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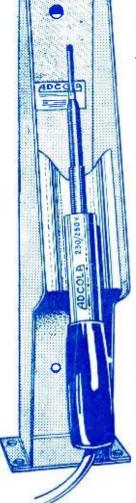
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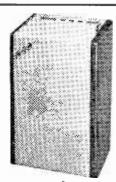
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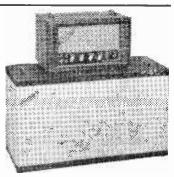
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Polished walnut veneer finish. Pleasing design. JUNIOR MODEL. Size 20 x 11 x 8in. for 8 x 5in. or 10 x 6in. speakers. £2.9.9.

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250-0-250v. 100m A. 6.3v. 3a, 6.3v. 1a 21/9
250-0-250v. 100m A. 6.3v. 2a, 6.3v. 2a 21/9
250-0-250v. 100m A. 6.3v. 3a, 6.3v. 1a 21/9
250-0-250v. 100m A. 6.3v. 2a, 6.3v. 2a,

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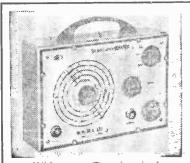
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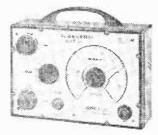
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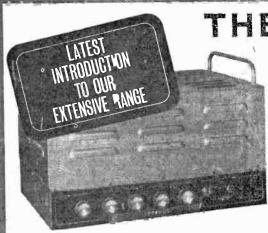
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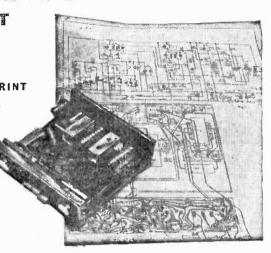
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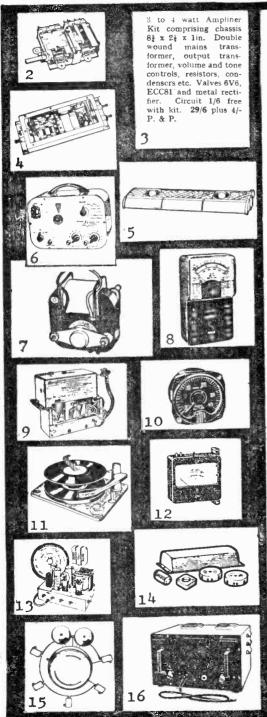
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SAB	2X2 - 8/- 6J7G	4/6 12AH8 10/9	50A5 21/10 D42	10/6 ECC189 11/6	EZ80 3/9	PCF84 8/8	UC92 6/8	W21 5/-	OC16W 85/-
SPT   6   6   6   6   6   7   6   6   7   6   6					EZ81 4/-		UCC84 8/9		OC19 95/=
\$\frac{3}{2}64 \frac{5}{3} \frac{6}{6} \frac{1}{7} \frac{6}{6} \frac{1}{8} \frac{3}{3} \frac{1}{2} \frac{1}{4} \frac{7}{6} \frac{1}{8} \frac{1}{2} \frac{1}{2} \frac{1}{4} \frac{7}{6} \frac{1}{2} \fr	3B7 5/- 6K6GT	5/6 12AU6 5/9	50CD6G40/9 DAC32	7/9 ECF82 6/8	FC2 14/6	PCF805 10/6	UCF80 8/9	W63 10/6	OC23 57/-
366 GFT   7 -   618G		1/8 12AU7 4/6		8/6 ECF86 11/6	FC4 8/9	PCL82 6/8		W76 8/6	
374   5/8   68.25   24/-   12BAS   5/9   77   5/-   D.41   10/6   ECH33   E/9   F.W.   10/6   ECH33   E/9   F.W.   10/6   ECH33   E/9	8Q5GT 7/- 6K8G	8/3 12AX7 4/6				PCL84 7/-			OC28 28/-
\$\frac{4}{5} \text{Figs. 5} \text{Figs. 6}						POL85 7/6			
584G 76 61.59 12/6 12/8 12/8 12/8 16/9 83 28/6 DF38 3/6 ECH81 5/9 62.50 7/- 504G 4/6 61.7GT 4/6 12/8 10/- 12/507 2/6 82.2 8/6 DF72 80/- ECH81 5/9 62.30 7/- 504G 7/6 61.18 10/- 12/507 2/6 82.2 8/6 DF72 80/- ECH83 5/6 62.32 17/6 F846DD UF85 6/9 X24 15/6 0-043 12/9 573GT 4/9 61.19 9/9 12/7GT 7/3 90.04 87/6 DF96 5/9 ECL80 5/- 62.32 17/6 F846DD UF85 6/9 X24 15/6 0-043 12/9 573GT 4/9 61.19 9/9 12/7GT 7/3 90.04 87/6 DF96 5/9 ECL80 5/- 62.32 17/6 F846DD UF85 6/9 X24 15/6 0-043 12/9 573GT 4/9 61.19 5/9 12/7GT 7/3 90.04 87/6 DF96 5/9 ECL80 6/9 12/3 ECL80 5/- 62.32 17/6 ECL80 5/-	4D1 3/9 6L1	10/- 12BE6 4/9				PCL86 8/9 PCL88 12/6			
5   5   4   6   6   6   7   6   6   1   6   8   2   8   6   6   1   6   8   7   8   6   8   8   6   8   8   6   8   8			80 5/3 DET26	7/6 ECH49 7/6	GU50 55/-	PEN4DD	UF42 4/9	X14 7/9	OC41 8/-
5.73   5.74   61.18   10/-   12.76   7.73   60.0   67.6   67.9   67.8			83 22/6 DF33	15/- ECH81 8/8		25/~			
523 7, 64,D15 7, 12,E767 3/6 9006 42, D797 10, 10, 10, 10, 10, 10, 10, 10, 10, 10,	5V4G 7/6 6L18		85A2 6/6 DF72	30/- ECH84 9/6	GZ33 17/6	84/-	UF86 9/-	X41 15/-	OC44 8/8
524   7/- 6LD93	5 X 3 GT 4/9 6 L19 5 Y 4 9/6 6 L13						UF89 6/-		
5024   67   68   68   68   68   68   68   68			90CG 42/- DF97	10/- ECL83 9/6	H30 5/-	12/-	UL44 23/3	X64 4/6	OC45M 8/-
6.A8G 8/9 8P1 9/8 128A7 8/9 15082 11/9 DH76 8/6 6.A8G 6/9 6P25 6/9 128C7 4/- 15052 4/6 DH77 3/c BP6 9/6 6.A8G 6/9 6P25 6/9 128C7 4/- 15052 4/6 DH77 3/c BP6 9/6 6.A8G 6/9 6P25 6/9 128C7 4/- 15052 4/6 DH77 3/c BP6 9/6 6.A8G 8/9 8P2 11/6 128H7 3/- 188F2 8/11 DH10 28/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/11 DH10 28/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/11 DH10 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/11 DH10 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/11 DH10 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/11 DH10 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 188F2 8/- 18/- 6.A07 8/- 6P28 11/6 128H7 3/- 18/- 6.A08 8/- 6P37 4/- 6.A08 8/- 6.A08 8/- 6.A08 8/- 6.A08 8/- 6.A08 8/- 6.A08 8/- 6.					HABC80 9/8	PEN46 4/-			
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6AC7 3/6 6Q7G 7/9 128K7 8/7 5/2 1586 6/8 DH0716/11 5F26 3/8 3/8 HL42D18/6 4/2 128K7 8/7 5/2 1586 6/8 DH0716/11 5F26 3/8 3/8 HL42D18/6 4/2 DH0716/11 5F26 3/8 3/8 HL42D18/6 4/2 DH0716/11 5F26 3/8 HL42D18/6 5						10/#		X78 90/6	0071 8/6
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6AJS 8/8 6B77 6/3 12897 8/- 301 90/- DK40 16/6 EP39 8/9 HNS0 25/- PL38 16/- UUT 7/8 X118 6/9 OCT7 8/6 6AKS 6/- 68A7 5/9 12UBG 7/- 303 15/- DK92 6/9 EP41 6/9 HVR2 8/8 PLS1 6/9 UUT 1/6 X119 6/6 OCT7 18/- 6AKS 6/- 68A7 5/9 12UBG 7/- 303 15/- DK96 6/3 EP41 6/9 HVR2 8/8 PLS1 6/9 UUT 4/- 8/4 5/- OCT3 8/- 6AKS 5/6 68C7 4/9 13D3 5/6 305 13/- DL33 7/- EP50 2/6 UW3 5/6 PL83 6/7 UUT 4/- 8/4 5/- OCT3 8/- 6AMS 2/6 68B7 3/- 14B6 20/9 308 13/- DL35 5/- EP50 3/9 KW4/50 6/6 PL83 6/7 UV1 10/8 Y65 6/- OC81D 4/- 6AMS 8/- 68J7 4/6 14H7 9/6 868A 12/6 DL63 5/3 EP73 5/- IW4/50 6/6 PL83 6/7 UV1 10/8 Y65 6/- OC81D 4/- 6AM6 8/- 68J7 4/6 16D2 6/- 955 2/- DL68 15/- EP50 3/9 KW23 6/6 PL85 1/9 UV1 4/- 4/6 Z66 7/3 OC82 10/- 6AR6 80/- 68L7 5/3 18 12/6 1203A 7/- DL72 15/- EP50 3/9 KF35 12/6 PL85 1/9 UV3 1/8 Z77 8/- OC33 6/- 6AT6 3/9 68N7 4/- 19 10/6 1622 1./6 DL63 5/- EP58 4/9 KF35 12/6 PL85 1/9 UV3 1/8 Z77 8/- OC33 8/- 6AT6 3/9 68N7 4/- 19 10/6 1622 1./6 DL63 5/- EP58 4/9 KF35 12/6 PL85 1/9 UV3 1/8 Z77 8/- OC33 8/- 6AT6 3/9 68N7 4/- 19 10/6 1622 1./6 DL63 5/- EP58 4/9 KF35 12/6 PL85 1/9 UV3 1/8 Z79 8/- OC34 8/- 6AT6 3/9 68N7 4/- 19 10/6 1622 1./6 DL92 4/6 EP58 6/- KL132 21/7 PX25 8/6 U16 16/- Z759 8/6- OC140 19/- 6AT6 5/8 68G7 8/9 6NK7 4/- 19 10/6 1622 1./6 DL94 5/9 EP59 4/- KKT32 4/9 PV33 8/9 U17 4/- C770 8/6 6BSG 12/6 6VG7 8/8 0000000000000000000000000000000000									OC74 8/-
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SALV   5/6   68C7   4/9   13D1   5/1   304   15/1   DK96   6/3   EF42   3/9   HVK2A   8/9   PL82   5/3   UI12   4/1   Y68   5/1   OC81   4/1   6AL5   2/8   68G7   4/9   13D3   5/6   305   13/1   DL33   7/1   EF50   2/6   W18   5/6   PL83   5/3   UV1N   10/8   4/6   OC81M   4/1   6AL6   3/1   44B6   20/9   306   13/1   DL35   5/1   EF50   2/6   W14/1   4/6   686   4/6   DL33   7/1   DL35   5/1   EF53   4/6   DL34   5/7   EF50   2/6   W14/1   4/6   Z66   7/3   OC82   10/1   6AL6   5/8   EF73   5/1   EF73   EF73   5/1   EF73					HN309 25/-			X119 6/6	0077 12/-
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6AM6 81- 68J7 4/6 14H7 9/6 866A 12/6 DL63 6/8 EF73 6/- W4/500 8/6 - PL500 15/9 UY41 4/6 Z66 7/8 O-O23 16/- 6AW6 20/- 68L7 5/3 18 12/6 1203A 7/- DL72 16/- EF83 9/9 KF25 12/6 PT15 10/- U10 9/- Z729 8/- 6AT6 30/- 68L7 5/3 18 12/6 1203A 7/- DL72 16/- EF83 9/9 KF25 12/6 PT15 10/- U10 9/- Z729 8/- 6AT6 3/9 68N7 4/- 19 10/6 1622 1./6 DL75 30/- EF83 4/6 KL52 21/7 PX25 8/6 U10 16/- Z739 8/6 OCL39 12/- 6AU6 5/8 68K7 12/6 19M6(2025) 4033 15/- DL94 5/3 EF93 4/- KL52 21/7 PX25 8/6 U10 16/- Z759 8/6 OCL39 12/- 6BSG 12/6 6U4G7 18/6 19M6(2025) 4033 15/- DL94 5/3 EF93 4/- KL52 21/7 PX25 8/6 U10 16/- Transitors 0C170 8/6 6BSG 12/6 6U4G7 8/8 2001 10/- 6763 7/6 DL810 10/6 EF92 2/6 KT52 4/9 PY33 8/9 U10 48/6 AAL29 4/6 OC200 18/- 6BSG 4/6 6U4G7 8/8 2001 10/- 5763 7/6 DL810 10/6 EF92 2/6 KT52 4/9 PY33 8/9 U10 48/6 AAL29 4/6 OC200 18/- 6BSG 4/6 6U4G7 8/8 2001 10/- 5763 7/6 DL810 10/6 EF92 2/6 KT52 4/9 PY33 8/9 U10 48/6 AAL29 4/6 OC200 18/6 6BSG 4/6 6U4G7 8/6 CUSG 5/- 20D2 21/- 6067 10/- DM70 6/- EF97 10/- KT33 4/9 PY33 8/9 U10 48/6 AAL29 4/6 OC200 18/6 6BSG 4/6 6U4G7 8/6 CUSG 5/- 20D2 21/- 6067 10/- DM70 6/- EF97 10/- KT33 4/9 PY33 8/9 U24 12/- AAL29 4/6 OC200 18/6 6BSG 5/6 5/6 5/6 5/6 5/6 20D2 12/6 000 4/6 DW4/5008/6 EF183 7/- KT44 5/- PY83 5/9 U24 18/6 AAL29 4/6 OC200 18/6 6BSG 5/6 6/6 5/6 6/6 5/6 20D2 12/6 000 4/6 DW4/5008/6 EF183 7/- KT44 5/- PY83 5/9 U24 18/6 AF102 27/6 ORP12 12/6 6BGG 4/6 6/6 6/6 6/6 6/6 6/6 6/6 6/6 6/6 6/6		4/9 13D3 5/6	305 18/- DL33	7/- EF50 2/6	1W3 5/6		UY1N 10/8	Y65 5/-	
6ARB 90/- 68L7 4/6   LiD2 9/- 956 27/   DL68 15/-   EP50 8/9   KBG32 20/5   PM34 9/3   UY86 8/-   277 8/-   OC83 6/-   6ARB 90/- 68L7 6/3 18 18/6   1203A 7/-   DL72 15/-   EP53 9/9   KBG32 20/5   PM34 9/3   UY86 8/-   2779 8/-   OC84 8/-   6ARB 90/- 6AL7 8/9   6BN7 4/-   19 10/6   1592 1./6   DL75 80/-   EP53 9/9   KBG32 20/5   PM34 9/-   U10/14 7/6 2749 8/8   6AU5 8/9 88Q7 7/-   19 10/6   1592 1./6   DL75 80/-   EP53 9/9   KBC32 20/5   PM34 9/-   U10/14 7/6 2749 8/8   6AU5 8/9 88Q7 8/-   19 10/6   1592 1./6   DL94 8/3   EP58 8/-   KL152 21/7   PX55 8/6   U16 15/-   Z759 88/-   OC140 19/-   6AU5 8/9 88Q7 8/-   19 10/6   18 10/6   DU76 8/3   EP59 4/-   KT2 5/-   EP53 16/-   U17 5/-   2759 8/8   OC140 19/-   6BU5 12/6   6U407 8/6   20/1   19/-   5763 7/6   DL810 10/6   EP52 9/6   KT32 4/9   PY33 8/9   U19 80/6   end diodec   6BAG 18/6 6U407 8/6   20/1   19/-   5763 7/6   DL810 10/6   EF52 9/-   EP53 16/-   U17 8/-   6BBG 18/6 6VG 3/9 20L1 12/6 7475 2/9   DW4/508/8   EF183 7/-   KT35 29/1   PY81 4/9   U24 12/6   AC127 9/6   6BBG 3/6 6VG 3/9 20L1 12/6 7475 2/9   DW4/508/8   EF183 7/-   KT44 5/-   PY83 5/9   U24 12/6   AF102 27/6   GR12 12/6   6BU5 3/6 6VG 3/9 20L1 12/6 902 4/6   DW4/508/8   EF183 7/-   KT44 5/-   PY83 5/9   U31 6/9   AF112 5/6   GR12 12/6   6BU7 A/6 6VG 18/6 8X5 3/9 20P3 12/-   2000 2/6   DW8/508/8   EF183 7/-   KT44 5/-   PY88 7/9   U31 6/9   AF112 5/6   GR12 12/6   6BU7 A/6 6VG 18/6 8X5 4/6 20P4 13/6   A154 2/-   DV87 8/-   EK2 25/1   KT65 3/9   PY80 6/-   30 18/6   AF115 10/6   T82 12/6   6BU7 A/6 6VG 18/6 8X5 4/6 20P5 12/3   AC042 23/3   E80F 24/-   EKS2 5/9   KT66 12/3   PY80 6/-   30 13/6   AF115 10/6   T82 12/6   6BU7 A/6 6VG 18/7 6/7 6VG 4/7 6/76   AC044 9/-   ESS8 24/-   EKS2 5/9   KT66 12/3   PY80 6/-   30 13/6   AF115 10/6   T82 12/6   6BU7 A/7 6 6VG 18/6 8X5 4/6 20P5 12/3   AC042 28/3   E80F 24/-   EKS2 5/9   KT66 12/3   PY80 6/-   30 13/6   AF115 10/6   T82 12/6   6BU7 A/7 6 6VG 18/6 8X5 4/6 20P5 12/3   AC042 28/8   ESS8 24/-   EKS2 5/9   KT66 12/3   PY80 6/-   30 13/6   AF115 10/6   T								263 4/6	
8AT6   8/9   68N7   4/1   10   10/16   1692   1/16   1692   1/16   1692   1/16   1692   1/16   1692   1/16   1692   1/16   1693   1/16   1/1	6AQ5 5/9 68K7	4/6 15D2 6/-	956 2/- DL68	15/- EFSO 8/9	KBC32 20/5	PM84 9/8	UY85 5/-	Z77 8/-	OC83 6/-
6AV6 5/8 68R7 5/- 19AQ5 7/8 2101 12/6   DL092 4/8   EF86 6/- KLL32 2L/7   FX25 8/6   U16 16/- Z759 88/- OCI 40 19/- 6AV6 5/6 68R7 12/6   19BAQ5 7/8 15/- DL04 5/8   EF89 4/- KT2 5/- FY31 6/- U17 5/- Transitors OCI 70 8/6 6BSG 12/6 68R7 2/- 19H1 6/- 4687 7/-   DL09 5/9   EF91 3/- KT2 16/- FY32 8/6   U16/20 6/6 6nd diodes OCI 71 9/- 6BSG 4/6   U16/20 8/6   EF91 3/- KT2 4/9   FY33 8/9   U19 48/6   AL129 4/6   OCI 71 9/- 6BSG 4/6   U16/20 5/- 20D2 2/-   6067 10/-   DM70 6/-   EF97 10/- KT33 4/-   FY83 8/9   U19 48/6   AL129 4/6   OCI 71 9/- 6BSG 4/9   OCI 71 9/-							U10 9/-		
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		12/6 19BG6G20/5	4033 15/- DL94		KT2 5/-			Transistors	
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BBGG 13/6   8V6G 3/9   20L1   12/6   7475   2/9   LW4/3508/8   EP183   7.4   KT41   7/6   V892   4/9   (25   8/6   AD140 25/- OCP1 17/8   6BBG 5/8   8V6GT 5/8   20P1   12/8   9002   4/6   LW4/5508/8   EP184   7/- KT41   5/-   V893   5/9   (105   7/6   AF102 27/6   ORP12 12/8   8BJ5   5/6   6K4   3/9   20P2   12/-   2006   2/6   DV86   C/9   E1199   7/- KT51   6/9   PV88   7/9   US1   6/9   AF114   11/- 8X641   10/- 6BG5   4/6   KX5   4/6   20P5   12/8   AC042 28/3   E80F 24/-   EKS2   5/9   KT56   12/8   PV80   6/3   US7   2/6   AF115   10/6   T82   12/6   6BG7A   7/6   6V7G   12/6   20P5   12/8   AC042 28/3   E80F 24/-   EKS2   5/9   KT56   12/8   PV80   6/3   US7   2/6   AF115   10/6   T82   12/6   BK7   8/3   6/4   5/-   5/6   6/6   7/6   AC044   9/-   ESS2   24/-   EL2   19/6   KT54   12/6   CP21   5/-   US7   29/-   AF117   5/6   VV0/18A   13/6   AF115   10/6   VV0/18A   13/6   AF115   AF117   5/6   VV0/18A   13/6   AF115   AF117	6BA6 4/6 8U5G	5/- 20D2 21/-	8067 10/- DM70	5/- EF97 10/-	KT33C 4/-	PY80 5/-	U22 5/9	AC107 14/6	
68B6 5/8 676GT 5/8 20P1 12/6 9002 4/6 LW4/5005/8 EP184 7/- KT44 5/- P783 5/9 1056 7/6 LAF102 27/6 ORP12 12/6 68D5 5/6 6X3 3/9 1023 12/- 9006 2/6 DY86 1/8 EH90 7/- KT81 6/9 PY88 7/9 U31 6/9 AF114 11/- 8X641 10/- 68Q5 4/6 6X3 4/6 20P3 12/6 AF134 24/- DY87 8/- EK2 25/11 KT80 3/9 PY800 6/- U33 13/6 AF115 10/5 T82 12/6 68Q7A 7/6 6YTG 12/6 20P3 12/8 AC042 23/3 E80F 24/- EK32 5/9 KT86 12/3 PY801 6/3 U33 13/6 AF115 10/5 T82 12/6 68R7 8/3 6/4 5/- 5/A6G 7/6 AC044 9/- E83F 24/- EK32 5/9 KT86 12/3 PY801 6/3 U33 13/6 AF115 10/5 T83 13/6 AF115 10/5 T82 12/6 C84 12/6 C8								AC127 9/6 AD140 25/-	
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6RQ7A 7/6 6Y7G 12/6 29P5 12/3 ACO42 23/3 E80F 24/- EK32 5/9 KT66 12/3 PY801 6/3 U35 16/6 AF116 10/- T83 15/- 6BR7 8/3 6Z4 5/- 25A6G 7/6 ACO44 9/- E83F 24/- EL2 19/6 KT74 12/6 QP21 5/- U37 29/- AF117 5/6 V10/15A19/-	6BJ6 5/6 6X4		9006 2/6 DY86	C/9 EH90 7/-	KT61 6/9		U31 6/9		
6BR7 8/3 6Z4 5/- 25A6G 7/8 ACO44 9/- E8SF 24/- EL2 19/8 KT74 12/6 QP21 5/- U37 29/- AF117 5/6 V10/15A19/-							U35 16/6	AF116 10/-	TS3 15/-
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7in Standard play, 1,900ft., Mylai base 12	1
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Sin Message lane 225ft. 4	Ľ
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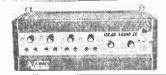
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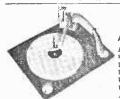
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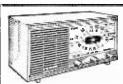
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2½tn., 12/6; 5in., 12/6; 6½tn., 15/-; 8in., 21/-;
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10in. x 6in.
Latest type E.M.1. 13 x 8in. with high flux
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T.V. or AMPLIFIER. EDGE CONTROL PANELS TWO 5008 LIM. pots: one 500k Log; one D/P mains switch, Brand New 3/8 per panel. P. a. P. 1/-. 3-PUSH BUITON SWITCH UNIT. 4 single pole changeover on each push-button. Approx. 3 r. 1 x 1/1 n. An absolute Bargain at 4/6 each. P. a. P. 1/- cach.
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EL84, EZ80 valves, heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 41 watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and

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COLLARO STUDIO DECK. 3 motors, 3 speeds, push button control. Up to 7in. spools. \$10,10.0. P. & P. 5/6.

