stabilised power supply.

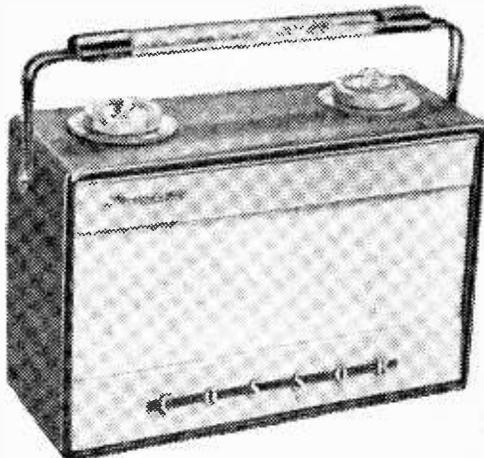


Both horizontal and vertical amplifiers are push-pull and a peak-to-peak calibrating source is incorporated. Other features include a three-step frequency compensated input attenuator for the vertical amplifier, automatic lock-in synchronising circuit using self-limiting cathode follower and provision for beam intensity modulation. The well illustrated construction manual gives full step-by-step assembly instructions together with large pictorial diagrams. Of professional appearance, it is finished in two-tone grey with knobs to match. It costs £34 15s. and is obtainable from Daystrom Ltd., Glevum Hall, Southgate Street, Gloucester.

PORTABLE RADIO RECEIVER

A NEW and improved "Transistor Six" Portable Radio Receiver Model 581 has been manufactured by Cossor Radio and Television Ltd., Cossor House, Highbury Grove, N.5. It has a built-in Ferrodyne aerial for reception on long and medium wavebands, and is fitted with a socket for connection to a car aerial.

The novel feature of station names on the handle, as on Model 569, is retained. It is sup-

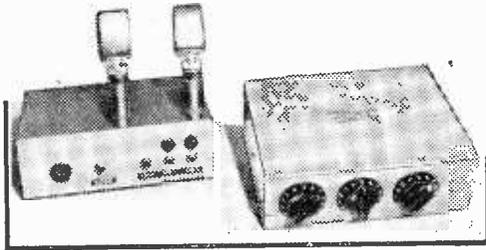


The Cossor Model 581 portable radio receiver

plied in a wooden cabinet covered with leather cloth in Noak Brown. It costs 22 guineas inclusive of purchase tax. Batteries are extra.

THE UNIMIXER

UNIMIXER I has been designed by experienced recording engineers for good quality tape recorders. This model has three independently controlled inputs for two microphones and one gramophone or similar input. A unique feature is that the microphone inputs are duplicated to permit the use of either high impedance crystal types or low impedance ribbon or moving coil types. The back plate of the unit has a cut-out for a miniature six-pin socket which can be



The Unimixer Model 1.

fitted if the user desires to take inputs and outputs all from one socket. The gramophone input is ideal for radio (tuner) or crystal gramophone pick-up or extension speaker.

It is manufactured by Sound News Productions, 10, Clifford Street, New Bond Street, London, W.1. and costs 9 guineas, plus packing and postage 5s.

NEW E.M.I. PRECISION DATA PROCESSIVE COMPONENTS

TO meet the needs of its own computing division, as well as those of others requiring electronic components and ancillary data processing equipment, E.M.I. Electronics Ltd. is manufacturing a new series of EMIDATA components.

Included amongst these is a fast start/stop digital tape deck. In this 1in. tape deck, engineers of E.M.I. have combined very high speed and fast start, stop and reverse times with first-class electrical and mechanical reliability. Bi-directional tape speeds of 200 in./sec. with start and stop times of four milliseconds are achieved by an advanced design of vacuum capstan.

Located below each main drive capstan is a tape bin which provides buffer storage between the tape spools and the capstans. These bins are electrically sensed to measure the amount of tape in them and the tape in each bin is maintained at a predetermined level by the servo controlled main tape spools and vacuum binning capstans.

The equipment has the following special features:

1. Out of contact operation with no wearing of oxide surface of tape.
2. 1in. tape 2,400ft. spools and up to 24 channels.
3. Bi-directional tape speed of 200 in./sec.
4. Easy tape threading and fully automatic operation.

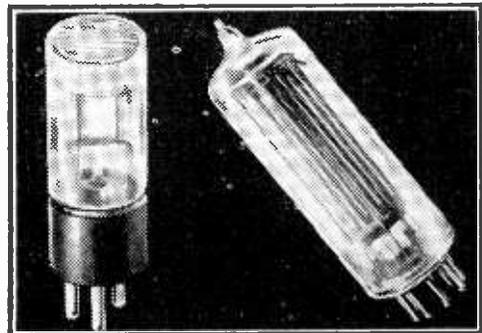
A new instrumentation tape deck specially designed to meet the requirements of the data processing engineer has also been produced. Four of its speeds within the range $\frac{1}{2}$ to 120 in./sec. can be selected instantaneously, and up to 24 channels on 1in. tape provided. Tapes made on one machine may be replayed on another of the same type with complete reliability. The equipment, which has been designed to give utmost flexibility to meet the diverse needs of modern data processing systems, provides four to six tape speeds on any deck.