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Incorporating 2 ECL82s and 1 E Z80 heavy duty double-wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



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Printed circuit panel (size 8] x 2\fm.\text{1.0}. \text{0.3} prealigned i.F. transformers. \text{0.1} High-grain Ferrite rod
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Switable for use with above. 2in. G.odmans. Ideal replacement for most pocket portables, 8/6, 3½in., 12/6; 5in., 17/6; 7 x 4in., 21/-.

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OC71 5/-; OC76 8/-; AFI17 7/6; Set of Mullard 6 transistors, OC44, 2—OC45, OC81D matched pair, OC81, 25/-EDISWAN MAZDA

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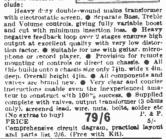


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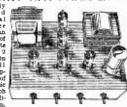
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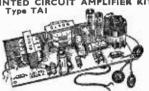
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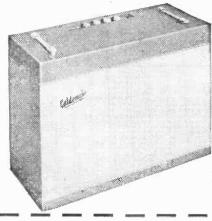
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Ideal for bass, lead or rhythm guitar, and all other musical instruments.

- The two 12 inch 25 watt heavy duty loudspeakers are specially designed for this type of amplifier, and give outstanding reproduction
- Robust attractive two-tone finished cabinet of compact size, 28"x 20"x 104" fitted with carrying handles.
- For standard AC mains 50 c/s operation.
- Four inputs provided can be used simultaneously with instrument pickups or mikes
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Full 12 months guarantee

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Carriage and insurance 25/- to be sent with deposit.

A high quality 30 watt amplifier developed for use in large halls and clubs etc. Ideal for bass' lead or rhythm guitars, schools, dance halls, theatres and public address. Suitable for any type of mike or pickup.

Valve line-up; two EF86; one ECC83; one GZ34; two EL34.

Four separate inputs are provided with two volume controls. Bass and Treble controls are incorporated. Amplifier operates on standard 50 c/s mains. 3 ohm and 15 ohm speakers may Bass and Treble controls are

Perforated cover with carrying handles can be provided if required, price



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IDEAL FOR HOME USE record decks and micro-

proceed decks also make phones. Cabinet size approx. 18 x 18 x 7m. The cabinet size approx. 18 x 18 x 7m. The cabinet is well made and attractively finished. Volume base and treble controls incorporated. Price 9rms, post paid. Send S.A.E. for leadet. ~~~<del></del>

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A wonderful educational kit for all children. Provides hours of amusement while following the

ment while following the easy step by step instructions. It is powered entirely by wireless waves, elimin-ating the expense of batteries. No soldering required. Receives all main stations. Price 25/-

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# THE GOLDENAIR GRAMETTE

A compact 3-4 watt gram, amplifier that can be used with all types of record players. Fitted with volume and tone controls. Incorporating mains isolating transformer, thus making the unit completely safe. A triode periode valve and modern silicon rectuler are utilised. and modern silicon rectifier are utilised. Price 3gns. P. & P. 5/-. Ready built and tested \$3.19.6. P. & P. 5/-.

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TYPE 1. Model C6.25 A beave duty loudspeaker by famous manufacturer. Diameter 12in. Frequency response 60-5,000 c.p.s. Power handling 25 watts. Impedance 15 ohms. Ideally suitable for Bass instruments used with high power amplifiers. Price \$9.19.6. F. & P. 5/\*. Send S.A.E. for leadlet. TYPE 2. A 12in. Heavy Duty Loudspeaker unit. 15 watts power handling. Frequency response 30-14,000 c.p.s. Pure aluminium cast frame. British made by famous manufacturer. Price 5gns. P. & P. 5/\*. Send S.A.E. for leadlet.

#### THE GOLDENAIR THREE

A uniquely designed 2 valve 3 watt gram. amplifier, fully enclosed

ampuner, they encoused in a compact well venti-lated metal case, size  $7 \times 5 \frac{1}{3} \times 23$  in. Three controls provided, Volume. Treble and Bass. A completely safe unit incorporating mains isolating transformer. Price 4gns. P. & P. 5/-

# SONA STREAMLINE MICROPHONE



Omni-directional response 60-10,000 c/s. Output level 52 dB. Built in on/off switch. Provision for conversion to hand-held, cord suspended or stand mike. Attractive satin chrome thish.

Microphone 37/6 P. & P. 2/6. Desk Stand 10/- P. & P. 2/6.
Floor Stands Available



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Compactly built to be carried by one man. This has a range or approx 10 mile-, and being rystal controlled, tuning avoided is avoided, and operation is as accurate as a telestations comprising re-ceiver transmitter, rod aeriai. One set of head-phones and mike, in carvas carrying bag, crysta-coll unit available for authorised use only. Price 35/- per set. Post Free, Brand new in Price 35/- per set. Post Free, Brand new in maker's sealed cartons. Price per station

£4.10.0 P. & P.

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# HANDY POWER PACK

Housed in compact metal case, 200/250 v. A.C. mains. Output 250 v. 50 mA fully smoothed, 6.3 at 2 amps. Can be used for powering ations any pre-amp, or radio timer. Price 39/6, P. x P. 26. 

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

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# TŘÁŇŠ. ŘÁDIO TŮBULÁŘ SPEAKER



Booster Speaker Plugs into ear piece socket o most radios recorders hi-fi stereo effect
25/- P. & P. and

will amaze you, ox 9 x 25m. Ph PRICE \$ **\$** 

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All valves 2/6 each. P. & P. 9d. 2 for 4/6 P. & P. 6d. 6K7G, EF50, 6H6, DF92, 6K8G \*\*\*\*

H.R.O. INSTRUCTION HANDBOOK 3/6 each P. & P. No. 19 SET INSTRUCTION HANDBOOK 3/6 each P. & P. 6d 1155 INSTRUCTION HANDBOOK

3/6 each P. & P. 6d FREQUENCY METER HANDBOOK

BCC 221 3/6 each P. & P. 6d. ~^^^**~** 



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Precision vernier dials with approx. 8 to 1 ratio. Surface mountwith a ratio. Surface ing. Accurately cent. metal insert for fut. Reads counter to 0-100 in T.503 16/-

\*\*\*

# TYPE 19 SHORT WAVE RECEIVING



Works straight off the An excellent requires uires only phones immediate operalor im Price £5,19,6.

F. & P. 206.
Suitable phones 151- per pair. P. & P. 2/6.
During an evening's festing on this excellent receiver, we obtained clear reception from scores or stations many of them thousands of infect infection including slap stations. Government transmission maritime broadcasts and also the short wave rather favorable our products. **\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*** 

# IMPEDANCE MATCHING UNIT

An impedance matching device enabling both high and low resistance phones to be used from any given piece of equipment. Incorporates a matching transformer. Enclosed in a metal case with pavolin terminal board. Four standard jack seeksts enabling four pairs of phones to be used simultaneously—two IIR and two LR. Price 19/11, P. 3 P. 2/6.

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for checking the radiation from a ig antenna. The sensitivity can be transputting antenna. controlled by adjustment of the panel control, the antenna length, or by increasing distance from the radiator. Frequency range 1-250 Me/s, 200mA tradiator. Frequency range 1-250 Me/s. 200m. b.C. Complete with instruction book. Post free. 67/8

#### LIGHTWEIGHT GRAMOPHONE PICK-UP ARM

with Acos hi-fl turnover cartridge. 

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TYPE 1. Filament Transformer. 200/250 primary 50 c/s. Secondary 6.3 voits at 2 amps. Price 5/11.

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P. & P. 316.

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TYPE 6. A really excellent well-made robust transformer. Fully shrouded and upright.

Transformer. Fully shrouded and upright. Primary 200/250 50 c/s. Secondary 450, 0, 450 v. 250 n.s. 6.3 v. at 4 amps. 5 v. at 3 amps. Price 65/-. P. & P. 5/-. 

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Six-transistor radios at 59/6 each, Fully gnarante-d. Will receive Home, Light, Luxent-bourg etc. Hi-Fi boned speaker, Few only. P. & F. 19/6, Battery 2/6 extra. Earplece 3/6 extra. Hurry while they last. 

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Ediswan X 19202 Germanium diodes
(P. & P. 3d) Transistor holder 3-pin (P. & P. 3d.) \_. 11d each

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For the 83 set. In good condition employing modern valves and built-in vibrator pack. Excellent smoothing facilities, 12v. p. cration. Many applications, including 39/6 P. & P. use with car radios.

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Morse key assembly. Key with base, cover and terminals. Comand terminals. Complete with lead. 6/11. for 12/6 post-free.



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Lightweight, Suitable for all applications, 11/- per pair, P. & P. 1/6, 2 pairs for 22/6, **>>>>>>>>>>>>** 

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35 to 40 Mc/s. Power supplies 12 volts and 250 volts D.C., in excelent condition with exceptionally fine slow-motion tuning and clean component layout. Price £2.19.6, P. & P. 6/-.

# SONA STREAMLINE BM3 MICROPHONE CRYSTAL INSERTS

Price 7/6, P. & P. 9d.

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◆Charge Rate Adjuster. ◆Government manufacture. ◆Easily fitted to charging circuit, 3/8 each; 2 for 6/8, P. & P. 2/6,

#### BM3 SONA STREAMLENE MICROPHONE STANDS

Heavy metal base. Black gloss finish, 7/8, P. & P. 2/6.

Chrome finish. Telescopic desk stand extending to 12in, height, heavy black gloss base, 25/-, P. & P. 3/6.

and, 3 sections. Chrome finish. Heavy

Floor stand, 3 sections, Unrome mass, base, 55/-, P. & P. 7/6.

# TX/RX No. 19 POWER UNITS 12 v. D.C. input. Output 275 voits at 110 m.a. and 500 voits at 50 m.a. The equipment is of American or Canadian manufacture. Price 21.

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Double throat mikes. Can be adapted for use with musical instruments. 5/11. P. & P. 9d. \*\*\*\*

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Save pounds this winter. PP3 type replacement, 6 for 10/-, P. & P. 1/9, 12 for 18/6, P. & P. 2/6. Limited stocks.

NEW WALK-ROUND STORE OPEN IN LAMBERT'S ARCADE, LOWER BIRGGATE, LEEDN I. NENT TO HALFORD'S CYCLE SHOP, OPEN ALL DAY SATURDAY, 18-HOUR DESPATCH SERVICE. ALL WAIL ORDERS TO OUR BRIGGATE HOUSE ADDRESS, Postage rates apply to U.K. only

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SONA ELECTRONIC CO. (Dept. PW12) BRIGGATE HSE, 13 ALBION PL, LEEDS

# THE TRIPLETONE HI-FI MAJOR

PRICE ONLY £15.18.9 COMPLETE



A 12 watt quality amplifier incorporating negative feedback, with a pre-amp for mic. and provision for mic.lgram fixing. Frequency response ± 1 dB 15-20,000 c/s. Distortion only 0.15%, with noise and hum -80 dB. Separate Bass, Middle and Treble lift controls. Valve line-up, 12AX7, 12AX7, 12AX7, 12AX and EZS, and EZS, Push-pull output with matching to 3 or 15Ω. Fully isolated Power supply from 200/250v. A.C. input, with take-off for tuner etc. Size 12 x 5‡ x 6in. high.

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I.F. TRANSFORMERS 7/6 pair 465 K/s Sing Tuning Miniature Can, 3 x 1 in, dia. High Q and good bandwidth. Data Sheets.

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W., 4d. 11 wg., 42 mg. 17 mg. 17 mg. 17 mg.
BEIMISTORS CZ1, 8/8; CZ2, 2/8; CZ3, 1/6.
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5 watt 10 watt 15 watt WIRE-WOUND RESISTORS { 2/-2/-10 ohms-10,000 ohms

12.5K to 25K 10 w Toggle Switches, s.p., 2/-; d.p., 3/6, d.p.d.t., 4/-, Min. Slide d.p.d.t., 3/6.

Volume Controls 80 CABLE COAX Linear or Log Tracks Semi-air spaced in.
Long spindles. Midget 40 yds. 17/6 6d. yd.

5 K ohms to 2 Meg. 60 yds. 25/- 6d. yd. D.P., 4/6,

L.S., 3/-, D.P., 4/8, Stereo L/S10/8; D.P.14/8 | Im. log + 1m.A/log, 7/8 | Low loss 5dB | Low lo

MAINS TRANSFORMER 200/250 v.	A.C.
Postage 21 cach transformer	
STANDARD 250-0-250, 80mA, 6.3 v. 3.	5 a.
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2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350	29/6
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	7/6
Ditto, tapped 1.4, 2, 3, 4, 5, 6.3 v	8/6
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GENERAL PURPOSE LOW VOLTAGE, 2	amp.
3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v.	22/6
AUTO TRANSFORMERS, 150 w	22/6
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MAINS POWER PACKS. Ready built	with
Transformers, Rectifiers, Condensers, prov	iding
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L.F. CHOKES, 15/10H, 60/65 m.A. 5/-; 1011, 85 m.A.
10/6; 1011, 150 m.A. 14/-.

C.R.T. BOOSTER TRANSFORMERS for heater cathode short circuit or tubes with failing emission. Full instructions supplied, mains input. Type A optional 25% and 50% boost 2v, or 4v, or 6.3v, or 10.8v, or 12.6v. State Voltake required. PRICE 10/8.

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TRANSISTOR PUSH-PULL  $_{3 \times 11 \times 1in.}^{Size}$  AUDIO AMPLIFIER

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A ready built mimature push-pull ampliller with
Driver and output transformers, 4 transistors,
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Price 47/6 instructions and circuit,
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FIVE VALVES THREE WAVEBANDS

THREE WAVERANDS FIVE VALVES S.W. 16m. -50m. LATEST MULLARD, etc. M.W. 200m. -5050 m. ECHBI, EFSS. ERUSI, L.W. 800m -2.000m. 12-mouth Gnarantee A.C. 2001/250 v. short-Medium Long/Oran. Ferrite Aerial A.C.V. 3 ohm output 5 watta. Tape Sockets. Glass dait, horizontal wording size 13 x 7in. Aligned and catibrated, isolated Chassis size 13 jin. x 7in. high x 5 jin. deep. \$29.15.6\$ Carr. & Ins. 4/6.

Post 1/- (unless otherwise stated) C.O.D. 2/- extra. Full list 1/-.

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CONNOISSEUR'S CHOICE

BAKERS Sin. JUNIOR SPECIAL 8w. 17.000 lines, 5 gns. Foam Suspension 40-20,000 c.p.s.



BAKERS 12in. GUITAK HEAVY DUTY 25w. 5 gns. 15 ohm voice coils. Unlimited Applications. Response 20 to 10,000 cps. Magnet 12,000 lines. Genuine. Musical Instrument Loudspeaker.

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# FERGUSON QUALITY AMPLIFIER 4 watts.

64 v 5 v 4in Muttard Valves, Mains Transf., 200/ 250V. Volume and tone controls. Sensitivity 200 m.v. Response 25 to 20,000 cps. Price 49/6 ea. or 2 units matched for Stereo. 89/6.

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Sp. 4-way 2 wafer long spindle
2 p. 2-way or 2 p. 0-way long spindle
3/6
4 p. 2-way or 4 p. 3-way long spindle
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Wavechange "MAKITS" Wafers available: 1 p. 12 way, 2 p. 6 way, 3 p. 4 way
4 p. 3 way, 6 p. 2 way; 1 water switch, 3/6;
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B7G, B9A, int. octal., 2/3. WAVECHANGE SWITCHES

HIGH GAIN TV PRE-AMPLIFIERS B.B.C. Channel 1 to 5. Gain 18dB. ECC84 valve. Kit price 29/8 or 49/6 with power pack. Details 6d. (PCC84 valve if preferred). Coils only 9/6. BAND III i.T.A.—Same prices. Tunable channels 7 to 13. Gain 17dB. Tunable channels 7 to 13. Gain 17dB. Circuit and coils only, 9/6. Chassis 4/9.

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## PLASTIC RECORDING TAPE

Double Pla	7in. reel, 5in. reel,	2,400ft. 4 1,200ft. 2	25/- Pla	are istic
Long Play	7in. reel, 5∦in. reel, 5in. reel,		22/6   04	2/-
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"EASI Leader	tape 4/6	' Tape   Splici:	Splicer ng tape	

CRYSTAL SET BOOKLET 1/-. CRYSTAL DIODE G.E.C. 2/-. GEX34, 3/-. OAS1, 3/-. HIGH RES. PHONES, 4,000 ohms. 15/-. 2,000 ohms. 12/6. MOVING COLL PHONES, 100 ohms, 10/-. SWITCH CLEANER. Fluid squirt spout. 4/6 tin.

TRANSISTOR RADIO TRANSISTOR RADIO First class components to make a 6 transistor 2 waveband superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, with car aerial coil, printed circuit, 84in. x 24in., but EXCLUDING Speaker and cabinet. Speakers, 35 ohms, 6x 4in., 21/- \$4.5.0 5in., 17/6; 3\frac{1}{2}in., 15/6.

5In., 17/8; 3/in., 15/8.

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/8; P194, 6-pin, 6/8 JACKS. English open circuits, 2/6. Closed circuit, 4/3, Grundig type, 3-pin, 1/3, Grundig lead jack, 3/8, Jacobs and Social Properties of the state of the state

465 kc/s. SIGNAL GENERATORS Price 10/6, ready made with valve 185. POCKET SIZE 2ix4ixiin. One resistor to change, full instructions supplied. Battery 8/6 extra. Details Free.

Coils Wearite "P" Type, 4/- each.
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T.R.F. Coils, A/HF. 7/- pair: HAX. 3/6.
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Blank Aluminium Chassis. 18 s.w.s. 4 sides, riveted corners, lattice fixing holes, 24n. sides. 7 x 4in., 4/9; 9 x 7in. 5/9; 11 x 7in., 6/9; 13 x 9in., 8/6; 14 x 11in., 10/6; 15 x 14in., 12/6. Aluminium Panels, 18 s.w.g., 12 x 12in., 4/6; 14 x 9in., 4/+; 12 x 8in., 3/+; 10 x 7in., 2/3; 8 x 6in., 2/+; 6 x 4in., 1/6.

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For Collaro 2 Track Decks 8 gns.

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COMPLETE RECORDING A PLAYBACK AMPLIFIERS
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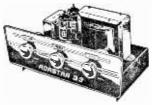
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# Pirate Saboteurs

RE-WAR amateurs were obliged to call "Test" on each transmission; today they call "CQ" like amateurs in other countries. This neatly illustrates a changing of attitude. Before the war, the amateur was encouraged as an experimenter and a potential radio operator in times of National emergency; today he is operating on sufferance. He is grudgingly tolerated, but is liable to be pushed around, his scope restricted.

Our national radio society, the RSGB, has fought long and tough battles to resist encroachments into amateur territory. It has struggled to retain frequencies, to get more. With other national societies it has done what it can to resist strong pressures for chunks of amateur bands from broadcasting, commercial and military services. The RSGB has done yeoman service in keeping so much for the amateur, but even so we have lost valuable (and irreplaceable) air space since the war.

It is manifestly obvious that in the incessant fight to retain the privileges of the radio amateur (for they are privileges and not rights, as many fail to grasp) it is incumbent on each individual amateur operator to conduct himself on the air in a manner, if not exemplary, at least not provocative.

It hardly needs stating that the continual efforts of national societies and responsible operators can be placed in jeopardy by the irresponsible behaviour of a few. Pirates notably sabotage and mar not only the good name of amateur radio but proffer, on a plate, strong arguments to those who wish to reduce even further the still reasonable freedom of licensed amateurs.

Dealers can help clean up the current situation by refusing to sell transmitting equipment to all-comers. The fact that a licence is necessary (or that certain equipment is not operable on licensed frequencies) is never pointed out to customers. And it must be patently obvious to store assistants that they frequently sell such equipment to unsuspecting youngsters who thereafter run the risk of fines and confiscation, not to mention possible disruption of existing radio services.

Ideally, of course, it should be illegal for anyone to purchase transmitting equipment except on the production of a transmitting licence—as it should be for any shop to sell such equipment to non-licensed customers.

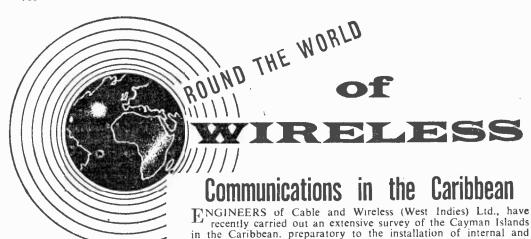
From the would-be operator's point of view the remedy is simple. The Radio Amateur Examination requires only a basic knowledge unlikely to strain the abilities of the genuine enthusiast. It covers only subjects which any active amateur must know to operate his station.

The cold fact is that anyone incapable of passing the RAE cannot really expect the privilege of putting a transmitter on the air. It has never stopped the real enthusiast.

A good deal of literature, including sample papers from previous examinations, is readily available. Our own new series on the RAE, too, we hope, will be of help to those aspiring to a

Taking it all round, it seems that there is no real justification, or excuse, for amateur radio piracy.

Our next issue dated January will be published on December 4th



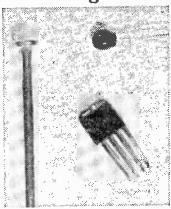
NEWS AT HOME AND ABROAD

# Miniaturisation in Hearing Aids

FOR many years Mullard developments have contributed to the gradual improvement and miniaturisation of hearing aid devices, and at the recent London convention of the Society of Hearing Aid Audiologists, the company demonstrated circuits which may soon be introduced to continue the trend toward smaller aids.

With devices such as those shown at the Convention, hearing aid manufacturers are advancing from the "behind-the-ear" instruments, once considered tiny, to "in-the-ear" types. The kind of device which is making the transition possible is the integrated circuit module on show by Mullard, measuring only 2mm x 2.5mm x 1mm. This plastic encapsulation contains what is effectively. a three-stage d.c. coupled amplifier made from a single slice of silicon.

Other components exhibited,



here a Mullard integrated d.c. coupled amplifier (lower right) and an epitaxial transistor are compared to a pin.

were silicon planar expitaxial transistors measuring only 1-5mm round by 1-8mm long, and pinhead resistors only 1-7mm in diameter.

available. However, a fully automatic telephone exchange is planned for Georgetown, the principal town, which will initially provide for 400 lines. A new wireless station is also planned which will link Grand Cayman with Jamaica by an h.f. circuit.

external communications equipment in these Islands. Precise details of the equipment and circuits to be operated has not yet become

The Georgetown telephone exchange will also serve West Bay, Boddentown, North Side and East End.

The Cayman-Jamaica link will provide the islands' external communications by carrying composite teleprinter and radio telephone circuits. The latter facility will be made capable of being linked over the Jamaica-Florida cable into the international telephone system.

The two islands Grand Cayman and Cayman Brac will be connected by another radio telephone link, which will give the latter access to the international services as well.

These plans were announced after the Islands had accepted Cable and Wireless' offer to install, maintain and operate all their internal and external communications.

# Photo-electric Equipment will Detect Fog

MODULATED photo-electric equipment supplied by Lancashire Dynamo Electronic Products Limited (part of the M.I. Group), is to be installed at the Haulbowline Lighthouse in the Irish Republic, to detect fog and mist.

The equipment in the lighthouse,

which is situated at the entrance to Carlingford Lough, will span the 1.300 yards to the north bank of the estuary with a light beam. Once this beam is broken by poor visibility, i.e. fog, mist, snow, rain, an integral relay system automatically brings into operation a large Swedish-made fog

horn which ceases operation when visibility clears.

The equipment consists of a light projector unit and a light receiver unit, each fitted with a 6in. lens, precision optical viewing sights, and a sensitivity control on the receiver unit for adjustment of the operating level.

# BBC RESEARCH SCHOLARSHIPS

THE Engineering Division of the BBC provides a number of research scholarships at United Kingdom Universities, intended to provide selected honours graduates with the opportunity to work for a higher degree, the subject chosen for post-graduate study being within those fields of physics or engineering that have an application to sound or television broadcasting. Scholarships this year have been awarded to G. Brown of Durham University, R. W. Smith of

Trinity College, Cambridge, and B. J. Vieri of Birmingham

University.

Mr. Brown's research will be on the microwave spectroscopy of maser materials, while Mr. Smith will be concerned with photo-electronic image delay and storage tubes.

Mr. Vieri will, under his scholarship, continue and complete the research he has been conducting for the past three years on the automatic bandwidth reduction of television and facsimile channels by statistical encoding.

# RADAR SIMULATOR FOR EIRE

EQUIPMENT that can simulate a surveillance radar has been ordered for the training of air traffic control personnel at the Shannon International Airport, County Clare, Eire. The transistorised radar simulator will be supplied by a division of Solartron Electronic Group Ltd.

# New Cable Factory in Scotland

THE demand for high voltage oil filled cables has increased so rapidly, that Scottish Cables Limited are to build a new factory at Renfrew for their manufacture.

This was announced recently by Sir William McFadzear, Chairman of the BICC Group, whose research organisation has been at the disposal of Scottish Cables during the planning of a £3 million expansion programme, of which the new factory is part.

The factory, with a floor area of approximately 160,000 sq. ft., will be equipped with a highly specialised plant for the manufacture and testing of single core and 3-core oil filled cables for voltages up to 130,000.

# NEW RECEIVERS ARE AUTOMATICALLY TUNED

A RADIO receiving system in which the receiver performs all tuning operations entirely automatically, has recently been introduced by the Marconi Company Limited.

The system has been designed to cut both capital and running costs for high-grade h.f. communications by taking advantage of new techniques and methods of construction. These include transistorisation throughout and the use of printed circuit techniques and modular construction.

The result has been more reliable, more stable and smaller equipment (the overall size has been reduced to a third of that of previous designs) automatic operation as far as possible, and very rapid frequency changing. The valve and the telegraph relay have been eliminated completely.

A Marconi Self-Tuning (MST) h.f. communications system enables one man, at a central point, to control every receiver. Simply by setting decade dials on a frequency sythesizer unit to the required frequency, and pressing a button, he initiates the self tuning action of the equipment and within 24 seconds all stages of the receiver are accurately tuned to the new frequency.

The MST communications system includes three separate

receivers; a dual-diversity telegraph receiver, suitable for diversity reception of f.s.k. or four frequency diplex signals; a dual-diversity i.s.b./s.s.b. receiver, and a single path i.s.b./s.s.b. receiver.

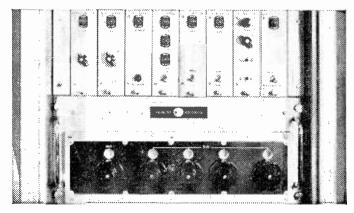
The associated units making up the complete system include the frequency synthesizer, a display and control unit, and a master frequency source.

The fully transistorised synthesizer provides the high-stability first oscillator input to any of the MST receivers and a 100kc/s signal used for carrier reinsertion and for generating the second

oscillator signal where a.f.c. is not used. Its coverage is from 3.0000 to 30.9999Mc/s, in steps of 100c/s, permitting any one of 250.000 frequencies to be selected.

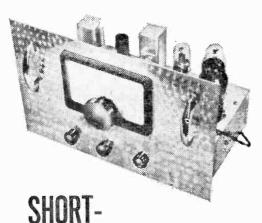
This synthesizer requires a 1Mc/s master frequency signal of a high accuracy and stability and this can be provided by the master frequency source.

In creating this new communications system, Marconi's have achieved reductions in size and cost of equipment; staff and cost of both operation and maintenance.



The control panel of a Marconi Self-Tuning receiver.

# A NEW RECEIVER FOR THE S.W.L.



WAVE
SUPERHET and
simple Alignment Oscillator

by H. Webster

MANY constructors make their introduction to short wave radio either by way of the familiar detector and l.f. receiver or alternatively via the t.r.f. receiver in which a stage of radio frequency amplification is interposed between the aerial and the detector stage.

These combinations have long been a favourite with the amateur, and although receivers of this type can be quite sensitive, particularly on the lower frequencies, they suffer from several serious defects. The most important of these are lack of selectivity, blocking by strong signals and the occurrence of dead spots when the aerial is directly coupled to the detector stage. A further, though possibly minor defect, is the element of skill required for the reception of weak signals.

Although the superhet receiver offers greater gain and selectivity, many beginners are deterred by the apparent complexity and the alignment of

such a receiver.

It is true that a superhet receiver can be quite complex when one considers multi-tuned stages, automatic volume control systems, noise limiters and the like, in actual fact a good basic superhet

receiver can give an extremely good performance on the short wave ranges. Even without the foregoing items the performance is vastly superior to

that of the t.r.f. type of receiver.

The receiver described in this article is intended to bridge the gap between the usual t.r.f. receiver and the more ambitious type of communications receiver. Although the receiver is basically quite simple and devoid of frills it gives an extremely good performance on all wave ranges. Careful attention has been paid to screening and to the use of good quality, low loss components in the receiver. Plug-in coils are used, the slight inconvenience entailed in band changing being outweighed by the gain in efficiency and ease of wiring.

Utilising Denco Maxi-Q coils, ranges 3, 4 and 5, the receiver covers 1:67 — 31.5 Mc/s, but the range can be extended to cover the medium and long wave band by the use of the appropriate plugin coils. Slight modification may be necessary if such coverage is desired. The modifications are quite simple and entail the substitution of C1, C2, C3 with 0.1 µF capacitors. The appropriate padding capacitors Cp1 and Cp2 are also required in the oscillator section. As an aid to alignment, a simple

alignment oscillator is also described.

#### CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. The incoming radio frequency signal is fed via the combination of L1, L2, VC1, TC1 to the signal grid of V1 which is a triode hexode frequency changer. The oscillator section of V1 injects a signal whose frequency is determined by L3 and the associated capacitors. This signal is such that it is always higher than the signal frequency by 1.6Mc/s. Mixing of this higher frequency with the signal frequency produces an intermediate frequency of 1.6Mc/s in the anode circuit of V1,

The intermediate frequency transformer i.f.t.1 after rejecting unwanted frequency components produced in the mixing process, passes the i.f. signal to the grid of V2 which is a variable mu pentode. After further amplification by V2 the i.f, signal passes to the grid of V3 which is a medium

impedance triode.

The detector V3 is of the so called infinite impedance type in which the load resistance is in the cathode circuit. Since considerable negative current feedback occurs, distortion is reduced to a very low level. At the same time the input impedance is extremely high and little loading of the grid tuned circuit occurs. In other words the selectivity is increased. Because some radio frequency component is invariably present in the output almost complete elimination is affected by C10 and C12. These capacitors have low reactances frequencies and high reactances at audio frequencies. The resulting audio signal is fed via C11 to the volume control VR1 and then on to the grid of the first audio valve V4, which, like the detector valve is a medium impedance triode. V4 is resistance capacity coupled to the output valve V5 which is a beam power tetrode. Provision has been made for headphones by the insertion of a jack socket in the grid circuit of V5. When phones are used the output stage is rendered inoperative.

### **DESIGN CONSIDERATIONS**

The intermediate frequency of 1.6Mc/s was chosen in preference to the more usual value of 470kc/s for two reasons. First, to avoid second channel interference and secondly, to avoid pulling. For newcomers to the field an explanation may not be amiss. The first effect arises because there are always two frequencies which when combined with a third frequency, in this case the oscillator frequency, produce the same intermediate frequency. Consider an example in which a receiver has an intermediate frequency of 100kc/s. If the frequency of the incoming signal is 1.000kc/s the oscillator must be tuned to 1.100kc/s in order that the difference or intermediate frequency of 100kc/s may be produced. Consider further a signal of frequency 1,200kc/s. This will again beat with the 1.100kc/s oscillator frequency to produce an i.f. of 100kc/s. Now since the i.f. transformer is tuned to 100kc/s it will accept this i.f. irrespective of the method of origin of this i.f.. In other words the i.f. transformer cannot discriminate between a station on 1.200kc/s and one on 1.000kc/s. The way to eliminate this so-called second channel interference is by adequate preselection ahead of the mixer stage. When one considers frequencies of the order of 5—30Mc/s this interference can be very troublesome, particularly when the i.f. is only a small fraction of the signal frequency. With an i.f. of 470kc/s at least two stages ahead of the mixer are required to give reasonable second channel rejection. An i.f. of 1.6Mc/s considerably reduces this interference and even without a tuned r.f. stage the effect only begins to show up at round about 20Mc/s. However, like all good things, this virtue must be paid for in other ways. As the i.f. is raised the selectivity and gain decrease. Although this loss can be compensated by further i.f. stages this would add unnecessary complication to the basic receiver. The selectivity and gain of the receiver described in this article were improved in two ways. First, by the selection of an infinite impedance detector and secondly by the introduction of regeneration in the i.f. stage. Regeneration is effected by loose coupling between the anode and grid of the i.f. stage pentode. The stability of the receiver is such that excellent control of regeneration can be made by this simple expedient.

The second effect is known as pulling. This effect is due to changes in oscillator frequency caused by the signal frequency. Pulling is caused by coupling of the input and the oscillator by means other than the ideal of pure electronic coupling in the mixer. The phenomenon can be alleviated by the use of a high i.f. and by adequate screening of the mixer and oscillator stages. These foregoing effects have been reduced to a minimum in the receiver by careful attention to screening and component layout.

Although a double triode such as the 6SN7 could have been used in place of the two separate triodes used in the detector and first audio stages, it was felt that the slight decrease in cost of the 6SN7 was hardly warranted by the increased complexity of wiring. The author offers no apologies for using the international octal series of valves in preference to miniature types. These valves were chosen because of their availability and cheapness.

At the same time they are robust and the comparatively large valve holders lend themselves to simplified wiring.

The power pack has been chosen for multipurpose application since it was felt that the experimenter would have other uses for this unit. The cost of separate power units for each receiver and instrument that the experimenter is likely to use can be quite considerable and is, in many cases, needless duplication. The unit described in this article has a nominal output of 250V at 100mA which is in excess of that required by the receiver. The large reserve of power results in "cold running" of the power unit. A further advantage is that the excess current can be usefully employed if additional units such as converters are used with the receiver.

Considerable latitude is permissible in the choice of transformer for the power unit. Provided the transformer delivers 60—70mA at 250V this will be adequate for the needs of the set. However, if additional units are envisaged for use with the set, it would be wise to choose a transformer with a more generous rating.

It will be noted that a specific list of parts for the receiver proper has been made. Considerable thought went into the design and layout of the receiver and the author feels that adherence to this specified list is essential, particularly to the beginner in the field. The use of dubious surplus capacitors and resistors is to be deprecated.

A good dial drive is essential for tuning on the short wave bands. Many inferior drives suffer from backlash, their reset stability being poor. For this reason an Eddystone slow motion dial was chosen. The dial has five ranges in addition to the 0—100° scale and can be calibrated by the individual constructor.

The importance of the mechanical side of a receiver such as this cannot be stressed too highly. The chassis, screens and panel must be rigid to avoid undesirable capacitive changes. These changes can affect the frequency stability of the receiver. Attention to this aspect of receiver construction will be well repaid by a stable, good looking job. It is the author's experience that many constructors, somewhat understandably, tend to neglect the purely mechanical side of construction.

Two under chassis screens bolted together in a composite unit are used in the receiver. Apart from screening the oscillator and aerial sections they also serve as mounting brackets for the volume control and aerial trimmer. In addition a degree of rigidity is given to the chassis.

A word concerning alignment of a superhet may not be amiss at this point. The alignment of a superhet has probably deterred and disappointed so many constructors that either they have given up the attempt or have been unduly critical of the superhet. Generally, such constructors have been unable to avail themselves of the services of a signal generator. Now while it is possible to align a superhet receiver by trial and error the process is extremely tedious, particularly with a new receiver where the inductances are often well away from their required values. Even after such an alignment procedure the constructor is left with the thought that the receiver could be improved upon. In other words a considerable element of

doubt exists. The time taken up in such an attempt can often be spent more profitably in the construction of a signal source. Such a source need not be complex and for these reasons the construction of a single valve oscillator is described for the benefit of constructors without such an aid.

# CONSTRUCTIONAL DETAILS—RECEIVER

The receiver is mounted on a universal 7in. x 13in. x 3in. chassis. The relevant dimensions and drilling details are given in Figs. 3, 8, 9 and 10. Note that the top panel supplied with the chassis is slightly less than the nominal 7in. x 13in. In the case of the author's receiver the actual size was  $6\frac{\pi}{8}$ in. x  $12\frac{\pi}{8}$ in. The drilling is best performed with the chassis unassembled. No mounting points for the twin gang capacitor have been indicated because it is easier to mount this unit when the panel and dial have been assembled.

The next stage is the marking out and drilling of the front panel. This panel is a nominal 9in. x 14in. chassis top plate. The actual dimensions are  $8\frac{7}{8}$ in. x  $13\frac{7}{8}$ in. On completion of the panel the dial and associated epicyclic drive are temporarily bolted to the panel. The chassis is then assembled and the panel and drive offered up to the chassis. The three holes in the panel should coincide with the three holes in the chassis front plate. Slight reaming of the holes may be necessary if the drilling has not been too accurate. Note that a slight overlap of the front panel occurs between the base and sides of the chassis. The height of the dial centre spindle above the chassis top should now be carefully measured. Two brackets to support the gang capacitor are then constructed as shown in Fig. 3. The mounting holes are slightly larger than the nominal 4BA clearance to allow some measure of flexibility in the final alignment of the gang capacitor shaft and the dial spindle. The two brackets are then bolted to the gang capacitor and a flexible coupler inserted on the shaft

The length of the capacitor shaft should be  $\frac{1}{2}$ in. If the shaft is longer than  $\frac{1}{2}$ in., the excess should be removed. Great care is essential during this operation. It is recommended that the end of the shaft be held in a vice and gang capacitor covered with a cloth

The gang capacitor with attached brackets is then offered up to the dial spindle making sure that the shaft is in exact alignment with the dial spindle. The chassis is then marked by inserting a sharppointed tool through the bracket base holes. The gang capacitor unit is then removed and the chassis drilled at the points indicated. The front panel may now be removed from the chassis.

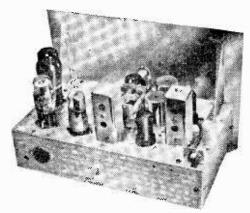
# UNDERCHASSIS SCREENING

The main chassis screen is constructed from a 3in. x 10in. chassis side plate. Cut away 2½in. and cut and bend the remaining piece to the shape shown in Fig. 9. The subsidiary screen is constructed from a 2¼in. x 5in. piece of aluminium. Although it is possible by prior measurement to mark out the holes for the aerial trimmer capacitor TC1 and volume control VR1 the method calls for great accuracy. A better method utilises the following dodge. The main and subsidiary screens

are bolted together making sure that the bottom flanges sit neatly on a flat surface. The unit is then bolted to the chassis. Two spindle bushes are then inserted in the holes in the chassis front plate. The holding nuts are tightened and a 6in, length of ‡in, diameter rod inserted through one of the bushes. A smear of paint is placed on the end of the rod which is then eased gently through the bush until the painted end makes contact with the screen. The process is repeated for the other hole. The screen unit is removed from the chassis and drilled in the positions indicated by the paint spots. Although the process of construction may appear tedious, care spent at this stage of the work is well worth while.

# GENERAL ASSEMBLY AND WIRING OF RECEIVER

Wiring of the receiver is facilitated by working with the chassis dismantled. Remove the chassis top plate and bolt the screen in its original position. The valve holders are mounted noting that the holders for VI and V2 are of the ceramic type. The remainder are standard moulded amphenol type. Before mounting the coil holders



A rear view of the finished receiver.

in position the lids supplied with the coil screens are cut to the dimensions shown in Fig. 6a. The slots in the lids are best cut with a single edged razor blade. The gauge of metal is sufficiently thin to allow this procedure to be adopted. This method gives a neater hole than that obtained by punching or shearing. Two lids are required and are held in position by the valve holders. The author found that distortion of the lids was avoided if the ceramic holders were dismantled before fixing.

Solder tags are placed under the fixing bolts of each valve and coil holder. Note that a tag is placed on the fixing bolt of each coil holder above the chassis and near to the gang capacitor. It is important that the holders are mounted correctly orientated with the locating holes in the correct positions.

The intermediate frequency transformers are then mounted, ensuring that the access holes to the iron cores face to the rear of the chassis. This is important when the alignment process is carried out. The tag strips are then mounted. Four tag

strips are required, noting that two small strips are mounted, one adjacent to the oscillator coil holder, the other adjacent to VI holder. The two small tag strips are obtained by removing the appropriate amount from 7-way strips.