MULLARD CADMIUM SULPHIDE PHOTOCCELL

THIS new cell (type ORP11) is designed for end-viewing and has a circular sensitive element 12.7 mm. in diameter. Its spectral response range extends from 0.5 to 0.8 microns, with maximum response in the yellow, red and near infra-red regions.

Like the ORP90, the first Mullard cadmium sulphide cell, the ORP11 has extremely high sensitivity and current handling capacity, and will operate relays directly, with no intermediate amplification. It is inherently robust and operates from A.C. or D.C. supplies. The chief applications of the ORP11 will be as a flame failure detector in oil-fired burners. For some types of burners, and particularly those of the latest design, the end-viewing construction will be especially advantageous, since it enables the cell to be mounted compactly and with maximum convenience behind the inspection window at the rear end of the burner.

Other potential applications of the cell include industrial counting and detection equipment, lighting control gear, smoke monitoring apparatus,



Two Mullard cadmium sulphide photo-conductive cells: left, Type ORP11; right, Type ORP90, for side-viewing.

warning systems and safety controls, and, in fact, most kinds of photo-electric equipment designed to perform on-off switching operations. It is made by Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

CHANGE OF ADDRESS

THE LAVENTA SOUND COMPANY inform us that they have now moved from Birmingham to London and their new address is 45, Kilburn High Road, London, N.W.6.

LASKY'S RADIO

SPECIAL OFFER! MINIATURE INSTRUMENT SOLDERING IRONS

Famous make, 230/250 v. 25 watts, complete with pencil bit and 3-core flexible lead. Overall length, 10 in. Tell-tale light in handle. LIST 22/6.

LASKY'S PRICE **16/6**
Post 1/3.

SPECIAL OFFER OF SOLDER
1-lb. reels of Ersine 5-core "Sav-
bit" Solder. LIST 15/-.

LASKY'S PRICE **10/-**
Post 1/6.

RADIO PARCELS

Circuit Diagram and building in-
structions for any of the following,
1/6 each, post free.

- 7-TRANSISTOR PORTABLE.
- 6-TRANS. POCKET RADIO.
- 4-VALVES/HET. PORTABLE.
- MIDGET T.R.F. 2-VALVE.
- T.R.F. 3-VALVE
- 4-VALVE SUPERHET
- TRANS. AUDIO
- AMPLIFIER.
- TRANS. S/HET. TUNER.
- 5-Valve F.M. TUNER.

SPECIAL OFFER OF MULTI-TEST METERS

FAMOUS MAKE, NEW AND UNUSED

AN/20. Pocket size 18-
range multi-test meter for
amateur or service engineer.
5,000 ohms per volt A.C.
and D.C. with accurate
linear scales for the lower
A.C. ranges. In black
leatherette-covered case, 3 3/4 x
3 3/4 x 1 1/2 in. deep. LIST 9 Gns

LASKY'S PRICE **£5.19.6**

Post 3/6. Leads 3/9 extra.



AN/27. Accurate, highly sensi-
tive 27-range Test Meter, 5,000
ohms per volt A.C. and D.C.

In black leatherette-covered
wood case. 7 1/2 x 9 1/2 x 3 1/2 in.
deep, with carrying handle
and ample room for small
tools as well as leads. An
ideal multi-range Test Meter
for all general purposes. LIST
15 Gns.

LASKY'S PRICE **£11.19.6**

Post 5/- Leads 7/6 extra.
Available on Easy Terms.

ANOTHER LASKY BARGAIN!

HIGH FIDELITY TAPE RECORDER HEADS

Leading make, new and un-
used, upper or lower track
RECORD/PLAYBACK, high
impedance, double wound,
will reproduce up to 12,000
c.p.s. at 7 1/2 i.p.s. Azimuth
adjustments. Output 5
millivolts at 1 kc. at 7 1/2
i.p.s. Low impedance ERASE
to match.

LASKY'S PRICE
49/6 PER PAIR.

Post 1/3.

Please specify upper or
lower track.

NOW IN STOCK

All the components to
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12 volt VALVE/ TRANSISTOR CAR RADIO

Including Printed Circuit.
Write for Price List and full
instructions. All com-
ponents available separately.

LASKY'S (HARROW ROAD) LTD.