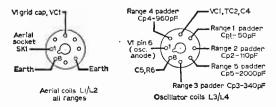
The volume control and aerial trimming capacitor TCI are mounted on the screening unit. Wiring of the receiver can now commence. Run the heater wiring round the perimeter of the base to minimise hum and interaction with other parts of the circuit. Note that the correct method of heater wiring is shown in Fig. 4. The remainder of the wiring is quite straightforward and no difficulties should be experienced. Wherever possible, short, stiff wiring should be employed, particularly in the signal frequency and oscillator sections. When the main wiring on the chassis plate is completed there remains the wiring of the oscillator trimmer TC2, output transformer T1, power input socket, phone jack and gang capacitor VC1/VC2.

The chassis side members are attached followed by the panel. Two spindle bushes for the volume control and aerial trimmer are screwed in position and the oscillator trimmer inserted in the remaining hole. Two wires are soldered to the tags on the gang capacitor stators and after bolting it to the chassis, are passed through the holes in the chassis. The two wires are then soldered to their appropriate points on the coil holders.

The frame of the gang capacitor is earthed by two heavy wires, outer braiding from screened cable being suitable. The two leads are taken to the fixing tags on the coil holders as shown in Fig. 3. Ensure that the dial movement is free and rotates smoothly over the entire range of travel. As a point of interest the gang capacitor is mounted on its side to facilitate coil changing.

## GENERAL DETAILS OF COILS USED IN RECEIVER

The well known range of Denco "Maxi O" plug-in coils is used in the receiver. Note that the blue type coils are used in the aerial section while the white type coils are used in the oscillator section. Automatic selection of the appropriate padding capacitors Cp1—Cp5 is made when the oscillator coil for a given range is plugged into the octal holder. To avoid confusion on the theoretical (Fig. 1) and main wiring diagram (Fig. 4) only one padding capacitor (Cp) has been indicated. This has been shown connected to pin 6 on L3/L4 coil holder. In fact, Cp5 will be wired in this position and the diagram below shows all the padding capacitors fitted. Cp1 and Cp2 may be ignored if long and medium wave reception is not contemplated. The underside pin connections for the aerial and oscillator coils for the various ranges are given below.



To avoid confusion the Denco range numbers for the various ranges in the receiver have been retained. For example, Range 3 1:67—5:3Mc/s, Range 4 5:0—15Mc/s, Range 5 10—31:5Mc/s,

The remainder of the wiring is now completed as shown in Fig. 4.

Now that the wiring of the receiver is complete a check on the receiver is made. A careful examination of the wiring against Fig. 4 should be made and any obvious mistakes remedied. Using a multi-range meter the resistance between the h.f. line and earth is measured. A reading of approximately  $300 \, \mathrm{k}\Omega$  should be obtained. Initially a somewhat lower reading will be observed due to the charging up of C9. After a short time the resistance will rise to the steady value indicated previously.

# POWER UNIT

The author's unit was built on a 7in, x 4in, x 3in, aluminium chassis. Since it was felt that many constructors would possess a mains transformer or suitable power unit no hard and fast rules have been laid down for the construction of this unit. Provided the unit delivers 200—250V at 60—100mA, this is adequate for the needs of the set. A wiring diagram is given in Fig. 5, Power from the unit is taken from an octal socket mounted adjacent to the rectifier.

#### VOLTAGE CHECK ON RECEIVER

The loudspeaker is connected and a set of coils inserted in their sockets. The power unit is plugged into the octal socket at the rear of the receiver. When the unit is switched on any obvious signs of overheating should be noted; the power switched off and the fault remedied. With the receiver working correctly the following voltage readings should be obtained. The author used a  $10.000\Omega/V$  meter set to the 1.000V range for h.t. measurements and the 10V range for bias voltage measurements. With a less sensitive instrument lower readings will be obtained.

Valve	Anode	Screen	Cathode	H.T. line
VI	Hexode 210 Triode 100	100	3.7	
V2 V3 V4	205 210 55	105 — —	3.5  1.6	220 V
V5	200	220	10.0	Ļ

#### ALIGNMENT PROCEDURE

The following notes are given for the benefit of constructors who have access to a signal generator. Insert a set of coils for the 1-67—5-3Mc/s range, noting that the blue coil is inserted in the aerial coil holder and the white coil in the oscillator coil holder. Connect the signal generator lead via a 0-1µF capacitor to the top grid cap of V1. Inject a modulated 1-6Mc/s signal and peak the cores of the i.f. transformers, starting with i.f.t.2. Gradually reduce the generator signal as the circuits come into line. This completes i.f. alignment.

Set the receiver dial to 100 and adjust the aerial and oscillator trimmers to approximately one third capacity. Inject a 1-67Mc/s signal via the top grid cap of V1 and peak the oscillator core until maximum response is obtained. Set the receiver dial to 0 and inject a 5-3Mc/s signal. Peak the oscillator trimmer on this signal. Repeat this procedure until

no further adjustment is required.

Remove the coupling lead from V1 and inject a 1.835Mc/s signal via a dummy aerial or 400Ω resistor into the aerial socket. Set the receiver dial to 100 and slowly tune to the high frequency end of the band. The signal should be picked up at a dial reading of approximately 87. Peak the core of the aerial coil on this signal. Inject a signal of 4.5Mc/s and tune the receiver to this signal. (Dial approximately 9.) Peak the aerial trimmer on this signal. Repeat the process until no further adjustment is required. A check on the tracking can now be carried out. Inject a signal of 2.64Mc/s and tune the receiver to this signal. Tracking is satisfactory if no further increase in signal strength is obtained.

Range 4 (5—15Mc/s) and Range 5 (10.5—31.5Mc/s) can be aligned in a similar fashion. The alignment frequencies for these two ranges are given in the accompanying table.

Comprehensive details of these coils are given in

the Denco Technical Bulletin DTB1.

# Alignment points. Ranges 4 and 5

and 6:3V for the heater is adequate. Only a small current is demanded by the instrument.

Three ranges are covered by the instrument, 700 —2.000kc/s, 1.8—5.8Mc/s and 5—15Mc/s. These three ranges are sufficient for alignment of the receiver. The range of the oscillator can be extended either way if a fuller coverage is desired.

The oscillator is constructed on a small aluminium chassis 5in. x 3in. x 2½in. The coils, switch and associated capacitors and resistors are mounted below chassis while the variable capacitor is mounted above chassis. The wiring of the oscillator is not critical. A diagram of the prototype is given in Figs. 11 and 13.

The inductances for the three ranges were wound on in diameter formers, the relevant winding details being given in the accompanying table.

LI	700 to 2000kc/s	105 turns, pile wound to occupy a length of $\frac{1}{2}$ in.
L2	1.8 to 5.8 Mc/s.	50 turns, close wound, length $\frac{7}{8}$ in.
L3	5·0 to 15 Mc/s.	19 turns, spaced to occupy lin.

Range 4 5	Oscillator		Aerial		
	Cores Mc/s 5·0 10·5	Trimmer • Mc/s 15·0 31·5	Cores Mc/s 5·5 11·55	Trimmer Mc/s 13-5 16-65	Tracking check Mc/s 7·93 28·36

When alignment is complete regeneration can be introduced into the i.f. amplifier in the following manner. Solder a short length of wire to the anode pin of V2 (pin 8). A 1in. length is ample. Slowly bend the wire towards the grid pin (pin 4). This capacitor is indicated by Cs in Fig. 1. The point at which oscillation commences is easily heard as a sudden increase in signal hiss. Reduce the coupling slightly until stable conditions are obtained. A useful increase in selectivity and sensitivity is obtained by this method.

# ALIGNMENT OSCILLATOR

The oscillator used for alignment of the beginner's short wave superhet comprises a double triode valve arranged in a simple feedback circuit. Feedback from one triode section is fed back in the correct phase to the other triode section. The circuit diagram is shown in Fig. 14. This particular method of feedback permits the use of a two terminal coil in the grid circuit. The necessity for tapping or separate feedback coils is thus avoided. To avoid the complication of a modulating section the anodes of the double triode are fed with raw a.c. The 50c/s modulation was found to be very effective and no difficulty has been experienced in identification of the signal. A small transformer capable of supplying 150-200V a.c. for the anodes

All coils wound with 28s.w.g. enamelled wire on ½in. diameter formers.

#### THE DIAL DRIVE

A direct drive dial calibrated from 0-100 was used in the prototype. The accuracy of this dial was found to be more than adequate for alignment purposes.

#### CALIBRATION OF OSCILLATOR

Range 1. For the calibration of this range a domestic receiver covering the medium wave band is required. Switch on the oscillator and allow a few minutes to elapse so that steady running conditions may be attained. Tune the domestic receiver to the medium wave band and select a station of known frequency near to 700kc/s. The BBC North programme on 962kc/s is suitable. Place the generator near the receiver and slowly rotate the generator dial until zero beat is obtained. By adjusting the coupling between the oscillator and receiver the zero point can easily be obtained by observing the throbbing note which slowly falls in frequency as the null point is neared. Note the generator dial setting and the frequency of the station. Repeat this procedure with

frequencies until the remainder of the medium wave band down to about 1,550kc/s is covered. In this way a complete set of readings can be obtained. The generator readings are next plotted against frequency on a sheet of graph paper. A curve will be obtained from which any frequency between 700 and 1,550kc/s can be obtained. For frequencies between 1,550 and 2,000kc/s the line may be extrapolated. Since the plot of frequency against dial readings is a curve the extrapolation procedure is subject to error. A better method for obtaining the 1.6 and 1.67Mc/s points, which are required for receiver alignment, is to plot wavelength against generator dial readings. A straight line is obtained which can be safely extrapolated. The accuracies of the 1.6 and 1.67Mc/s points are more than sufficient for receiver alignment. The relationship between frequency and wavelength is

 $W = \frac{300,000}{f}$  where W is in metres and f is in kilocycles,

An actual plot obtained by the author is shown in Fig. 7. Note that some points may be slightly off the line. This is caused by several factors of which the most important are observer error and inaccuracies in the variable capacitor. When the points are made on the graph the straight line is drawn to give the best possible fit. The dotted line is the extrapolated portion of the line. From this dotted line are read off 1-6Mc/s, the i.f. and 1-67Mc/s required for range 3 alignment.

# ALIGNMENT OF RECEIVER I.F. SECTION

Now that a 1.6Mc/s signal is available the i.f. section may be aligned as described in the receiver construction. Set the generator to 1.6Mc/s and wrap a piece of wire loosely round the top cap of VI. Run this lead near the generator. Coupling may be reduced by shortening the lead. Peak the cores of i.f.t.2 and i.f.t.1 for maximum noise and working with the smallest possible i.f. signal. I.F. alignment is now complete and on no account must the iron cores be disturbed.

# ALIGNMENT OF 1.67Mc/s—5.3Mc/s RANGE OF RECEIVER

A set of coils to cover this frequency should have already been plugged in during i.f. alignment. Set the receiver dial to 100 and adjust the aerial and oscillator trimmers to roughly half capacity. From the graph find the generator reading corresponding to 1.67Mc/s (180m), Inject this signal via the top cap of V1 and peak the oscillator for maximum response. From the graph ascertain the generator reading corresponding to 1.325Mc/s (226.4m). Set the generator to this reading and slowly tune the receiver to the h.f. end of the band. Harmonics should be heard at 2.65, 3.975 and 5.3Mc/s. The oscillator trimmer is peaked on the 5.3Mc/s harmonic with the receiver dial at 0. Return to the l.f. end of the band and repeat the process until optimum results are obtained.

The coupling lead is taken from the top cap of VI and inserted in the aerial socket. The core of the aerial coil is adjusted on a 1.67Mc/s signal

while the aerial trimmer is adjusted on the 5.3Mc/s harmonic of 1.325Mc/s. The exact procedure is as before. This completes the alignment of Range 3. Note the position of the pointer knob of the oscillator trimmer and mark this position on the panel.

A partial calibration of the receiver dial may now be carried out. From the graph determine the 1Mc/s point and inject this signal via the aerial socket. Tune the receiver from the l.f. to the h.f. end of the band. Four peaks corresponding to 2, 3, 4 and 5Mc/s should be heard. From the receiver dial read off the points corresponding to these frequencies. A record of these readings should be retained for future use. The 1.8—5.8Mc/s range of the generator may now be calibrated against range 3 of the receiver.

# CALIBRATION OF THE 1.8—5.8Mc/: RANGE OF GENERATOR

Switch the generator to this range and set the receiver dial to the point corresponding to 2Mc/s. Adjust the generator dial until a signal is heard. Repeat for the 3, 4 and 5Mc/s points. This simple calibration is sufficient for alignment of range 4 of the receiver. Note the generator dial reading corresponding to the above points.

## ALIGNMENT OF RECEIVER RANGE 4. 5-15Mc/s

The procedure is exactly the same as for that employed on Range 3 except that a 5Mc/s signal is injected for adjustment at the l.f. end of band. The 15Mc/s harmonic of 5Mc/s is used for alignment at the h.f. end of the band. Note that when 5Mc/s is injected peaks will be heard at 5, 10 and 15Mc/s. When alignment is satisfactory note the positions of these frequencies on the receiver dial. The 5—16Mc/s range of the generator may now be calibrated against these three points.

## ALIGNMENT OF RECEIVER RANGE 5. 10.5-31.5Mc/s

On this range switch the generator to Range 3. At the l.f. end of band inject a 10Mc/s signal with the receiver dial set to 96°. The h.f. end of the band is peaked on the 30Mc/s harmonic of 15Mc/s with the receiver dial set at 5°. Note that at the h.f. end of this band two peaks will be heard on adjusting the oscillator trimmer. Select the peak requiring least trimmer capacity.

A fuller calibration of the receiver dial may now be carried out. Points for 2, 3, 4 and 5 Mc/s will have already been noted for Range 3. Inject a 1Mc/s signal into the aerial socket and note the positions on the dial at which the harmonics of 1Mc/s are received on Ranges 4 and 5. For example, on Range 4 calibration points at 5—15Mc/s will be obtained separated by 1Mc/s intervals. The points between the 1Mc/s intervals may be obtained as follows:

A glance at Fig. 13-14 will show that a blank position has been left on the switch. A long wave coil is inserted in this position and the coil can be conveniently placed above chassis. The aerial coupling winding on the coil may be ignored. Switch the generator to this range and place a

-continued on page 758

# INVERTED by R. F. Graham

FOR ALL-BAND RECEPTION AND TRANSMISSION ON 160, 80, 40, 20, 15 AND 10 METRES

THIS aerial can be used for reception only, over the range 10-200 metres (30-1.5kc), or for both receiving and transmitting, on 160, 80, 40, 20, 15 and 10 metre bands. It is particularly intended for locations where only one pole or other high support is available.

The aerial is shown in Fig. 1, and the high anchor point needs to be about 38ft. above ground level. A pole may be secured to a chimney with TV-type lashings, or may be held with strong pass through the insulators. An insulator is fitted

each end.

If cords pass down to ground pegs, a total width of about 76ft is required. If a building, fence, tree, or other convenient anchor point is available, this reduces the total space necessary Cord or polythene line is used for the aerial. between aerial insulators and anchor points. If the aerial is employed for transmitting, its ends should be out of reach of children.

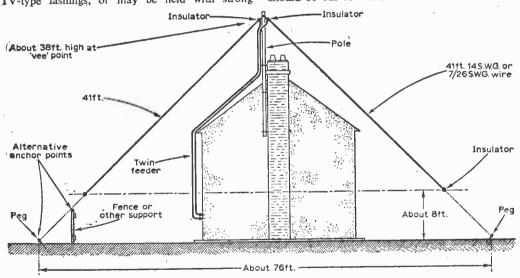


Fig. 1: The construction of the aerial.

brackets, or with spikes securing it in an angle between chimney and house. The aerial wires act as halyards, helping to prevent sideways movement.

A piece of 2 x 3in. timber, free from knots, makes a good pole. A "ladder pole", available from large timber suppliers, is also inexpensive. If the supporting point is a little under 38ft, high, the lower ends of the aerial can be spread out more, or may be 6 or 7ft, above ground.

Each element of the aerial is 14s.w.g. hard drawn copper wire, or 7/26s.w.g. aerial wire. Each piece is 41½ft., to allow 3in. each end to

The apex of the aerial is most easily raised by threading a long line through an insulator or strong eyebolt at the pole top, before fixing the pole. The aerial can then be hoisted up, when ready.

#### Feeder

The aerial is designed to operate with an openwire twin feeder, which has negligible losses at all the frequencies covered. The feeder is made from 7/26s.w.g. aerial wire, with 5in. or 6in. spreaders.

Ceramic spreaders of this kind can be purchased, or spreaders can be cut from insulating material. If the feeder is reasonably taut, one spreader every 4ft. to 5ft, will do.

If the aerial is to be used for reception and transmission on 3.5. 7, and 14Mc/s (80. 40 and 20m) bands only, then 300 ohm flat twin ribbon may be used for the feeder. The efficiency with this type of feeder is less than with an open wire feeder.

Each feeder wire is soldered to one of the 41ft, aerial elements. The open wire feeder should not touch the roof, pole, or walls. An extra insulator or two can be attached to the feeder, with a cord to any suitable point, to keep the feeder in position.

#### Coupling

There are several different ways in which the twin feeders can be coupled to the receiver or transmitter. The one chosen depends to some extent on the receiver or transmitter, and the purpose in view.

Receiver Dipole Input. Communications type receivers generally have a dipole or twin feeder input. There are then two aerial terminals for this purpose. One feeder wire is taken to each terminal. This method is simple, and can be used on all bands without adjustment. It is often employed with twin feeders, despite the fact that the best impedance match between feeder and receiver (and thus best signal strength) is only obtained on some frequencies.

Receiver Tuner. A tuner allows the aerial to be tuned to resonance, and also provides an impedance match. It thus gives best possible signal strength at all frequencies.

The tuner can be made as described for a transmitter tuner (Fig. 2) except that a wide-space tuning capacitor is not required, for reception. If the receiver has a  $75\Omega$  or similar aerial input, it is best to use a piece of  $75\Omega$  co-axial cable between tuner and receiver, with a coupling loop exactly as described for transmitting.

Some receivers have an input for  $300-600\Omega$ . If so, signal strength is improved by taking the receiver feeder to a tapping some turns out from the coil centre tap.

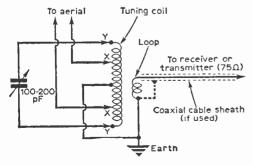


Fig. 2: The method of coupling a twin feeder.

With a receiver tuner, the tuner variable capacitor is adjusted for best signal strength, as shown by the tuning meter, signal strength meter, or by maximum volume. The increase in signal strength obtained from the tuner will be important, on those frequencies where a bad impedance match would otherwise exist between feeder and receiver.

Transmitter Pi-Output. Twin feeder systems are sometimes operated directly from a transmitter pi-output circuit, one feeder wire being earthed at the transmitter. This method can be used when the feeder impedance falls within the range of impedances to which the transmitter output circuit can be adjusted.

In this case, the transmitter is loaded up into the aerial in exactly the same way as if an endfed wire were in use.

Transmitter Tuner. This is the most satisfactory way of all-band operation, and the same tuner may be used for both receiver and transmitter. A suitable tuner circuit is shown in Fig. 2. The variable capacitor needs to have spacing about equal to that in the anode circuit of the transmitter P.A., to avoid sparking over.

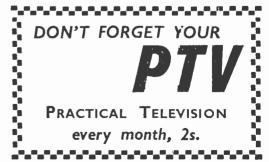
A coil for 10-80 meters can be made by winding 26 turns of 18s.w.g. wire on a 2½in. diameter or similar former, turns being spaced to occupy about 3in, in all. The loop can be 3 turns of well insulated wire, over the centre of the 26 turn coil.

Any convenient length of  $75\Omega$  co-axial cable passes from the tuner to the transmitter pi-output socket.

In use, taps Y-Y are clipped on the coil at equal distances from the centre tap, to obtain resonance on the required band. This is most easily done by observing signal strength on the receiver, while tuning to some transmission in the required band. Clips X-X are placed at equal distances from the centre tap, until the transmitter can be loaded to the required input.

If a dipole or Zepp tuner is to hand, this may be used instead, with series tuning for low feeder impedances, and parallel tuning for high feeder impedances. The tuner is best housed in a case near the receiver or transmitter, so that it can be adjusted as required.

During tests, the aerial was found to give good results, for both receiving and transmitting. This was also so on Top Band (160m) where the performance exceeded that expected.



# PREPARING PREPAR

#### BRIAN ROBINSON.

# 2: PERMANENT MAGNETS, ELECTROMAGNETS, INDUCTANCE AND CAPACITANCE

#### 2.1 Permanent Magnets

THIS type of magnet retains its magnetism and is generally made of steel (modern magnets may be made of alloys such as Alnico, a combination of aluminium and nickel). The main uses of permanent magnets in radio work are in loudspeakers and moving coil meters. Magnets have a North and South pole and the magnetic field associated with a bar magnet takes the form of "lines of force". The magnetic field associated with a bar magnet is shown in Fig. 10 and that associated with a North and South pole in opposition is shown in Fig. 11.

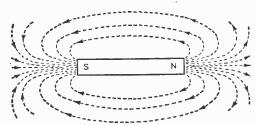


Fig. 10: Magnetic lines of force around a bar magnet.

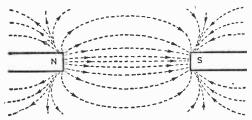


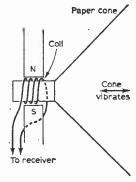
Fig. 10: Lines of force associated with a North and South pole in opposition.