Open All Day Saturday. Early Closing Thurs. Mail Orders to Harrow Rd.
42, TOTTENHAM COURT ROAD, W.1. 370, HARROW ROAD, PADDINGTON, W.9.
Telephone: MUSEUM 2605. LADBROKE 4075 and CUNNINGHAM 1978.

An important new book on the design of
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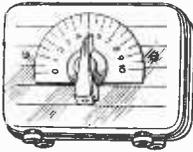
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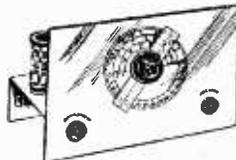
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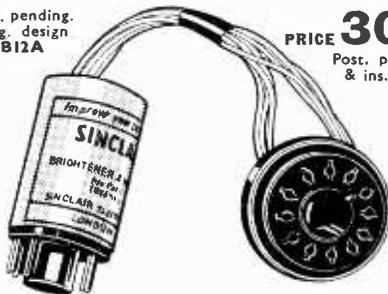


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Programme Pointers

OUR CRITIC, MAURICE REEVE, REVIEWS SOME RECENT PROGRAMMES

I AM far from being alone in thinking that speaking on the BBC is much too stilted, correct and "refeeced." One has long had the impression, now approaching a conviction, that before anyone is allowed to ask Mr. Dulles at London Airport what he expects to achieve from his talks with Mr. Selwyn Lloyd, or to tell us that a depression is approaching our western coasts, or that the orchestra will now play Beethoven's *Fifth Symphony*, he must at least hold honours degrees from Oxford, Cambridge, Paris, Harvard, Heidelberg and Elysium. Some of their accents and final consonants are indeed so "perfect" (?) and so unnaturally artificial—especially in programmes like *Radio Newsreel* and *At Home and Abroad* that many of us want to go for a bus ride and sit in a marble-topped table café in order to let in a little dialectical fresh air and to listen to some naturally and uninhibitedly spoken English. Our behaviour in church is rough and uncouth compared to the speech of the average staff man when he gets in front of a microphone (women, as always, are different).

It was bracing and refreshing to listen to Bill Harney, from "down under," talk in *Harney's War*. Mr. Harney, a well-known Australian writer and broadcaster, was an infantryman—a "digger"—in the first war. Although possessing the strongest and most penetrating of Australian accents, he spoke with a forthrightness, a sincerity and a vivid picturesqueness which were most captivating. The whole picture, forty years old, was brought back alive and complete.

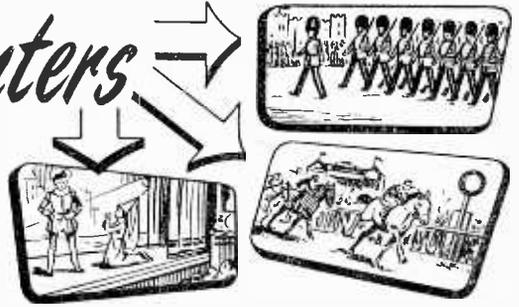
How refreshing it would be to hear more of our own dialects instead of a more or less constant stream of neo-Oxford and pseudo-Cambridge plus "Debussy," the "ss" of which spit in your face, and "Ravel," the "Ra" of which is made to sound like someone gargling at his ablutions!

Signature Tunes

The worst of an appalling collection of signature tunes is surely the one introducing "Radio Newsreel." Terrible is hardly the word. How unnecessary it is is proved by the Sunday edition of this feature when, without any "musical" recommendation, it acquires a degree of dignity unknown to it during the week.

Ibsen

We are always grateful for Ibsen, so it was good to hear *Rosmersholm* well done with Irene Worth as Rebecca West, Paul Schofield as Rosmer and Ernest Milton as Brendel. Rebecca's jumping off the bridge into the torrent, as her



daughter had done previously, was Ibsen's "modern" version of "the sins of the fathers. . . ." Russell Napier was Kroll, Dorothy Holmes-Gore played Mrs. Helseth and Peter Cloughton, Peter Mortensgaard. It was Mary Hope Allen's last production after thirty years' work with the BBC.

Comic Opera

Schwanda the Bagpiper. Weinberger's comic opera, has become such a favourite with opera goers (the "Polka" has entered into all orchestral repertoires) that it was good to hear the broadcast of it from Sadlers' Wells Theatre. Dennis Arundell's English version of the libretto sounded admirable: judging by the audience's laughter, they thought so, too. The music is charming and melodious: not too modern in astringency and dissonance. It was grandly played, under the direction of James Robertson. John Hargreaves, Victoria Elliot and Howell Glynne headed a strong cast. I thought it was wholly enjoyable.

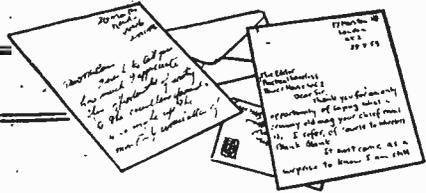
Whilst on the subject of opera, the centenary of the birth of Puccini, in the form of a performance of *Butterfly* from Covent Garden, must be recorded. Having always had the greatest liking for his music, I felt he had, on the whole, been roughly handled in the spate of writing to which the event gave rise—critics will always be critics. What a tragedy for Puccini's fame, if not his fortune, that excerpts from his operas were ever played in every restaurant and café throughout the world!

The *Butterfly* broadcast came over beautifully and again showed itself as one of the loveliest of operas. Sena Gurinac, as Cho Cho San, showed a magnificent voice, though her rendering of the part seemed a little on the weighty side compared with some other Butterflies. Josephine Veasey as Suzuki, Charles Graig as Pinkerton, Jess Walters as Sharpless, as well as the others, each contributed to a memorable evening.

"Blood on the Coral Sea"

Blood on the Coral Sea was a fairly dramatic Thursday evening piece, by Bruce Stewart, of a merchant captain, wanted for slave trafficking, unsuccessfully trying to implicate Mr. Grayson when his ship goes down with the loss of eight lives. Arthur Young, as William Pine, the captain and narrator, was salty and crafty and Godfrey Kenton, as Mr. Grayson, protested innocence and got himself out of a horrible fix.

Open to Discussion



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

Amateur Bands

SIR.—I am a keen amateur bands listener. The receiver I use is a PCR2 covering the 7 Mc/s to 28 Mc/s bands; 28 Mc/s in conjunction with a RF24 unit. I have now been a listener for more than a year (I started when I was 15) and have kept a log for the last six months. I cannot remember any time during that year when the 21 Mc/s amateur has been so active. Signals from New Zealand, South Africa, Egypt and a medley of other DX stations have been received by my set, during the last five days (beginning on January 9). The band was generally open between 5.45 and 7.15 p.m. in the evening.

Are these freak conditions due to the recent sun spots and their effects on the reflecting powers of the Heaviside and Appleton layers?—P. WESSON (Melton Mowbray). [Yes.—ED.]

Stereo Reproduction

SIR.—In reply to G. R. (S.W.3) I should like to state that engineers are not sitting tight but are doing their very best to make stereo systems easy and cheap. I suggest for G. R.'s peace of mind that he reads any good text book, where the "Phantom" principle is employed using one amplifier for two channels. I hope the above information will help to get some facts straight.—M. ALBERTS (Edinburgh).

Information Required

SIR.—Could any reader give me some information on fitting an "S" meter in a Collins T.C.S.-6 receiver?—D. LANE (60, Greenland Crescent, Southall, Middlesex).

Novice Licence

SIR.—I am 35 years old and my one immediate ambition is to have my own G. Call. Since 1956 I have been swotting up on the technical workings of amateur radio; first I became a listener and began to learn QSB, QRM, etc., and the art of QSL. I then began to look for a good RX which would be useful when I became licensed. I chose the CR100 and it is giving me fine service.

My next step was to learn the morse code, which, of course, must be understood for the exam, and this process took me about 14 months and am still on about 12 w.p.m. I taught myself

the code, five letters at a time and the only other assistance was some records loaned by an amateur friend. To learn the morse code is a fine and worth-while job, and if the P.M.G. issued any novice licence it would be for C.W. only, so I am qualified for that, but there again, hours had to be spent in practice before I became proficient. The technical side of the R.A.E. I am studying at Hull Technical College and I have to travel after work, 30 miles by train to my class, and hope to sit for the exam in May this year.

Incidentally if I fail I shall try again next year, and the next, and so on until I get the much desired G. Call. I am writing this because Mr. P. Bloor must realise that no such thing as a novice can exist on the overcrowded bands; you must know how to operate, and most of all know what you are talking about. After all, the basis of amateur radio is to learn from and pass on your knowledge to other operators who have had the time and patience to use their spare time for a fine hobby.—E. W. PHILLIPSON, I.S.W.L. G. 6667 (Goole).

SIR.—Again on opening PRACTICAL WIRELESS I am confronted with a column headed "A Novice Licence" and feel I must air my views on this subject which annoys me intensely.