#### 2.2 The Loudspeakers

When a conductor such as a copper wire or coil is suspended between the poles of a magnet and a current is passed through the coil the coil will move. This principle is used in the loudspeakers. A coil is held between the poles of a magnet and is made to move or vibrate by passing a varying current through the coil. This varying current takes the form of speech or music in the form of

electrical impulses. The coil is connected to a paper cone which also vibrates and produces audible sounds.

Fig. 12: In a loudspeaker, a paper cone is connected to a coil suspended between the poles of a magnet.



#### 2,3 The Moving Coil Meter

This also uses the same principle as the loud-speaker. A constant current is, however, passed through the coil, which is connected to a pointer, and an indication is given which is proportional to the strength of the current. Moving coil meters can only be used to measure d.c. current but voltages can be measured by connecting a resistance in series with the meter. The formula used to convert a milliammeter into a voltmeter is:

E × 1000

 $R = \frac{2}{I} - Rm.$ 

Where R is the desired series resistance E is the

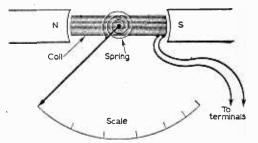


Fig. 13: The basic arrangement of the component parts of a moving coil meter.

desired full-scale reading of the voltmeter, I is the current drawn by the meter (in milliamps) and R is the resistance of the meter. A circuit and typical values are given in Fig. 14.

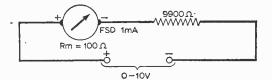
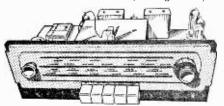


Fig. 14: A circuit for making voltage measurements.

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4in. 900ft 22/6	3in. Stand., 150ft.	3/6
5in. 1,800ft. 42/6	Sin. Long Play, 225ft	4/11
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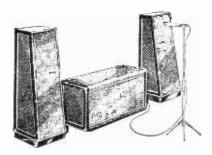
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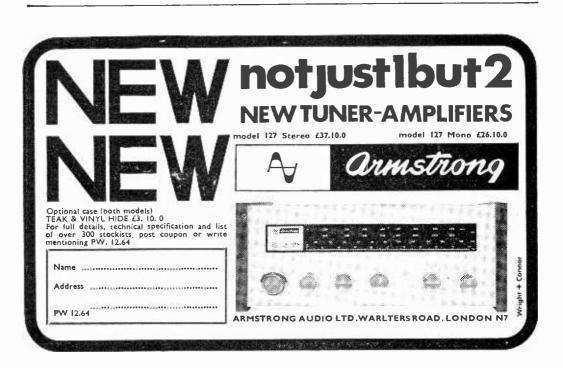
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To convert a milliammeter into an ammeter or a milliammeter having a higher full-scale deflection a shunt resistance must be used. The formula used to find the value of the shunt is:

$$R = \frac{Rm}{n-1}$$
 where R is the shunt resistance,

Rm is the meter resistance and n is the factor by which the original f.s.d. has been multiplied. A typical example is shown in Fig. 15.

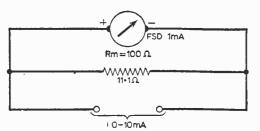


Fig. 15: Inclusion of the shunt resistor (II+I  $\Omega$ )gives the milliammeter a higher full-scale deflection.

#### 2.4 The Electromagnet

When a coil of wire is wound round a piece of soft iron and a current is passed through the coil the soft iron will become magnetised. When the current is switched off the soft iron immediately loses its magnetism. This type of magnet is called an electromagnet. Electromagnets are generally used in electric bells and buzzers and relays, all three of which are really switching devices. See if you can work out how the relay switches on the current in a separate circuit in Fig. 16 and how the electric bell in Fig. 17 rings continuously.

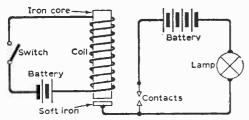


Fig. 16: Here an electromagnet is used to operate a relay for switching on the lamp.

#### 2.5 Self-Inductance

If a wire is wound into a coil and a current is passed through the coil the coil will oppose any change in the value of the current passing through it. This property of opposing a change in current is called *inductance* and is due to the fact that a second current is *induced* in the coil which opposes the change in current. The amount of inductance possessed by a coil depends on the number of turns, the area of cross-section of the coil, the length of the winding and the material

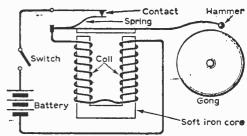


Fig. 17: The circuit of an electric bell.

on which the coil is wound. If a current passes through a coil the current does not at ouce rise to its maximum value because of the inductance of the coil. This is shown in Fig. 18.

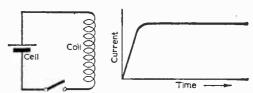


Fig. 18: The rise of current with time in the coil shown on the left, is illustrated graphically on the right.

Inductances are measured in *Henrys*. The Henry is a large unit and in radio frequency coils the inductance is generally measured in *microhenrys* 

 $\left(\frac{1}{1,000,000}\right)$  of a Henry. The inductance which

acts when a current passes through a single coil is called self-inductance.

#### 2.6 Mutual Inductance

When current flows through a coil a magnetic field is set up round the coil as shown in Fig. 19.

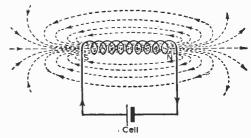


Fig. 19: The magnetic field set up around a coil of wire.

If a second coil is now brought near to the coil shown in Fig. 19 so that the lines of magnetic force "cut through" it a current will be produced in the second coil. This current is produced as a result of a mutual inductance between the two

coils. This is shown in Fig. 20, a milliammeter being used to demonstrate the induced current in the coil. The coil connected to the cell is called the primary coil and that in which the current flows is called the secondary coil.

Two coils such as those in Fig. 20 are said to be coupled and the coupling effect is greatest when the two coils are on the same axis and close

together.

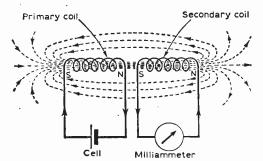


Fig. 20: The effect of placing one coil in close proximity to another.

#### 2.7 Inductances used in Receiving and Transmitting Circuits

Adding an iron core (generally powdered iron) to a coil increases the inductance considerably and therefore for receiving purposes coils can be made very small. Also the inductance of a coil can be reduced by adding a core of a metal such as brass. As will be seen later when a.c. theory is dealt with the inductance of a coil varies according to the frequency of the current which passes through it. Generally, in transmitting circuits where there is considerable radio frequency power, the inductances used in the circuit will be self-supporting (i.e. not wound on a "former"), will be made of stout wire and will have an air core.

#### 2.8 Capacitance

If two metal plates are separated by a small distance and connected to a battery and switch, as shown in Fig. 21, the instant the switch is closed

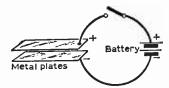


Fig. 21: How electrical capacitance is obtained.

electrons will travel from the upper plate towards the positive terminal of the battery and electrons will leave the negative terminal of the battery and travel to the lower plate. The plates are now said to be charged. The switch can now be opened but the plates will retain their new charge. The charges can be neutralised by short-circuiting the plates, a spark often resulting.

Two plates as shown can therefore be used to store an electrical charge and a device which can do this is called a *capacitor* or condenser. capacity or storing power of a capacitor is dependent on the area of the plates, the number of plates, the distance between the plates and the material (dielectric) between the plates.

The unit of capacitance is the farad. too large for most radio applications and the

microfarad of a Farad and the 1,000,000 picofarad or micromicrofarad 1

> of a microfarad 1,000,000

are more commonly used.

Capacitors fall into two main types, fixed capacitors which have a fixed capacity and capacitors which have a variable variable The symbols for these two types are capacity. generally represented as shown in Fig. 22. Fixed capacitors are physically usually small and may



Fig. 22: The circuit symbols of capacitors fixed and variable.

often be made of metal foil with a thin layer of dielectric, such as waxed paper, between the plates. The capacitor may also be made of two long lengths of foil separated by waxed paper and the whole being wound cylindrically so as to occupy a small space only. A special type of fixed capacitor is called an electrolytic capacitor but this will be dealt with later.

Variable capacitors have two sets of plates, one set variable and the other fixed; moving the position of the variable plates alters the capacity of the arrangement. The two sets of plates are almost always separated by air but occasionally

mica may be used.

The voltage which can be applied to a capacitor depends upon the distance between the plates and the material separating the plates. If too high a voltage is applied sparking will occur between the plates and the breakdown voltage of the capacitor will have been exceeded.

#### Question-

A meter has a full-scale deflection of 10mA and an internal resistance of 50 $\Omega$ . Calculate, using Ohm's Law, the following:

- The value of the series resistance required to convert it into a voltmeter reading up to 250V.
- The value of the shunt resistance required to convert it into an ammeter reading to 2A.

Use the formulae given in the article to check your answers. Answers to Question 1 last month are given on page 790.

Part 3 Next Month

# A MODEL CONTROL TRANSMITTER

by

F. G. Rayer G30 GR

THE circuit shown here is extremely simple, and has proved to be very useful. When experimenting with radio control equipment indoors, power can be drawn from a small mains unit. This unit should deliver 6.3V a.c. for the 6C4 heater, and 10mA at 150V h.t. supply. When mains are not available, the mains unit is removed, and the transmitter operated from batteries. As 0.15A is drawn from the 6V supply, reasonable battery life is obtained.

Fig. 1 shows the transmitter circuit and battery connections. Any home-built or ready-made c.w. type receiver may be used. The transmitter is not suitable for controlling tone receivers. The unit is tuned to the required frequency by TC1 and the control switch or key used to control the model is connected in the 6C4 cathode.

The transmitter is built on a piece of thin paxolin 4in. x 4in. Drilling positions can be taken from Fig. 2. The valveholder requires a fin. diameter hole. Short 6BA or similar bolts are provided with tags and fitted in the positions

indicated, for battery, coil and key connections.

An extra tag is fitted at point 1, Fig. 2, and one projecting tag of TC1 is soldered to this. A stout lead passes from the centre tag of the trimmer, through a small hole, and to tag 3 in

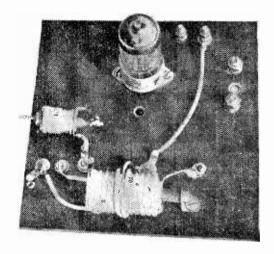
All underneath wiring is shown in Fig. 3, and leads and parts should be positioned approximately as illustrated. Wires are short and direct, and insulated sleeving is used on all leads. The wire

ends of resistors and capacitors are cut down as necessary. Connections should be rigid, so 20 s.w.g. tinned copper wire, with 1 m.m. sleeving, will be satisfactory. A lead passes from h.t. positive to tag 2, as in Fig. 2.

#### Coil LI/L2

This need not be wound exactly as described, provided it can be tuned to 27Mc/s with TC1 trimmer about half closed. For this type of circuit, a self-supporting coil is not recommended. A smooth paxolin tube can be used as a former, though a former with notched ribs is better as turns are then evenly spaced and cannot move.

The former actually used was approximately 4in, across the ribs and 14in, long, 1.2 consists of 10 turns of 20s.w.g. tinned copper wire, the winding occupy-



ing 1 in. A short lead is soldered on the centre turn, this being the tapping 2 in Fig. 1. The ends of L2 coil are soldered to tags 1 and 3 in Fig. 2, and the tapping is soldered to tag 2.

Two turns of insulated wire are used for the aerial coupling winding L1. These are wound round the centre of L2 coil, the ends being twisted together, and taken to tags 4 and 5. In Fig. 2,

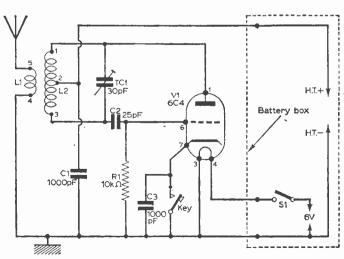


Fig. 1: The 27Mc s transmitter circuit.

this winding and its connections are shown with broken lines.

A former which would hold 10 turns, \$in. in diameter, was tried, and was also satisfactory. A 7/8 in. diameter former would also do well. Formers smaller than fin. diameter are not recommended. The wire gauge and spacing between turns are not critical, provided the finished coil can be tuned around 27Mc/s. The finished coil was mounted with a lin. bolt, spacer and bracket, as in Fig. 2.

#### Tuning and Aerial

The heater may be run from a.c. or d.c., the polarity with d.c. being unimportant. The h.t. supply is 90V to 150V according to power required or the supply available.

The transmitter must be tuned to a frequency in the Model Control band (26.96 - 27.28 the aerial is Mc/s) before attached. If desired, a test for r.f. can be made by soldering a 6V 0.06A bulb to a 2-turn loop, and bringing the loop near the transmitter coil. The bulb should light at reasonable brilliance.

To tune the transmitter, a calibrated wavemeter is required. The wavemeter is set to a frequency near the middle of the band (say about 27.1Mc/s) and is coupled to the transmitter coil. If the wavemeter has a bulb indicator, the wavemeter coil will need to be in line with the transmitter coil, with an inch or Coupling hetween coils. should be loose (coils as far apart as possible, provided sufficient power is transferred to light the bulb). TC1 trimmer is then rotated until the wavemeter bulb lights best. A 9in. length of insulated tube, filed to engage the trimmer, is handy for tuning.

If the wavemeter has a sensitive moving-coil meter indicator, coupling between transmitter and wavemeter can be small, the units being separated by such distance as will give a satisfactory deflection of the meter.

If the coil has been wound to dimensions other than those given, the tuning range obtained may be unsuitable. If 27Mc/s is approached with TC1 trimmer

-continued on page 782

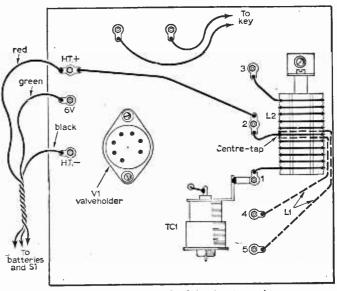


Fig. 2: Layout on top side of the chassis panel.

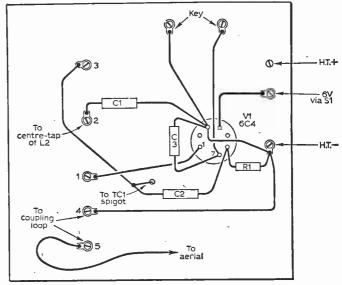


Fig. 3: Wiring on the underside.

#### **COMPONENTS LIST**

10kΩ IW RI

1000pF 250V or similar CI

C2

25pF mica or ceramic 1000pF 250V or similar **C**3

6C4 ٧I

One B7G valveholder. Idin. x gin. diameter coil former. 4in. x 4in. x 16in. paxolin panel. 20s.w.g. wire, 6BA nuts, bolts, connecting wire,

# monitoring a BIG

# A RAPID FAULT-FINDING SYSTEM FOR COMMUNICATIONS RECEIVERS

# Receiver

by S. Simpson

A NY item of electronic equipment is liable to break down but, in the case of communications receivers, such "down time" must be kept to a minimum if communication schedules are to be maintained. Rapid maintenance of the receiver when the fault has been found is very largely tied up with the design and layout of the receiver, but rapid fault finding can be greatly helped by a comprehensive monitoring system.

Monitoring a receiver such as that shown in Fig. 1 can be a very extensive arrangement if all possible points are to be covered. Obviously h.t. lines have a priority and one could feasibly monitor all h.t.-carrying electrodes at all valves.

One could also check all bias voltages where such are developed.

All this could lead to a monitoring system so complex that it might itself require monitoring to ensure its serviceability, to say nothing of the risk of malfunctioning of the receiver caused by interaction in the numerous monitor leads!

A compromise can, however, be obtained and is described in the following paragraphs. It leaves several gaps in information but does narrow the field such that the operator should be able, firstly, to say with fair certainty what has happened and, secondly, by using normal metering and tools to quickly clear the fault.

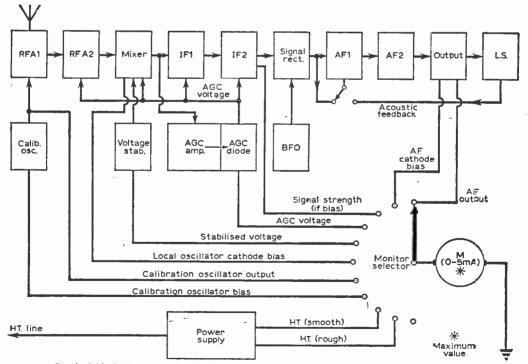


Fig. 1: A block diagram indicating the monitoring system in a typical communications receiver.

#### **Monitoring Points**

H.T. supplies must be known, thus the rough h.t. and smoothed supply are monitored. One thus has a check on the filter system, also a check on serious breakdown of decoupling capacitors. Working backward through the receiver the next useful point is the a.f. output signal (for a reason explained shortly). This signal is taken from the output transformer secondary, rectified, smoothed and passed as a fluctuating d.c. voltage to the monitor switch.

The a.f. output valve is a "hard" worker and a check on its bias condition is desirable. (The paralleled resistance of the meter will temporarily alter the actual operational bias but a reading taken during normal operations gives a figure for comparison when abnormal operation is suspected.)

(4) The stabilised voltage applied to the local oscillator in the frequency changer; a voltage can be present even if the stabiliser valve has failed but will differ appreciably from normal.

With these facilities the operation of the entire receiver can be checked as follows:

(1) The crystal calibrator is switched in.

- (2) The r.f. gain control is turned to maximum and the receiver tuned to a known harmonic on, say, the medium wave band if a 100kc/s crystal is in use.
- 3) A.G.C. is switched in, also b.f.o. at 1kc/s.
- (4) The monitor circuit is switched to i.f. cathode bias and the receiver carefully retuned to maximum signal (minimum bias reading). This should coincide with a previously logged dial setting of the tuning capacitors.

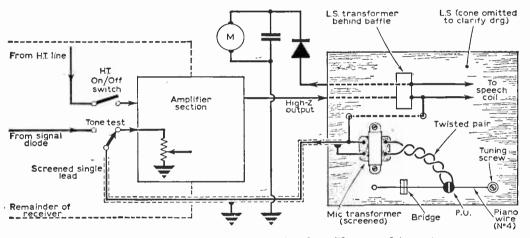


Fig. 2: A 'tone-test' arrangement for checking the a.f. amplifier stage of the receiver.

In the receiver shown amplified a.g.c. is used. The full output of the a.g.c. diode is monitored, also the cathode bias of the last controlled i.f. valve. Drift in tuning of that i.f. amplifier, which is part of the amplified a.g.c. system, is thus shown by a fall in diode output: a fault or drift in the main i.f. amplifier is also made apparent by comparing a known diode output against the effect of a.g.c. in the i.f. amplifier.

The question arises: How does one know that the a.g.c. i.f. amplifier is receiving a normal signal to cause it to produce a known diode output? This doubt is settled by further monitoring at the points listed below:

(1) The r.f. output of the calibration oscillator, rectified by a diode, to show that r.f. is indeed coupled to the receiver input

indeed coupled to the receiver input.

The cathode bias of the calibration oscillator to show whether the valve is oscillating normally (weak oscillation shows up as an increased voltage).

(3) The cathode bias of the frequency changer (again weak or non-oscillation gives a noticeable rise above a normal operation figure).

(5) The monitor circuit is now switched to a.f. output.

(6) The a.f. gain control is set to a predetermined position (gained from experience).

(7) If the receiver is behaving normally a known figure of a.f. output is shown on the monitor.

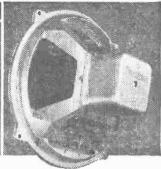
The above procedure has proved satisfactory in checking the receiver diagrammed in Fig. 1 but will, of course, be modified to suit individual cases.

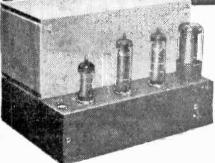
So far the monitor has covered the complete front end, the i.f. amplifier, the a.g.c. system and a check of a.f. output. It is, however, useful to be able to check the a.f. amplifier on its own and the following method, illustrated in Fig. 2, is used by the author for the purpose.

A taut 10in, length of piano wire is stretched across the wooden baffle board supporting the loudspeaker (tightening is achieved by passing one end of the wire through a hole drilled in the shank of a No. 6 wood screw which has been run well

-continued on page 758







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8" H.F.810	10,000 gauss	£2 17 0		
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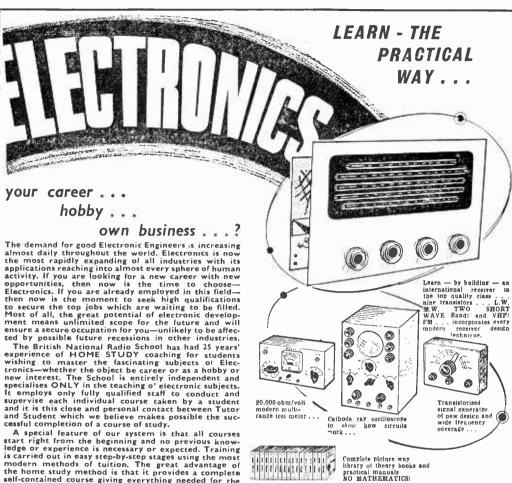
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# PRACTICALLY WIRELESS

# No. 4 For the Present

THE national dailies are clamorous, just about now, with suggestions of seasonal gifts. The lady columnists slink between laden counters, licking their pencils, filling their notebooks with apt ideas.

In these days we have to shop this early for Christmas, otherwise the stores will only have

Easter eggs on show.