What does your correspondent from Burton-on-Trent want? From all accounts an amateur transmitting licence just for the asking! No knowledge needed, just buy an ex-Government surplus transmitter and receiver and be permitted to radiate R.F. on amateur bands! What's the matter? Haven't they, the initiative to pass the R.A.E.? Obviously not or such letters would not be written. I notice they are prepared to pay more for this "licence," why not spend this money on an evening course or correspondence course? The P.M.G. doesn't ask much of you, nothing more than knowing the basic fundamentals of radio theory. How can anyone say he is a radio amateur if he doesn't know how the signal he is radiating is produced and how it reaches its ultimate destination? Having a licence will not tell you this, but a little study will. Not so long ago the P.M.G. made, in my estimation, a great mistake when he stopped the C.W. low-power, probation period. It did assist in teaching operating edification. It would seem that given a yard certain people want a mile.

(Continued on page 171)

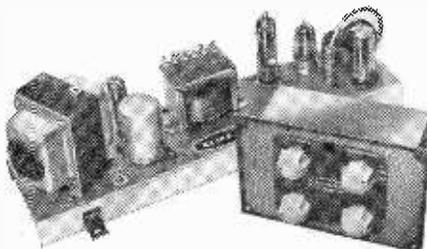
Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO 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 cover.

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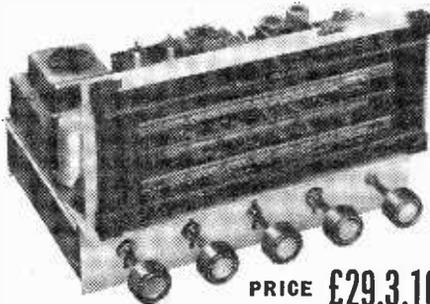


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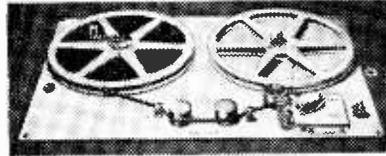
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My personal advice—dry up! Spend the time you spend complaining in study and learn to be an amateur that your fellow "hams" will respect on the air. Remember, Amateur Radio licences are issued to promote development in the field of Radio Communications and Electronics, not just for swapping QSL cards. No doubt your correspondent that was so rightly caught pirating was not using equipment he knew anything about or he would have the knowledge to take his R.A.E.—D. A. PILLEY G3HLW (Warcham).

Correspondents Wanted

SIR,—I am nearly 14 years of age and am very interested in radio. I would like to correspond with any amateurs of the same age.—D. F. HARDMAN (51, Newearth Road, Walkden, Manchester).

SIR,—I am 14 years of age and I should like to correspond with any short-wave listeners of my own age and preferably those who are intending to sit for their Radio Amateurs Examination in May this year.—R. E. MCHENRY (54, Orby Road, Belfast).

SIR,—I wish to correspond with any radio amateurs and short-wave listeners who are 15 years of age.—J. FALCONER (18, Doon Street, Motherwell, Lanarkshire, Scotland).

SIR,—I am 16 years old and a corporal in the A.T.C. I transmit most Sunday mornings using TR 1154-1155 equipment, sending C.W. under the call sign of A2K7 to other A.T.C. stations. I would like to correspond with another A.T.C. cadet who transmits or who is interested in radio.

One day while I was putting a simple type of amplifier on my own R 1155, which consisted of a 6V6G valve, I happened to switch out the loudspeaker and could still hear the programme to which the receiver was tuned to, coming through, but now coming from the amplifier valve itself. Can anyone give an explanation?—T. FULLER (Beaminstor).

Frequencies

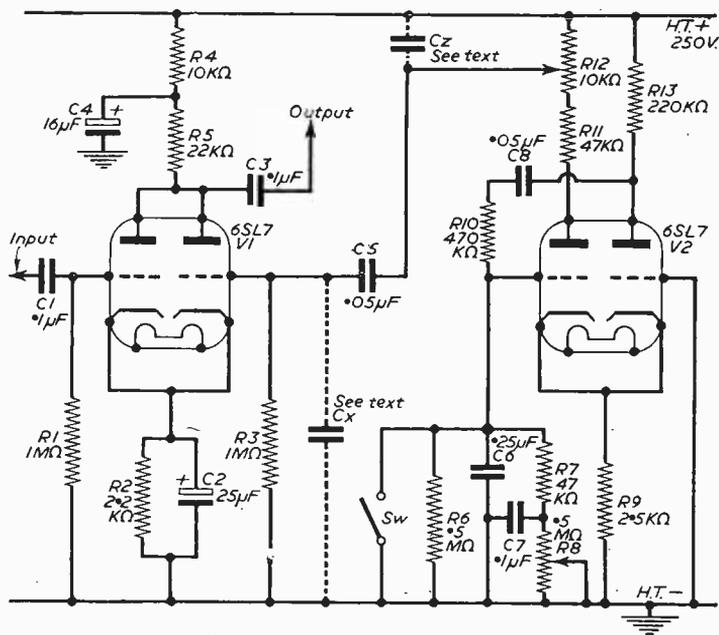
SIR,—Could you please publish details of the wavelength used by police, fire and ambulance services, taxis, etc.? I often hear messages on my radio and I should like to know the frequencies.—J. E. H. (S.E.1).

[Such information is not supplied to the general public and it is an offence to listen to or to pass on such messages. The relevant conditions governing reception are printed on the back of your Broadcast Receiving Licence.—ED.]

A Practical Tremolo Circuit

SIR,—The circuit given below is embodied by the author in his own guitar amplifier, but can be used for any amplified musical instrument. The well-known multi-vibrator is used for producing the tremolo (V2), the output of which is amplified by the second half of V1. The first half of V1 is used to amplify the incoming signal. The secret, of course, lies in the fact that a common anode load is used for both halves of V1. The fluctuating voltage across R5 also fluctuates the signal output and produces the desired tremolo effect, and is fed out to the remainder of the main amplifier. A certain amount of experiment was done to produce a smooth and effective tremolo without distortion of the signal. The circuit is self-explanatory. R8 is used as the tremolo speed control with quite a wide range and R12 is used for tremolo depth also with a wide range.

To avoid a "plop-plop" effect, Cx may be



The tremolo circuit shown above can be used for any amplified musical instrument.

added and should be between .01 μF and .1 μF. The author uses a .05 μF here. The rather complicated bank of resistors and capacitors in the grid circuit of V2 was arrived at after some experiment, and the constructor could vary these to alter the tremolo speed. C5, too, can be varied for depth.

Cz can be added if a "rustle" is heard when using R12, which is wire-wound. This is a 1 μF capacitor, but is not essential. An on/off switch is used to switch on the tremolo, but can be replaced with a closed circuit jack plug and socket if a foot-operated switch is desired. If a foot switch is used it is essential to use screened cable to avoid hum pick-up.

As the circuit was incorporated into an existing amplifier, R5 was purposely made small to avoid overloading the main amplifier, but it can safely be increased if necessary. It is desirable to have the main volume control *after* this circuit.

As the reader will have realised, this circuit is open to experiment, but is incorporated as shown with success in the author's amplifier.—B. JOHNSON (Maidstone).

Midget Receivers

SIR,—I have been reading your excellent magazine for many years now, but cannot recall ever having seen constructional details of a midget transistorised radio receiver which uses commonly available parts and a regenerative detector. It should also have a ferrite rod aerial, for what is the use of making a miniature set if it needs 50ft. of aerial wire and an earth?—F. J. (Bradford).

[We hope to publish such an article in the near future.—ED.]

Interference from TV Receivers

SIR.—I am in complete agreement with F. J. Lord (Stamford), March issue. "Open to Discussion." Six months ago, my neighbour bought a new television set which completely ruined my radio reception. Luckily my neighbour is a great friend of the family and he soon suggested moving his TV to the other side of his room. This greatly reduced the interference, but in the end I had to move my radio to get acceptable results.

Why cannot manufacturers prevent line time-base radiation and avoid all this interference? Surely the extra expense would be worth it?—F. P. (Wolverhampton).

Singing the "H's"

SIR.—On the subject of "Slanguage" (Thermion, PRACTICAL WIRELESS, March, 1959), there is another aspect of pronunciation which has come to light more and more generally in recent months both on BBC and ITV programmes. I refer to the hawful way some singers split up vo-hov-hels in rendering the words which follow a run of notes. We had an example of this very recently when the Burns cult came on the air. Robbie Burns would turn in his grave if he could hear himself being sung about as: "Ra-ha-an-ti-hing, Ro-ho-bi-hin wa-has u-ha ro-ho-vi-hin' la-had."

Composers who want their songs sung that way should have written them that way.—J. RODGER (Stirlingshire).

Ex-Service Reference Numbers

SIR.—On reading several letters *re* ex-Service components, I think it would be quite a task to compile a complete list, as I have a list of about 6,000 components, and have found several that are not in my list. It would be best to have, or make, a tester of some kind if one is using many of these components, especially condensers, as they deteriorate with age.

Numbers referred to in February issue:
10W/8676 1 meg. 2 watt carbon, linear, spindle $\frac{1}{2}$ in. \times $\frac{1}{4}$ in.
10W/8740 100 k \pm 20 per cent., linear, spindle $\frac{1}{2}$ in. \times $\frac{1}{4}$ in.

10W10719 5 k 2 watt wire wound spindle .187in. \times .781in.
10C/3317 8 mfd. electrolytic. 150 volt, tubular, wire ends.
10C/4256 .005 mfd. 1,000 volt. moulded mica.
10F/1257 switch 1 pole 5 position with short circuiting blade, spindle $\frac{1}{4}$ in. \times 13/16in.—R. C. (Newmarket).