Remembering some of the presents we have received from misguided maiden aunts, and malicious colleagues, we thought it could be a good notion to suggest a few suitable ideas for some of the characters who have haunted the radio enthusiast in these pages and elsewhere.

Simple gifts, as for example a second-hand flea-trainer's outfit for the chap who thinks up those diminutive designs which so tax the constructor's evesight and defeat his fumbling fingers.

Or a "Lucky-Dip" parcel of unrelated oddments for the contributor whose constructional article advocates: "33 turns of 42s.w.g. enamelled copper on a 4in. former, and 100 turns of 42s.w.g. double-silk covered on XYZ former type 54321", I mean, have you ever tried to calculate how many inches (feet. yards?) make 100 turns of



Lady columnists slink between laden counters.

42s.w.g., then ask for that odd length at your local factor's spares counter?

Then there is the chap who thought up the modern, plastic knob, which disintegrates at a touch. This horror—for which a replacement can seldom be obtained—has to be pulled or twisted off before any work can be done on the receiver. Perhaps a blown-out Chinese egg, suitably mounted?

And for the creator of the other kind of knob, with concealed security, a grub-screw beneath a flange, or an angled spring just beyond the reach of one's longest screwdriver, a set of wire puzzles.

A ball of tangled string would not be inappropriate as a gift for the bright bloke who thought up the combination of harness and printed circuit used on some television receivers. Tracing h.t. on these without a circuit diagram—and sometimes with one—is like touring Wales with a home-made

Don't let us forget, while on the subject of diagrams, two wellearned awards. First, one of " Present to those teasing "Present to follow" postcards we used to get at school for the producer of the radio for which a circuit is never-not nohow-obtainable. And a modern, do-it-yourself novel for the technical author whose manual flops about like a stranded fish, with components on one page, tables of values on another, and portions of the circuit scattered about like plums in an alms-house pudding.

Jig-saw puzzles used to be frequent presents when Henry was a lad. One of the interlocking type would do well for the designer of the set which used those banks of moulded components in which the middle one always seems to go.

Then there is always the tool and equipment market—we could think of more examples



A ball of tangled string.

here than the Editor would allow us to cite. But we must not forget to send a tube of burn salve to the genius who first thought up the method of mounting multi-contact switches in a printed-circuit panel. He must have burned his fingers mightily while mocking up that prototype.

Remember those games that used to swell our stocking, the ones that required the victim to get a dozen balls simultaneously on a dozen shallow depressions, annoyingly beneath glass? Suitable, don't you think, for the chap who wants us to hold four pen-light cells at once, or even five U-11 type cells, to make any test on a small transistor receiver that entails removing the back.

And, going even further back in memory, a cats-cradle of string for the inventor of some of the more irrational drive-cord designs. A rubber one, if such can be imagined, for the tape recorder brain who loops his belts around hidden pulleys in inaccessible places.

I leave you, gentle Reader, to think up gifts that might suit others of our tormentors. I must away to consult with fellow contributors to cook up something special for the Editor.

# An Experimenter's

# GALVANOMETER

BY C. J. PAULL

THIS article describes the construction of a moderately sensitive D'Arsonval-type galvanometer for the amateur experimenter. The complete instrument consists of three separate parts: (a) The galvanometer itself, (b) the lamp and lens assembly and (c) the scale over which the lightspot moves.

#### The Galvanometer (a)

This consists of a coil, two suspensions which act as current leads and provide the restoring force, a mirror glued to the bottom of the coil, a U-shaped magnet to provide the magnetic field

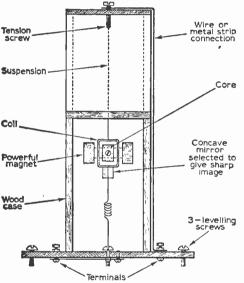


Fig. 1: This shows, approximately full-size, the construction of the galvanometer itself.

and a soft iron core to concentrate the field in the region of the coil.

The coil was made from 100 turns 36s.w.g. enamelled copper wire wound on a rectangular wooden former about \(\frac{1}{2}\)in. narrower than the air gap of the magnet. After winding, the former was removed and a little glue rubbed into the coil to hold the strands of wire together.

The suspensions were made from "silver paper" (actually aluminium foil) cut to 1/100in. wide strips, 4in. long, with the ends widened to about kin, to facilitate joining to the copper wire. The necessary fineness of the suspensions was achieved with the help of a very sharp pointed modelling knife, a steel rule to act as a guide and a sheet of aluminium to afford a suitable base for the cutting The suspensions (above and below) were joined to the bared copper leads from the coil by winding them round and round these leads and then binding some fine copper wire over them to make certain of a good contact. The other ends were connected to suitable terminals at the top and bottom of the case by a similar method, the top terminal being rotatable.

A small, carefully chosen piece of a concave shaving mirror was stuck to the bottom of the coil.

The case was made from mahogany-faced ply and had the dimensions 1 in. x 2½ in. x 3 in. with a removable glass panel inserted in the front.

#### The Lamp and Lens Assembly (b)

The lamp was rated at 6V 0.5A and the lens was an ordinary 1in. diameter magnifier, adjustable to between 3in. and 6in. from the lamp. A fine

—continued on page 794

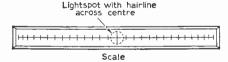


Fig. 3: Details of the scale.

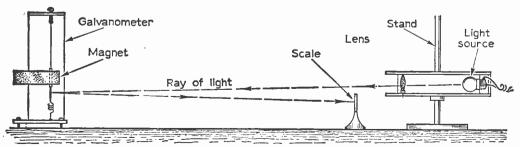


Fig. 2: The complete set-up of galvanometer, scale and light source. Approximate total cost of the complete instrument, los.

# **PHOTOCONDUCTORS**

# BY B.R. GAINES

## The Cadmium Sulphide Photo-conductive Cell in Practice

PART

NTIL the advent of the photo-transistor, the only light-sensitive devices generally available were the barrier-cell used in photographic exposure meters, the photo-emmisive cell used in sound-film projectors and the selenium photo-conductive cell (often made up from a burnt-out rectifier!).

None of these has the sufficient sensitivity or ease of use for practical general-purpose work, and it was only when photo-transistors became readily available about six years ago that real interest in light operated devices was stimulated.

Even photo-transistors have disadvantages in some applications however, especially where robustness, high-sensitivity, wide-range of illuminations, power-handling, voltage-handling or exact measurement of light intensity have to be catered for. There has, however, become available a device which fulfils all these requirements: this is the Cadmium Sulphide Photo-conductive Cell, which operates on the same principle as the old

Selenium Cell but is in all respects a great advance on these.

The characteristics of one very good example of this type of cell, the Ericcson K42, are shown in Fig. 1. The K42 may be regarded as a resistor whose resistance is determined by the amount of light falling upon its sensitive surface.

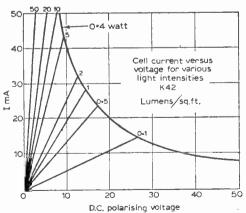
It is the enormous range of this resistance from 10Ω in bright sunlight to more than 10MΩ in darkness, from virtually short circuit to virtually open circuit, which makes this cell so useful.

Its colour response also does not have the great peak in the infra-red of photo-transistors and extends over the entire visual range, making the K42 suitable for light measurement.

The sensitive part of the K42 consists of a layer of cadmium sulphide with traces of copper and chlorine added. This unit is potted in epoxy resin inside a metal can behind a glass window scaled with silicone rubber.

Fig. I (below): Data on the Ericcson K42 photo-conductive cell.

A: Maximum Ratings Maximum Polarising Voltage Maximum Photocurrent Maximum Power Dissipation Ambient Temperature Range	50V 50mA 0·4W 25°C-60°C
	—25°C-60°C



C: "Rule of Thumb" Sensitivity Guide Cell Resistance in: Bright Sunlight ... ... 100

 Daylight ...
 ...
 60 Ω

 Late dusk ...
 ...
 ...
 Ik Ω

 Darkness ...
 ...
 ...
 10 M Ω

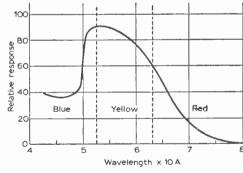


Fig. 2: This graph indicates the K42's relative response to different colours.

The system is extremely robust and moisture resistant, and the writer has certainly found no way of damaging the K42 except by using it with voltages and currents well outside the manufacturer's ratings. The constructional part of this article centres about the K42 and describes its use in light-operated switches and automatic volume controls.

#### Direct Operation of Relays

Because of its high sensitivity and ability to handle large currents the K42 is able to control relays directly without prior amplification; in this application it may be regarded as a variable resistance of  $100\Omega$  or less in light,  $1k\Omega$  in the dim light of late dusk,  $10M\Omega$  in darkness.

Supply, up to 50V,50mA)

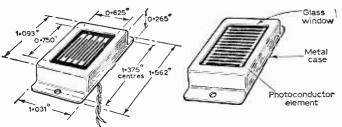


Fig. 3 (above): Dimensions and general appearance of the K42.

Fig. 4 shows the simplest circuit for direct relay operation in which the K42 is placed in series with the relay coil and its power supply. When the photo-conductor is in darkness little current flows because its resistance is high, and the relay is open. When light falls on the cell its resistance decreases and sufficient current flows to close the relay.

Note that there is no need for a protective diode across the relay coil, since the K42 in series with the relay coil does not generate large back e.m.f.'s

as do some transistor circuits.

In the operation of the circuit of Fig 4, there is "electrical backlash" in that, whilst the relay may close on a certain current (about 6mA for a  $1k\Omega$  P.O. relay with one contact), it will not open again until the current falls rather below this (about 4mA for the relay considered).

This effect is of considerable importance in practical applications which require the relay to operate on currents due to slowly changing

illumination.

If there is little backlash the relay tends to "chatter" when the light-level brings the current near its open/close point; backlash by making a very definite difference between open and close currents obviates this defect.

The only restriction on the relay used in Fig. 4, is that it should not require more than 50mA or 50V to operate. The writer has found that Post Office relays with coil resistances of about  $1k\Omega$  work satisfactorily on a supply of 12V and has designed parking light switches about these.

Almost any relay may be used however, and the simplest procedure with one of unknown proper-

ties is to find out what voltage will just cause it to operate and then to use a supply voltage about one and a half to two times this, subject to the restriction above.

#### Parking Light Switch

The simple circuit of Fig. 4 has insufficient backlash to guarantee chatter-free operation when the K42 is used to open and close a relay in the slowly changing light of dawn and dusk.

Additional backlash can be created by connecting a shunt resistor, R1 (Fig. 5), in parallel with the relay coil when the relay is open. This takes some of the

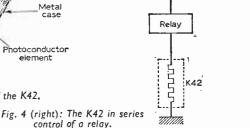
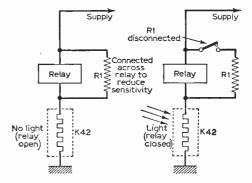


Fig. 5 (below): Here RI is added in parallel with the relay to provide additional backlash. Its operation with RI disconnected is described in the text.



current supplied to the relay and thus reduces its sensitivity when open.

If R1 is disconnected once the relay has closed the sensitivity goes back to normal, and hence the difference between "open" and "close" currents has been made greater, i.e. the backlash has increased. In practice the relay is made to switch the shunt resistor in and out by means of its own contacts.

Fig. 6 shows a practical circuit for this type of parking light switch and the method of connecting it into the car wiring. The centre section is the

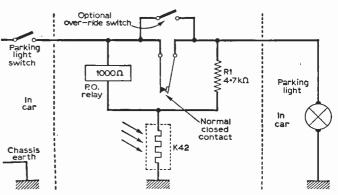


Fig. 6: A car parking light system using the K42.

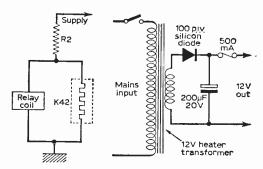


Fig. 7 (left): Parallel control of a relay.

Fig. 9 (right): A power supply for 12V relays.

switch itself which is essentially that of Fig. 4 with the addition of automatic backlash described above.

The K42 is in series with the relay coil, opening the relay during the night, and therefore the switch contact on the relay must be of the "normal-closed" type. This same contact is used to switch the shunt resistor R1 in parallel with the relay coil when the relay is closed, thus increasing the backlash as described above.

If a relay of different resistance to that shown

is used, R1 should be changed to be about five times the relay resistance. The "over-ride" switch bypasses the relay contacts and converts the parking light to normal manual operation.

The actual details of construction and connection of the parking light switch will vary with the requirements of the individual car. The K42 must, of course, be placed so as to see the full effect of the ambient light. and the most convenient place to put it is just behind the front window facing outwards; it need not face straight up into the sky.

The relay unit can usually be found a place behind the dash or in the map or glove compart-

ment: for reliability a sealed relay is preferable, and some protection of the contacts should in any case be provided.

The wire to the parking light may be broken into and the automatic switch fitted (Fig. 6) at any point after it has left the main lighting switch. The chassis-earth connection should be securely attached to the metal-work.

A 2A fuse in the 12V line is some worth-while protection against blowing the main car fuses

when installing the unit!

#### Parking Light Switch II

In many towns parking lights are only required after 11 p.m. or when the street-lighting goes off, and the automatic switch has only to switch them off at dawn, there being no advantage in one which would switch them on long before they were required.

This "single-shot" working has the advantage that relay chatter can be completely eliminated by a switch which switches off the lights automati-cally, but requires manual re-setting to switch them on. Then the relay opens at dawn and once open stays open.

The previous circuit could be changed to this mode of operation, but there is an alternative way of controlling a relay directly with a K42 which is sometimes advantageous and the writer will describe this rather than cover the same ground again.

In this mode of operation the K42 is connected in parallel with the relay coil and therefore shares with it the current supplied by R2 (Fig. 7). In darkness the K42 has a high resistance and all the current flows through the relay.

In light the K42 is low resistance and takes most of the current so that the relay opens. R2 should be greater than a third of the relay resistance and must limit the current through the K42 to less than 40mA.

This switch is converted to single-shot working described above, by arranging for the relay to cut off its own power supply when it opens, so that it cannot close again.

Fig. 8 shows a practical circuit for this type of parking light switch and the method of connecting

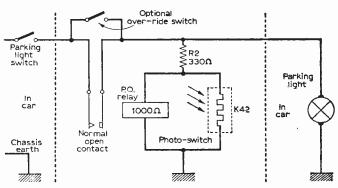


Fig. 8: A 'single-shot' parking light system (II).

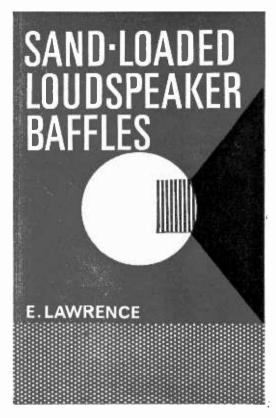
it into the car wiring. Only one switch contact on the relay is used as before, but since the relay is now closed in darkness this must be of the "normal-open" type.

This contact not only controls the supply to the parking light but also that to the relay itself, and hence once the relay opens it cuts off its own supply and cannot close again.

When the lights are to be switched on at night the supply to the relay must be mementarily switched on, whence the relay will lock-in until it opens automatically at dawn.

The simplest way to do this is to push in the relay armature, which makes the relay contact and acts as the required starting switch; if some means of locking the armature in is also provided this

-continued on page 774



THE quality of sound produced by lower-priced tape-recorders and small radio receivers is of a high order bearing in mind the restricted space within the cabinet which must of necessity accommodate both the speaker and the rest of the "works" and it is generally appreciated that given a specially designed enclosure the same loudspeaker would perform more efficiently so that for the equivalent amount of electrical power a greater volume of sound over an extended frequency range would result.

In some cases a listener may wish to effect an improvement in his equipment but he will be deterred from embarking upon the project for fear that it will be a complicated task beyond his capabilities or resources or more likely he will doubt whether, as applied to inexpensive equipment, his efforts are likely to be rewarded with

success.

If the reader wishes to prove to his own satisfaction the importance of the correct mounting of loudspeakers and has a spare which can be used as an extension unit, it is an easy matter to compare the effect of a rudinentary baffle, fashioned from a large piece of stiff cardboard with a central hole of appropriate size, added to the otherwise unmounted speaker while this is in operation, to observe the immediate improvement in reproduction especially in the lower register.

Even though this arrangement is not by any means ideal, the sound now has a more pleasant 'quality' compared to the thin 'toppy' effect

without the baffle.

There is a risk, of course, that an ill-designed

or poorly constructed complex enclosure may prove disappointing where a well made simple one may give satisfaction, especially if it is desired to have the equipment in portable form for lectures and recitals where the question of transportation weighs heavily.

It is suggested that the reader who desires to find out whether his equipment is capable of producing better results may care to construct a plain baffle for test purposes and if he is satisfied with what he hears he can then convert it into

something more elaborate.

#### WHY A BAFFLE IS NECESSARY

A full discussion of the theory governing this subject is beyond the scope of this brief article but it must be explained that the air vibrations which constitute the sound waves from the loudspeaker are the result of the reciprocating action of the cone.

It is easy to see that air compressed as the cone moves forward will escape round the unprotected edge of the speaker to reinforce the low pressure region created at the rear so that the two trains of waves, being in anti-phase, tend to cancel out; an effect which is less pronounced as the frequency

rises, hence the apparent lack of bass.

By interposing a physical barrier between these two vibrating air masses it is possible to reduce the effect by a factor which depends upon the area of the baffle, which should be as large as possible, although in practice the dimensions need not exceed about three feet per side for reasonable performance from a small speaker.

performance from a small speaker.

It is important, however, to choose a material having sufficient density to prevent the structure yielding to the effects of the sound waves impinging upon it and thus transmitting the wave motion. It is especially important to avoid the natural frequency of vibration of the baffle falling within the frequency range of the equipment as such reasonance can cause a very objectionable boominess.

Mounting the speaker in a hole in a brick dividing wall between two rooms is an excellent practical solution to the problem but this and other bizarre ideas, often proposed in Hi-Fi circles, such as the use of a length of drainpipe or a brick corner cabinet are ideas which are seldom received with enthusiasm by other members of the family so that the average listener must be content with conventional materials such as thick plywood or blockboard.

#### MAKING A SIMPLE BAFFLE

Fig. 1 shows one way of making an efficient baffle from materials which at first seem unsuited to the task. Hardboard is an attractive alternative to the other popular materials by virtue of its cheapness but it lacks the requisite degree of density, a deficiency which can be overcome by producing a composite structure of cellular form in which the cavities are filled with sand.

The sheet of hardboard selected for the front is first prepared by cutting a circular hole of the required diameter to suit the loudspeaker. Strips of planed wood about 1in. square are then fixed round the edges and to form a square enclosing

the speaker opening with cross members inserted to sub-divide the intervening space. Liberal use of adhesive, supplemented by tacks, is recommended to ensure sound joints. Fig. 1a shows a

detail of the construction.

When the adhesive is set, the cavities may be filled with dry sand which is settled by tapping the edge of the sheet. The second piece of hardboard, with a square central hole to match the wood frame surrounding the speaker then completes the assembly. It may be prudent to enclose the speaker in a fabric bag as a precaution against stray sand grains entering between the speech coil and the magnet gap.

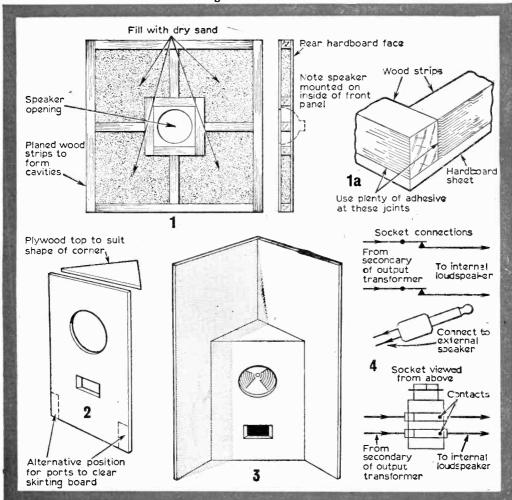
It is advisable to ensure that the sand is quite dry to prevent deterioration due to dampness which could occur after a lapse of time and when securing the loudspeaker to the inside surface of the front sheet the use of bolts with wing nuts will render its removal easy for storage and transportation. The face of the baffle may be covered with one of the ornamental woven fabrics. Attach a couple of rubber feet, a carrying handle and a hinged rear support with safety chain and the job will be finished.

The principle of sand loading is not, of course, confined to this simple form of baffle. Almost any enclosure will benefit from the increased density obtained in this way. A plain baffle

density obtained in this way. A plain baffle modified to form a corner cabinet by including a port and a triangular plywood top is shown in Fig. 2.

The writer has successfully used a simple baffle mounted in a disused fireplace so that the chimney acts as the cabinet. In a large hall or on stage a temporary corner can be fashioned from two large plain rectangular sand-loaded panels set at right angles as shown in Fig. 3.

Figs. I to 4 below



#### CONNECTING THE EXTERNAL SPEAKER

Most commercial tape-recorders and some radio receivers provide an outlet for an external loud-speaker and it is important to ensure that the component which you propose to use has a speech

coil of the correct impedance.

If in doubt, consult the handbook or the manufacturer's agent and if it should happen that your loudspeaker has a  $15\Omega$  coil and the equipment is designed for  $3\Omega$ , or vice-versa, a special transformer, designated type WMT 1. is available from Messrs. Wharfedale to take care of this situation.