SIR,—After reading the February issue of the PRACTICAL WIRELESS I see that I can give more information concerning Service reference numbers, as below. Perhaps some other reader can give me information on a moulded potentiometer, No. 10W/8310.

Service Number	Description
5L/1319	12 v. indicator bulb.
5L/1928	24 v. indicator bulb.
	Condensers
10C/12148	.01 μ F mica.
10C/12502	.1 μ F 600 v. paper.
10C/12507	.25 μ F 800 v. paper.
10C/12633	.25 μ F 500 v. paper.
10C/13046	.5 μ F 800 v. paper.
10C/13734	4 μ F 600 v. paper.
10C/14251	.005 μ F mica.
10C/15168	25 μ F 5% ceramic.
10C/16688	.1 μ F 350 v. paper.
10C/16689	.1 μ F 500 v. paper.
10C/16690	.05 μ F 500 v. paper.
10C/16691	.01 μ F 1,000 v. paper.
10C/16793	50 μ F 12 v. electrolytic.
	Relays
10FB/724	2,000 Ω P.O. relay, 1 change-over, 1 make.
10FB/1346	20,000 Ω P.O. relay, 2 make, 2 break.
10FB/1347	6,500 Ω P.O. relay, 2 make.
	Resistors
10W/10791	.50 k. pot.
10W/8727	20 k. pot.
10W/8742	200 Ω W.W. res.
10W/8844	1 M Ω pot.
10W/15089	100 k. pot.
10W/15103	47 k. W.W. res.
10W/15709	3.9 k. W.W. res.
10W/15791	4.7 k. W.W. res.
10W/15862	200 k. pot.
10W/15864	500 k. pot.
10W/16389	50 k. pot.
10W/17578	25 k. pot.

—R. P. HUBBARD (Margate).

An Economy Mains Transportable Correction

In the circuit diagram of this receiver which was given on page 894 of the January issue, the wire joining the "pole" of SW1 to the top of L1 should be omitted. The ferrite rod aerial used in this receiver is obtainable from Osmor Ltd., 418, Brighton Road, South Croydon, as are L2, IFT1, IFT2, T1, T2, Ch. and Sw.1.

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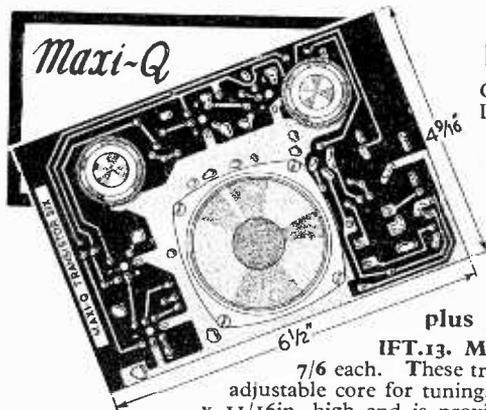
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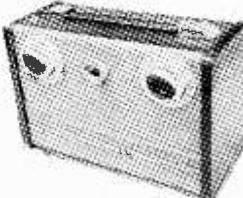
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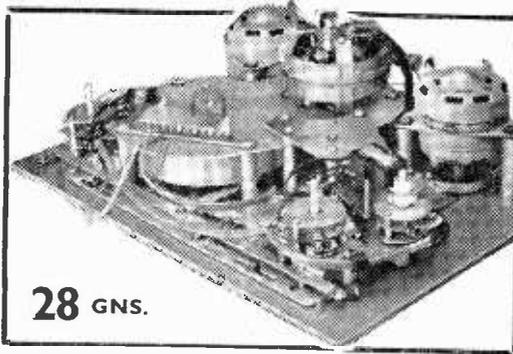
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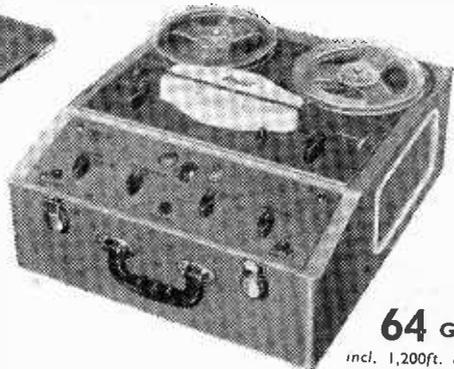


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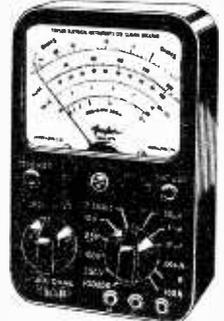
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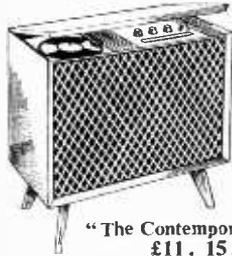
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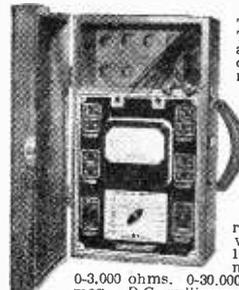
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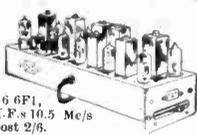
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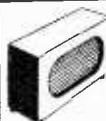
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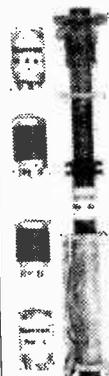
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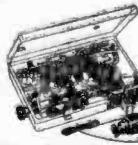
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As above, but with extra stage and Mullard OC 45, R.F. stage. 72/6, p.p. 2/3.

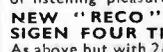


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As above but with 2 1/2" Celestion moving coil spkr. A fine portable with gleaming pale blue polystyrene case with contrasting red spkr. grille. Complete with pencil batteries, easy build practical wiring diagrams. 99/6, p.p. 2/6.



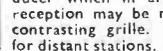
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As above, but with push-pull output stage and 2 1/2 in. moving coil speaker which fits under red contrasting grille. Gleaming pale blue polystyrene case. Size: 6 1/2 in. x 4 1/4 in. x 1 1/4 in. Complete with data. 99/6, p.p. 2/6.

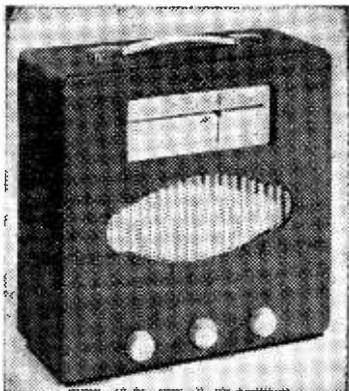


Practical wiring diagrams, parts price list, circuits, 1/3 each.

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Type C—
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Complete in screened case with 6SL7GT; 28D7; relays; jack; plug, etc. Handbook. Sealed in carton

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All items supplied special inclusive price of

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All components sold separately.
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Three-valve : 2/6 each	
Experimenter's Short-wave Three (SG, D, Pow) ...	PW30A*
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AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated	
One-valve : 2/6	
B.B.C. Special One-valver ...	AW387*
Mains Operated	
Two-valve : 2/6 each	
Consoelectric Two (D, Pen) : A.C. ...	AW403

SPECIAL NOTE

THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk denotes that constructional details are available, free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appears. Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

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, Strand, W.C.2.

*No. of
Blueprint*

SHORT-WAVE SETS

Battery Operated	
One-valve : 2/6 each	
S.W. One-valver for American ...	AW429*
Two-valve : 2/6 each	
Ultra-short Battery Two (SG, det Pen) ...	WM402*
Four-valve : 3/6 each	
A.W. Short Wave World-beater (HF, Pen, D, RC, Trans) ...	AW436*
Standard Four-valver Short-waver (SG, D, LF, P) ...	WM383*
Mains Operated	
Four-valve : 3/6	
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ...	WM391*

MISCELLANEOUS

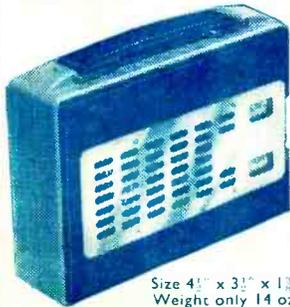
Enthusiast's Power Amplifier (10 Watts) (3/6)	WM387*
Listener's 5-watt A.C. Amplifier (3/6) ...	WM392*
De Luxe Concert A.C. Electrogram (2/6) ...	WM403*

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- ★ Attractive moulded cabinet with gold trimmings
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- ★ Fully guaranteed

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Push-Pull Portable Superhet

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- ★ 8 EDISWAN Transistors
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(A pair in push-pull will give up to 250mW audio output)	
Continental OC44 12 Mc/s osc./mixer, r.f. amp.	... 30/-
Continental OC45 6 Mc/s i.f. and r.f. amp.	... 25/-
Continental OC72 325mW in push-pull	... 20/-
Red Spot 800 kc/s audio amplifier	... 7/6
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- ★ Highly sensitive
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- ★ Drilled and mounted chassis
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- ★ Internal ferrite aerial
- ★ Weight less than 4 oz.
- ★ Complete layout diagram

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MINOR—1



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- ★ 3-stage reflex circuit
- ★ Highly sensitive
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- ★ Drilled chassis
- ★ Long-life battery
- ★ Complete constructional details
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