In the absence of an external speaker socket it is a simple matter to instal one. Purchase a standard telephone jack socket and plug and locate the former in a conveniently placed hole in the cabinet, disconnect the internal speaker leads from the matching transformer and re-connect them to one side of the socket as shown. Connect the

internal speaker to the remaining contacts on the socket. For details of socket connection see Fig. 4.

The external loudspeaker should now be connected to the plug through a length of fairly thick flex, such as five ampere mains flex, and when the plug is inserted into the socket the internal speaker will be automatically disconnected as the external one becomes operative.

It is important not to use an audio amplifier without a speaker, or some other form of load, as this may be detrimental to the output transformer.

It must be stressed that you cannot make a silk purse from a sow's ear. In the type of equipment considered here, mediocre results are very often due to deficiencies in that part of the circuit which converts the electrical energy into sound and the use of a properly mounted external speaker will often give a very satisfying improvement for a small financial outlay.

#### MONITORING A BIG RECEIVER

#### -continued from page 748

into the board. The other end is looped around a strong steel pin).

A right-angled piece of aluminium is placed as a bridge under the wire at about one-third of its length from the pin and the wire then tuned to

about 800c/s.

Under the wire an electromagnetic pick-up (made from an Eclipse button magnet wound with 200 turns of 36s.w.g. enamelled wire) is mounted. The output from the pick-up is passed into a microphone step-up transformer placed clear of the field from the loudspeaker output transformer.

The output from the transformer is passed by an earthed, screened lead to a switch ("tone test") on the receiver panel. Closing the switch applies the transformed output to the input of the a.f. amplifier and disconnects the diode output.

To test the amplifier the receiver h.t. switch is opened and the "tone test" switch closed. The monitor is set for a.f. output. The a.f. gain control is set to about half-travel and the h.t.

switch is then closed.

The noise pulse emanating from the loudspeaker on application of h.t. will cause a wide range of frequency vibrations in the baffle board, also acoustic shock waves, and their combined effect

will set the tone string into vibration.

This produces an output from the pick-up which passes to the amplifier, thence, if all is well, to the loudspeaker, thus sustaining the vibration which initiated the string movement. The note from the loudspeaker will build up to a maximum determined by the gain setting and the a.f. output can be visually checked at the monitor.

Knowing the output to be expected from a given a.f. gain setting the output performance of the amplifier (if not its quality!) can be checked.

The above systems still leave something to be desired but have proved quite effective in practice and are far better than nothing. To those readers who use a big set and have no means of monitoring other than an S-meter or a magic eye they may possibly cause some interesting thought on the subject.

#### SHORT-WAVE SUPERHET

#### -continued from page 737

domestic receiver tuned to the BBC Light Programme on 200kc/s near the generator. Tune the generator until zero beat is obtained. The 200kc/s signal may now be injected into the main receiver. In this way the points between the 1Mc/s intervals may be filled in. Note that for the higher harmonics the coupling between the generator and receiver will have to be increased.

The receiver dial is marked with *Indian* ink, using a fine nib. The author found that a gentle roughening of the dial surface with a moist rag sneared with a trace of scouring powder was necessary to achieve a good writing surface. Care is essential during this operation.

#### ALTERNATIVE USES

The author has found other uses for this simple generator. For example, because the oscillator is a two-terminal type coils may be matched exactly by inserting them in the grid circuit of the generator. With one coil in position the generator dial is set an arbitrary point and the signal tuned in on a receiver. The coil is removed and with the generator dial unchanged the other coil inserted. The turns on the coil are then adjusted until the radiated signal is picked up on the set. Similarly, by using known values of inductances the capacities of capacitors may be measured over the range 50—1,000pF.

The unit may also be used, if so desired, as an audio frequency source by modifying the oscillator as follows: Insert the secondary of an old audio frequency transformer between the blank position on the switch and earth. A capacitor of approximately 5,000pF should be placed in parallel with this secondary winding. Delete C1 and insert a 0.01 µF capacitor in place of C1. Disconnect the a.c. source to the oscillator and connect the oscillator to a d.c. supply of approximately 200—250V. The heaters, of course, are still fed with 6.3V a.c. The audio output may be taken from the grid via a 0.01 µF capacitor.

# **IMPROVEMENTS**

# to transistor portables

by J. Longrise

SEVERAL small improvements or modifications can be made to most home built transistor receivers, and it is useful to make some of these, to fill the need for an external aerial, personal phone, or other features not already provided. It is assumed that the receiver is in good condition, and may have been used for some time.

#### External Aerial

Due to directive effects and screening, the internal ferrite rod aerial is unsatisfactory in a vehicle. To overcome this, an outside aerial is often clipped to the vehicle window.

The external aerial is best coupled to the receiver by having a small additional winding on the ferrite rod, as in Fig. 1. This coil can be

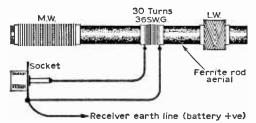


Fig. 1: A coupling coil for an external (car) aerial.

purchased, or may be about 30 turns of any thin insulated wire. A screened co-axial lead is generally taken from the vehicle aerial, so a co-axial socket is best on the receiver. The inner pin goes to the aerial, and the outer sleeve to the outer brading of the co-axial cable.

If the external aerial is merely to increase range and sensitivity, the screened lead is not wanted, and is best omitted. A single sucket of ordinary type will then do for the aerial connection. The loop is returned to the receiver earth line (battery positive). A telescopic or wire aerial can then be plugged in.

#### Reduction Drive

Many receivers have a knob directly on the tuning capacitor spindle. Miniature tuning capacitors of the type fitted in transistor sets may be obtained with integral reduction drive. This

has a ratio of about 6:1, and makes tuning easier. With some receivers, a small ball drive can be

with some receivers, a small ball drive can be fitted, as in Fig. 2. For example, this is possible in the Practical Wireless Celeste if the gang capacitor is moved to the rear of the panel.

Such epicyclic drives have a lug, which must be securely anchored. This may be done by using a long bolt and extra nuts or spacing washers, or fitting a strong bracket. The pointer rotates with the capacitor. The usual ball drive of this type has a ratio of about 6:1.

#### Typical Circuit

Fig. 3 is the circuit of a typical transistor receiver, which may be of ordinary size, or miniature type. This circuit is given to illustrate connections for other modifications. Most of the points covered would apply equally to somewhat different circuits,

#### Clamp Diode

In Fig. 3, automatic gain control bias is obtained from the diode, and applied to the base of Tr2, via R10. Much better control of strong transmissions will be obtained if a clamp diode is added. This requires  $680\Omega$  and  $2.2k\Omega$  resistors, a  $2\mu F$  or similar capacitor, and a diode such as the OA79.

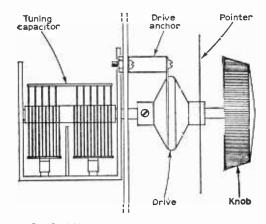


Fig. 2: Adding a ball drive to the tuning gang.

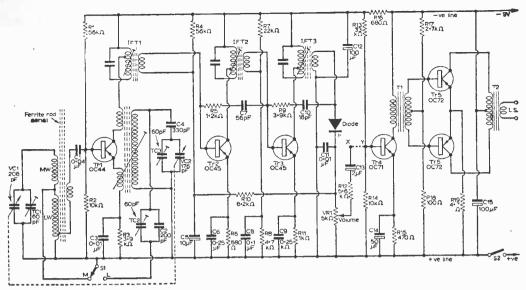


Fig. 3: A typical transistor superhet circuit used to indicate the various modifications.

The second i.f.t. is disconnected from the negative line, so that the  $2.2k\Omega$  resistor may be added, and the circuit changed to that in Fig. 4. Diode polarity is important. The original a.g.c. circuit is left unchanged.

Bias from the voltage drop in the  $2.2k\Omega$  resistor results in the diode only conducting when very strong signals are tuned in. This prevents overbading and improves the a.g.c. action at these signal levels.

#### Low Noise First I.F. Stage

A transistor receiver may have an almost silent background when a reasonably strong station is tuned in, but may have a severe background hiss on weak transmissions. This is because the gain off Tr2 in Fig. 3 is maximum with weak signals. With strong signals, Tr2 base voltage shifts in a positive direction, reducing gain and hiss.

The hiss may be bad if an unlucky combination of R4 and R10 makes Tr2 base voltage rather negative. If this is so, shunting a 33k, 47k or  $100 \, \mathrm{k}\Omega$  resistor across C5 may reduce the hiss considerably. Alternatively, R10 may be slightly reduced in value; or R4 may be increased in value.

With 10 per cent tolerance resistors, the actual base voltage of Tr2 may vary considerably, between different receivers. Tr2 base voltage must not be too far positive, or gain is reduced badly. If one of the transistors Tr2 or Tr3 is relatively noisy it should be in the Tr3 position.

#### Low Noise A.F. Stage

If bad background hiss is present, and does not change in volume when the  $5k\Omega$  volume control VRI is adjusted, it is probably generated in the first audio amplifier stage. This is most likely when an additional audio amplifier precedes the driver, as in popular 7-transistor circuits.

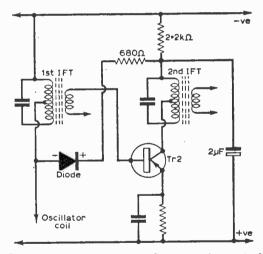


Fig. 4: A clamp diode circuit for improved control of strong transmissions.

If hiss arises in Tr4 in Fig. 3, it may be better to change R13 to  $47k\Omega$ , or to increase R15 to  $1k\Omega$ . Values in Fig. 3 are typical when Tr4 is the first audio, amplifier and driver.

If an extra audio stage is wanted, or if an existing stage is already present before the driver and values are suspected, then the circuit in Fig. 5 may be adopted. Values are chosen to allow good amplification at moderate power levels, with low noise.

The amplifier in Fig. 5 can be added to a circuit like that in Fig. 3, by taking the OC71 base lead X to X in Fig. 3. The new coupling capacitor in

Fig. 5 goes to the existing driver base, Y, Tr4, in Fig. 3. The existing connection between X and Y in Fig. 3 is disconnected.

The additional audio stage is useful if the volume of some stations needs to be increased, though many receivers give an adequate performance with the arrangement in Fig. 3.

#### **Battery Economy**

An unfortunate combination of resistor values in the output stage, in particular, may reduce battery life, yet result in no improvement in performance. This may happen if R17 and R18 are 10 per cent tolerance resistors, and if R17 proves to be a little low in value, and R18 a little high. The current drawn by Tr5 and Tr6 may then be much higher than necessary.

If this is so, the simplest cure is to shunt R18 with another resistor, values from about 470 $\Omega$  to  $2k\Omega$  being tried. This can be done with the set working. Or R17 may be increased in value. The receiver must not be switched on with R18 disconnected.

Should reproduction be distorted, especially when the battery is a little discharged, or when the receiver has been left in an unheated room in winter, R17 may be too high in value, and R18 too low. If so, shunt R17 with resistors of about  $5k\Omega$  to  $15k\Omega$ , or increase R18 in value. Tr5 and Tr6 should draw about 2mA, with no signal.

To obtain maximum gain and output, R19 is sometimes omitted, or is of very low value. This causes high peak currents. It is better that R19

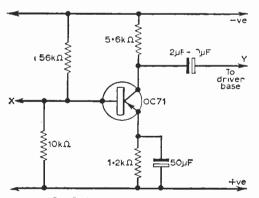


Fig. 5: A low noise first a.f. stage.

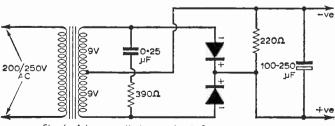


Fig. 6: A battery eliminator circuit for mains operation.

should be  $4.7\Omega$  or  $5.6\Omega$ , which allows good power and sensitivity, with reasonable current drain.

#### Mains Powered Eliminator

When a receiver is often used indoors, and for long periods, it is economical to draw current from the mains. A suitable eliminator circuit is shown in Fig. 6.

An output of about 9V is obtained from a 18V secondary with centre tap. The 220 $\Omega$  resistor helps to maintain a uniform voltage, with changes in current drawn. The 390 $\Omega$  resistor and 0.25 $\mu$ F capacitor form a transient suppressor to protect the equipment from surges caused by switching on and off domestic apparatus.

Half-wave rectification is also satisfactory, though the capacitor should then be increased to 1000µF. For half-wave circuits, the transformer needs no secondary centre tap, and only one rectifier is required.

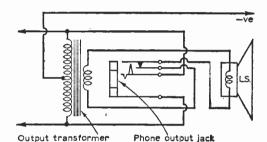


Fig. 7: Incorporating a phone jack socket which mutes the loudspeaker when the plug is inserted.

The unit is best built in an insulated case, with the socket strip taken from an old battery, so that the transistor receiver can be connected easily.

#### Phone Jack

Phones, or a personal phone, allow listening without any disturbance to other persons. If a jack is used with contacts which open when the plug is inserted, these contacts can silence the loud-speaker.

A circuit for this purpose is shown in Fig. 7, and does very well for most medium impedance phones. Few changes are needed to existing wiring.

With some receivers, a phone jack is simply connected so that phones may be plugged in while the speaker still operates. This is also quite

useful, as the volume needed for the phones is quite small.

Occasionally, a jack for low resistance phones is wired in parallel with R18 in Fig. 3. The phones are then operated from the driver stage, and the reduction in resistance across R18 causes the output transistor base voltage to be more positive than usual, so almost cutting off the cutput transistors Tr5 and Tr6.

# on the Short Waves MONTHLY NEWS FOR DX LISTENERS

All times are in G.M.T.

All frequencies are in kc/s.

# The Broadcast Bands-by John Guttridge

A smost aspects of interest to the new shortwave listener have been covered now in this feature, in future much more space will be devoted to schedule changes and observations of various stations. Information from readers will be a great help in making this as comprehensive as possible.

First this month, though, there is an announcement of interest to all shortwave listeners from the International Short Wave Club, which is at present conducting a poll (held every three years) to find the most popular short wave station.

All listeners, whether members of the club or not, are invited to take part. To do so all that is necessary is list your five favourite short wave stations in order of popularity, together with a short note explaining the reasons for your No. 1 choice.

Your vote should be sent to ISWC. London, S.E.16 by December 31st, 1964. Some winning stations have in the past given prizes for the best reasons put forward by listeners in support of their choice. ISWC, by the way, has just celebrated its

35th anniversary-congratulations!

Some good results in the 90 and 60 metre bands have been achieved recently by **D**. A. Lavender of Gravesend. He reports hearing Radio Santa Fe, Bogota, Colombia in Spanish from 0630—0730 on 4,965; Radio Abidjan, Ivory Coast, with news in French at 2225 on 4,940; Radio Rumbos. Venezuela, on 4,970 in Spanish at 2220; and Radio Tananarive. Malagasey Republic. with music and French on 3,232 between 2200—2230. On Sundays, he says, the programme continues until 2300.

Good reception of the European service of Radio Habana (Apt. Postal 7026, Habana, Cuba) is reported by P. H. Holgate of Blackpool. English

is carried on 15,155 from 2010-2140.

Over in Ireland, D. Walsh has been picking up Damascus, Syria, on 15.165 in English from 1600—1630 and French from 1630—1700. E. H. Conduit of Wolverhampton, however, reports hearing these transmissions on 15,230.

D. Walsh also reports that the General Service of *Radio Japan*. Tokyo, Japan, is getting through between 0800 and 1200 on 15,310 and 1200 and

1400 on 9,740.

Several other stations are reported by E. H. Conduit. He says that relays of debates of the United Nations Security Council can be heard on 15,190/21.610. The Voice of America. Bound Brook, transmitter is used. Radio Pekin's transmission to Australia in English comes in well at

0830—0930 on 15,060 he says. Finally he has heard Radiodiffusion Television Marocaine in English between 2030—2130 on 11,735. In London this programme has also been heard on 15,410.

programme has also been heard on 15,410.
From Arbroath in Scotland, **D. Taylor** reports on *Radio Vilnius*, Vilnius, Lithuania, U.S.S.R., which, he says, has an English transmission between 0000—0030 on a frequency in the 42

metre band.

Extensive frequency changes were made by Radio Australia (P.O. Box 428G, G.P.O. Melbourne, Australia) on October 24th. English transmissions affected are: To Southern Asia 2214—2345 on 15,2220 and 1430—1730 on 9,570/7.220; to East Asia 0859—1000 on 11,810/9,570, 2059—2300 on 17,820/15,240, 2300—0015 on 15,240; to Mid Pacific Islands 0630—0915 on 11,710/9,570 and 1800—2115 on 9,600; to North Pacific Islands 0029—0645 on 15,240; to North America 0100—0345 on 17,840/15,220; to Africa 0400—0515 on 17,820/15,220.

The British Isles transmission on 11,710/9.570 moved to the new time of 0814—0915. French can now be heard at 2315—0015 on 17,820 and 0515—0615 on 11,710/15,180/15,220/17,820. Finally new frequencies for the 2245—2345 Indonesian transmission are 11,760/15,330/17,870. Radio Australia's programme for DX'ers may now be heard on Saturdays at 1930 and 2200, Sundays at 0500, 0900, 1300 and 1530, and Mondays at

0215.

A colourful QSL giving all verification details is issued free of charge by Radio Warsaw, Warsaw, to those who submit correct reception reports. Until April, Warsaw broadcasts in English to the British Isles as follows: 1830—1857, 1930—2000 and 2135—2155 on 6,135/7,125; 2030—2100 on 5,950/7.145; and 2230—2300 on 9,540/5.950 and 1.502 medium wave. Listeners' letters are answered on Thursdays during the 2030 and 2230 transmissions. You may also be able to pick up the Australian service which goes out from 0730—0800 and 0830—0900 on 15,120/11,840/9.675.

On November 1 the Swiss Broadcasting Corporation, Berne, put a new schedule into operation. It is valid until May 1st, 1965. Several quite sweeping changes are made including the switching of the British Isles transmission to the morning. It is now aired from 1200—1300 on 7,110/9.665. Other English transmissions are 0715—0845 to Japan and China on 9.670/11.865/15,305; 0900—1030 to Australia and South-east Asia on 0900—1030; 1315—1445 to India and

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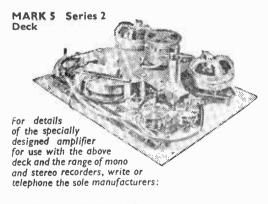
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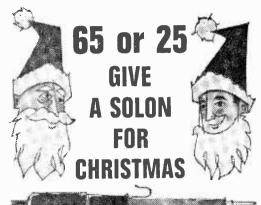


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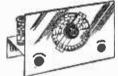
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Africa on 9,535/11,865/17,845/17,795; 1500—1630 to Western North America on 15,305; 1500—1700 to the near and middle East on 9,535/9,665/11,865; and 0115-0245 to Eastern North America on 6,105/6,080/9,535. S.B.C.'s DX programme will as before be transmitted during Saturday's programmes.

An early morning 0600—0630 broadcast in English to Europe is now aired by the Canadian Broadcasting Corporation on 9,625. "Short wave listener's club" is now broadcast on Saturdays and

"Listeners' corner" on Sundays during the European transmission from 1215—1313. This is on 17.820/15,320.

Kol Israel, Jerusalem, Israel, has switched beams for its 2015—2045 English transmission. It now uses 9,625 to Europe and 9,009 to South Africa.

Finally a note on a fairly easy South American. Radio Clube de Pernambuco, Brazil, can be heard well on 11,865 after 2100. There is slight interference from the BBC on 11,860.

## The Amateur Bands-by David Gibson G3JDG

HE Amateur Bands this month have proved quite interesting and DX has shone through here and there, although it has been a bit of a struggle at times.

#### 160m

The first band out of the hat this month is "Top Band" and is proving to be very lively indeed. Some years ago when I was first licensed, "G" stations were the usual thing expected of the 1,800-2,000kc/s section.

By way of contrast one recent listening period of 30 minutes only logged GW3SUY (RST569), GW3TJE (569), GI3JEX (579), OH3NY (569), and OK1AHB. Some 15—20 "G" stations were in evidence at the time, notable signals from "G's" 3ARD. 3SPJ, 3NTD, 3RBP and 6BX.

All were received on a dipole cut for 14,100 and just 15 feet high! Anyone with a decent aerial should be having a ball and American stations are rumoured to be roaming around top band. How about a postcard from you SWL's with a better antenna (or sharper ears)?

#### 20m

From trawlers and top hand out into the wild and woolly 20m. 14,000—14,350 is really hotting up these days and with the numerous contests which are in favour at the moment the band is really humming.

Newcomers might like to note that the band (as are all bands) is divided into two sectors, the CW sector and the Phone sector, the CW sector occupying the l.f. portion of the band. However there is no shortage of activity at either end of the 20m band at the moment.

The 1964 Scandinavian Activity Contest was very much in evidence and OH5SM, OH1VR, OH1QY, OH5NQ and OH0NI (Aaland Island) were worked in 14 minutes on a.m. 'phone. After this the novelty rather wore off, hearing the other station coming back "Ur 58082 73—CQ..CQ..etc."

Later in the month it was decided to check how popular single-sideband was by logging only stations using this mode of transmission in the 'phone sector of 20m. One sitting, over a period of 1½ hours resulted in some thirty stations logged on s.s.b.

"Twenty" at the moment dies out from about 01-00 onwards but from mid-afternoon till midnight it's a virtual hive of activity. Heard in one hour from 2045—2145: W9ECC, W1QCL. W2GWE, W4HCM/P, W0HLT, HB9NY, W9NWQ, W0QUU,

W8NKW, W9JT, VE3COB, W2KXL, W1HZ, WA2SFP, W0VQ, K2UYG, CN8AX, W4HZR, K8LTT, W4ODL, CT1SQ, W4HZI, W8LXU, W3ZAO/MM (Maritime mobile), PY4AEB, SV0WGG (Crete) and K2YLM, all averaging five and eight except PY4AEB. All these with a dipole just 15ft high. Anyone with a beam hear anything else: JA—VK?

Speaking of VK, the VK/ZL contest might have afforded someone their first station from that part of the world, or was it the same as at G3JDG—rather quiet? At the time of writing the 'phone event has passed silently on but the c.w. event is scheduled for the coming weekend, needless to say the receiver is being checked and the dial polished in readiness.

#### 15m

In the 15m band report last month I said that things at this QTH were rather dead. This brought a letter from K. J. Clark in London, N.15, reporting W2JY, G3CAZ, HL1JP, WA4YO, K1WPF and HL4OX, using an HE40 receiver acquired the day before, and the antenna a 30 foot vertical.

So there it is. There are stations about on 21 Mc/s so perhaps it's a question of what time to listen. K. J. Clark's times for the above list was the period 19:30—20:00.

#### 40m

7000 --7100 has been almost hopeless at the time of writing. Listening in the evenings from 1900 onward, European stations have appeared but the QRM from commercials (who have no right to be there anyway) makes it extremely difficult.

there anyway) makes it extremely difficult.
On one occasion a 9M call sign (Malaya) was located and read as 9M2L?? (either LD or LO or even LM), but due to terrific QRM from a commercial the station was lost. Remarks made at the time will not be repeated here!

A suggestion which might prove hopeful is that all licensed amateurs who run tests with the antenna connected, in future should do so on frequencies occupied by these stations. If this procedure were adopted on a world-wide scale it might well prove a success, especially if our friends in W-land joined in, since their licence permits them to run 1,000W as opposed to the British amateurs' 150W.

#### I0m

Activity on the 10m band is still quite high. Local nets are very much in evidence still, though

-continued on page 786



# "Practical Wireless" Report

★ A summary of new models seen at Earls Court and the trade exhibitions around London, and notes on design trends and features.

★ The tables list new models only and do not necessarily represent the complete range of the makers concerned.

★ For details of all the new TV sets, refer to the November issue of *Practical Television*.

CONTINUED FROM PAGE 640 OF THE NOVEMBER ISSUE

## Earls Court, August 24-September 5, 1964

Last month, our Radio Show Report covered radiograms, transistor portables and table radios, leaving record players and tape recorders for comment this month.

## Tape Recorders

This was perhaps the least novel market, makers concentrating more on general improvement than innovations. New models were shown by Dansette, Sound, Defiant, Ferguson, HMV, Ultra and the luggage makers, Wood and Son (Revelation), at Earls Court.

Outside the main show there was more variety from the many low-priced Japanese and German models to the very fine American design by Roberts shown by Argelane.

Those of most interest to enthusiasts were the newer Grundig offerings, including the TK32A at

49gns, which now includes a switch to cut out the automatic recording level circuit this firm brought in with a flourish originally.

The "automatic" facility has also been added to the two lower priced models, Auto-2 and Auto-4, 25 and 27gns., of the Elizabethan range, in a determined effort to capture the "pop" market. Similar circuitry can be incorporated in the new Sound range of five machines on demand at no extra cost, we are informed.

Of the Elizabethan offerings the two attractive newcomers were the stereo models LZ511 and

			TAPE REC		
Model	Deck	Tracks	Speeds	Price	Features
COSSOR 1606	Own	4	31	29 gns	Transistorised, M/C Mic.
1607	Own	4	32, [7	57 gns.	Mono/Stereo Rec. and P/B Multiplay.
DANSETTE Empress	B.S.R.	4	3 1 1 7 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1	37 gns.	Professional type control panel. Legs optional 7 in spools.
DEFIANT TI6	B.S.R.	4	33	38 gns.	Conso'ette
ELIZABETHAN LZ507	Own	4	74, 32, 17	49 gns.	Transistorised.
LZ511	Own	4	71, 32, 12	65 gns.	Stereo.
Auto-2	B.S.R.	2	32 31	26 gns.	Automatic Record.
Auto-4	B.S.R.	4	3 <del>1</del>	28 gns.	Automatic Record.
FERGUSON 3204	Thorn	4	3ž, 17	33 gns.	M/C Mic. Remote Sw.
3206	Thorn	2	33, 17 31, 17	26 gns.	Key operation.
GRUNDIG TK23A	Own	4	33	49 gns.	Switched automatic.
PIZT	Own	4	3 }	54 gns.	Wood case, Auto-stop,
HMV 2204B	Thorn	4	31, 17	36 gns.	8 x 5 ins. L/S.
KORTING MT3624	Own	4	7≟, 3≩, 1≩	95 gns.	Dubbing facilities. Fully stereo.
MARCONIPHONE 4204	Thorn	2	3½, 1½	25 gns.	Fast wind muting.
4204	Thorn	4	37, 17	33 gns.	Sync track replay. Auto control.
PHILIPS Stella	Not on \$	how-see	text for deta	ils.	
Peto Scott	Not on s	how-see	text for deta	ils.	
REVELATION RTIB	Collaro	2	71, 32, 12	42 gns.	To match R18 R/P.
ROBERTS (Argelane)	_	4	33, 71	£175	Stereo, two 5 x 7 in speakers. Transportable.
SOUND TREIA	B.S.R.	2	33, 71 31	24 gns.	5∄ in. spools•
TRE23	B.S.R.	4	33	27 gns.	DIN sockets (all models).
TRE32	B.S.R.	2	7호, 3호, 1급	30 gns.	Auto-record (all models).
TRE34	B.S.R.	4	74, 3초, 1급	33 gns.	7 in. spools.
TRE40	B.S.R.	4	71. 32, 12	45 gns.	Separate tone controls. Mixing, Monitorin Straight through amp.
ULTRA 6202	Thorn	4	34, 17	33 gns.	Remote control.

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Panei, Knobs, etc.	£5,12,6	+ 3/6 Carr.
B.S.R. Monardeck Type TD2	£7.7.0	+ 4/6 Carr.
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Lead and Pluga, Instructions, etc	£1.0.0	+ 2/- Carr.

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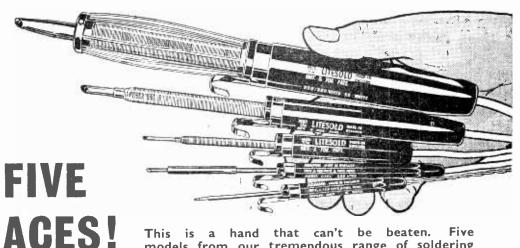
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ALBA 212B	BSR UAI4	19½ gns.	7 x 3½ in. L/S. 2W o/0.
DANSETTE Imperial		16 gns.	7 x 4 in. L/S.
DECCA RP205	BSR Transcription	30 gns.	Separate tone controls. Diamond stylus. 9½ x 5½ in. speaker. BW push-pull amplifier. Detachable legs.
	Garrard AT5	32 gins.	Deram stereo cartridge. 8 x 5 in. speaker.
DEFIANT CPI	Garrard AT5	38 gns.	Part of Unit-plan, Consolette. Stereo facilities, less second speaker.
DYNATRON GRIO	Garrard AT6	39 gns.	10 x 6 in. L/S. 5 watts push-pull output from 3-stage amplifier.
EKCO RP432	Garrard	27 gns.	Ronette cartridge, diamond stylus.
FERRANTI RPI106	BSR UAIS	27 gns.	Independent tone controls. Adaptable for stereo
RP1105	Garrard	19 gns.	7W output. Straight-through amplifier.
FALCON Falcon	BSR UA16		7 x 4 in. speaker.
FERGUSON 3006	Garrard ATS	14 gns.	2-valve amplifier.
FIDELITY HF27	BSRUA25	27 gns	Transistorised. Mic. input.
HF28	BRS	15 gns.	<del>-</del> .
HACKER GP40		24½ gns.	9 x 6 in. and tweeter L/S.
KOLSTER-BRANDES KP031	Garrard SP25	65 gns.	Consolette. Version of Serenade gram, less radio unit.
KP032	Garrard Autoslim	19½ gns.	I ransistorised. 7 x 3\(\frac{1}{2}\)in. L/S.
MARCONIPHONE 4006	Garrard AT5	23½ gns.	Transistorised. 7 x 3½in. L/S.
MILE 3HV AN ACCIO	BSR UAIS_	24 gns.	Transistorised, Mic. input.
MUINZHY A-Major A851G	Garrard AT5 p	34 gns	3W push-pull. 8 x 6 in. L/S and 4-in. tweeter. Sonetone head.
HMV 2010	Garrard AT5	45 gns.	Transistorised. Two side-mounted 8 x 5 in. speakers. Two tweeter.
PAM 5205	Garrard Autoslim	18 gns.	7 x 4 in. speaker
5206	BSRUA15	25 gns.	7W output. Separate tone controls.
PERDIO Deciay	BSR UAIS	14 gns.	7 44 Output. Separate tone controls.
Startime	BSR UAIS	17 gns.	Transistorised.
Starmake <b>r</b>	BSR UAIS	19 gns.	
PYE Achoic	BSR UAIS	69 gns.	Transistorised.
Transistor Black Box		_	Transistorised. Stereo. 6 loudspeakers. Batterfly head. 5W each channel.
	BSR 4-speed	41 gns.	Transistorised version of popular range.
REVELATION API8	BSR UA15	28½ gns.	Impact cabinet. Stereo adapted. 6W p-p amp. 8 x 5 in. L/S. Separate tone controls.
RIB	BSR UAI4	23 gns.	Styled to match RT18 tape recorder.
REGENTONE TP431	Garrard Autosim	19∮ gns.	Transistorised.
TP432	BSR UAIS	23 gns.	
RGD RP231	Garrard Autoslim	194 gns.	Transistorised. Separate tone controls. Pilot It. Transistorised.
RP232	Garrard 3000	23 gns.	Transistorised.
STELLA 571A	Philips. 4-sp.	27 gns.	
ULTRA 6004	BSR UAIS		Thermometer-type scale indicators.
	DU. OA 13	15½ gns.	2½W output. 7 x 4in. L/S.

LZ507. The former is an Anglicised version of their very successful American export with 6W output and two detachable speakers, while the latter is a fully transistorised mains model selling at only 49gns, with three speeds and two recording

Fidelity again showed established models and added their name to the list of those making a debut into stereo radiograms.

#### Record **Players**

Transistorisation, with its attendant advantages of instant operation, cooler running and claimed greater dependability, as well as an obvious weight saving, makes the record player market again newsworthy.

It was pleasing to note one subsidiary feature of this trend—the smaller, cheaper mains transformer could now be fitted on all models requiring the low power consumption of the "solid state" circuit and, consequently, the dangerous a.c./d.c. chassis was much less in evidence.

Common features were the front-facing speaker of generous proportions, more comprehensive tone control systems, provision of a tape socket (despite the strong copyright law against its use!) and input arrangements that allowed the record player to be employed as a straight-through amplifier, some makers featuring this as a speciality by also providing a microphone.

Lighter pick-ups, improved versions of the popular mechanisms and common provision of a stereo cartridge are to be found even in quite

modest price brackets.

The new Thorn deck was much in evidence, being incorporated in models by Ferguson, HMV, Marconi, Ultra and the Retra "Five-Star".

Kodak made news with a quadruple-play tape, type P400, made for portable battery tape recorders, on 3in. spools (or 34in.) at £1 13s. 6d. and £2 2s. for 600ft and 800ft respectively, giving a playing time for an 800ft spool of 42min, at 3\frac{1}{4}in./sec.

One or two specialities made an impact, including the Pye Achoic, claimed to be the smallest truly stereo unit quality performance. Side-mounted banks of two-plus tweeter speakers bounce the sound from adjacent walls. The deck uses the "butterfly" pick-up now widely employed by this company which tracks at only two grams but has a floating action, enabling the stylus to keep its groove, even on a warped record or under sudden shock.

Several newcomers to this field were noted. Sound, the Tape Recorder (Electronics) people, had a record player on show, as did Perdia, better known for portable radios, Arnolds (Arts) Ltd., Sanders (Electronics) and Robuk.

Among those of particular interest outside Earls Court was a stereo portable, battery-powered record player with hi-fi stereo headphones by S. G. Brown, marketed by Lugton's. With the addition of baffle speakers in matching shoulder bags this three-speed player at 32gns., plus 7gns. for the phones, makes a notable return to domestic entertainment for this firm.

PART 3—TRANSISTOR VOLTAGE
AMPLIFIERS

# Understanding SEMICONDUCTORS BY LESLIE MOORE

CONTINUED FROM PAGE 666 OF THE NOVEMBER ISSUE

THE basic requirement of an amplifier is to make some electrical signal larger. The "voltage swing" or peak to peak voltage of the input signal should be known to enable the design of an amplifier. The frequency range of the input signal is also of great importance.

Input signals to transistor amplifiers are usually applied across the base-emitter terminals. The output is taken from the collector and emitter.

It was seen that the base current necessary to operate a transistor is in the order of microamps and a variation of a few pA base current produces a variation of mA collector current.

a variation of mA collector current.

Consider the circuit in Fig. 19—B1 and R in series provide the emitter-base voltage, B2 and R<sup>1</sup> in series provide the collector-emitter voltage.

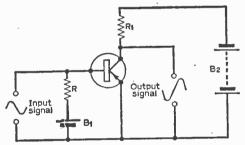


Fig. 19: Illustrating the principle of the transistor voltage amblifier.

Upon the application of a small alternating voltage signal across the base and emitter the collector current will also alternate. A rise of the input voltage will result in a decrease of collector current, a fall in input produces a collector current rise.

Assume the input signal voltage variation to be 0.1V causing a collector current swing of, say 10mA. A value of  $500\Omega$  for R would produce a voltage swing across R of  $10\text{mA} \times 500\Omega = 5\text{V}$  by Ohm's law. This is the principle of the voltage amplifier.

There are several disadvantages, however, with the circuit in Fig. 19 and a more practical circuit is shown in Fig. 20. Only one battery is used in the circuit and the base-emitter bias has been achieved by the inclusion of two additional resistors and a capacitor.

The values of components may be obtained simply with the aid of the transistor static-characteristic curves and a knowledge of the current flow directions in the circuit. The current directions marked in Fig. 20 are those of hole conduction. R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and C provide the base-emitter bias.

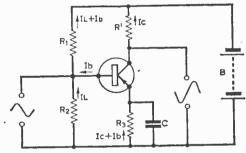


Fig. 20: Illustrating hole conduction in a p-n-p transistor voltage amplifier.

To obtain the static value of collector current a "load line" must be drawn on the output characteristic curves.

The position of the load line depends on two factors:

(1) the value of supply voltage;

(2) the value of R1.

Two points, one on the Vce axis and the other on the lc axis of the output characteristic graph provide sufficient information to allow the construction of the load line.

When no current flows through the transistor (cut off) no current will flow through R' or through the emitter-resistor R<sub>3</sub>, therefore the value of Vce is equal to the supply voltage. This point can be plotted on the Vce axis when the collector current is equal to zero.

For maximum collector current flow the transistor will be virtually a short circuit so that the whole supply voltage will be seen across R<sup>1</sup>.

From Ohm's law, maximum value of current is

given by  $\frac{VS}{R^1}$  amps.

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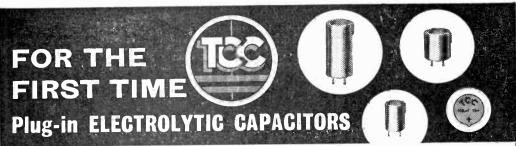
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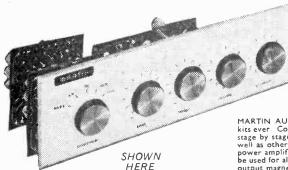
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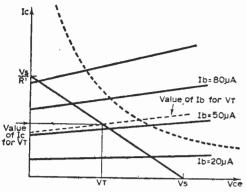


Fig. 21: Use of the load line for obtaining circuit parameters. The dotted line represents the power limitation curve set by the manufacturer.

A suitable working value of collector-emitter voltage is chosen (VT in Fig. 21), and hence a value of base current and collector current from use of the load line.

The voltage drop across R1 is calculated, again, by Ohm's law:

Voltage drop =  $I_c \times R^1$  volts

VT is known

Therefore the voltage across  $R_s = Vs - [(I_c \times R^1) + VT]$ .

From the appropriate input characteristic curve for the transistor (Ib against Vbe), a static value of V<sub>be</sub> may be obtained.

The voltage drop across R<sub>2</sub> must then be the

voltage drop across  $R_a$  less  $V_{be}$  i.e. Voltage drop =  $[(R_a \times [I_c + I_b]) - V_{be}]$ . By choice of a suitable value of  $I_L$ , a value of  $R_a$ could then be calculated from:

 $[(R_3 \times [I_c + I_b]) - V_{be}]$ 

· IL The voltage across R<sub>1</sub> is the difference between the supply voltage and the voltage across R2. A value of IL has been chosen, a value for Ib is taken from the load line and hence R<sub>1</sub> can also be calculated by Ohm's law.

It is important that the input signal neither saturates nor cuts off the transistor.

Some of the design points of a transistor amplifier have now been dealt with, but frequency range, which has only been briefly mentioned, can be the most important consideration.

The collector and emitter of a transistor them-selves act as a capacitor, the value is extremely small but sufficiently large to limit a transistor's

working frequency.

The required working frequency range of an amplifier is important as the gain of an amplifier varies with frequency due to a number of factors. These include frequency response of the transistor used, choice of components and type of inter-stage coupling.

An amplifier may consist of more than one transistor stage; Fig. 22 shows the circuit diagram for a typical two stage amplifier using R-C

coupling.

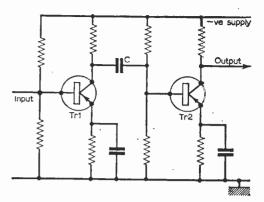


Fig. 22: A two-stage transistor voltage amplifier.

Capacitor C blocks any d.c. levels on the collector Tr1 from the base of Tr2 but allows an alternating signal to be passed on.

Capacitors oppose the flow of alternating currents to a certain amount, the amount of opposition depending on the frequency applied and the value of capacitance of the capacitor. Opposition of this kind is known as capacitive reactance.

Considering the first transistor stage of Fig. 22 we know that its output resistance can be large. Opposition to both a.c. and d.c. is known as impedance. The output impedance will also be

The input impedance of a common emitter transistor is small compared with its output

impedance.

With reference to Fig. 22, if the first stage amplifies a signal with a factor of 40 (i.e. a gain of 40) and the second stage has a gain of 40, the overall gain of both amplifier stages will be:  $40 \times 40 = 1600$ 

The second stage appears as a low impedance to the first, but the first stage has a high output impedance. The total effect is for the internal impedance of the source to "drop" a greater proportion of the output signal than is desired, the actual output being less than the theoretical value of 40 times the input value. The overall gain of the amplifier would effectively be Jess due to the "missmatch" of impedances.

A circuit with a considerably higher input impedance than the grounded emitter amplifier and a much lower output impedance could be included between the two amplifier stages nullify the effect of missmatched impedances. The "emitter follower" is suitable for this purpose.

In Fig. 23, R1, R2, R3 and C supply the Vbe bias.

If the base were to go positive with respect to Vbe, the current in the collector becomes smaller the transistor appears to have a larger resistance. A greater proportion of the supply voltage is dropped across the transistor thus making the emitter go more positive.

Conversely, if the base were to go negative with respect to Vbe, the emitter would go more negative.

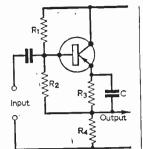


Fig. 23: Common-emitter circuit diagram.

The gain of this circuit is slightly less than unity but the output voltage remains more or less constant for whatever load is applied to it providing the current being drawn is allowing the transistor to work within its power limitations.

We have then a method of providing a method of amplifier stage impedance matching.

It is often desirable to have a reasonable power output from an amplifier. Unfortunately the characteristics and limitations of the more inexpensive transistors do not allow a large power dissipation. Power transistors are expensive and require a high static current.

An amplifier known as a "push-pull" amplifier is very often used to overcome such difficulties. The circuit diagram is in Fig. 24.

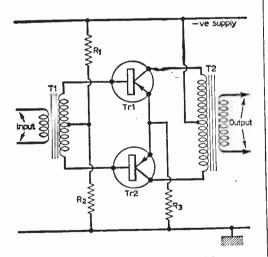


Fig. 24: The push-pull transistor amplifier.

To direct current the windings of the transformers are virtually short circuits.  $R_1$ ,  $R_2$  and  $R_3$  act as biassing resistors for both Tr1 and Tr2.

Across the secondary windings of T1 the positive and negative half cycles of the signal would alternatively act in opposite directions. Tr1 will amplify one half of the cycle, Tr2 will amplify the second. T2 operates in the opposite manner to T1 and an amplified output is obtained.

Part 4 follows next month

#### **PHOTOCONDUCTORS**

—continued from page 755

will serve as an over-ride switch, cutting out the photo-cell control and converting from automatic to manual operation.

Alternatively both starting and over-riding may be done electrically by fitting an over-ride switch as shown in the diagram. Switching this on momentarily locks in the relay at night, and leaving it on cuts out the automatic control; in some cars the parking-light switch position already provided may be used in this way.

The same considerations about construction and mounting applied to the previous switch also apply to this.

#### Light Operated Switches in General

The circuits so far described have obvious applications not only to parking light switches but also to automatic shop display-lighting switches, simple burglar alarm systems, automatic counters etc. The following notes will help the reader to modify the previous circuitry to his specific requirements.

In counters and alarms speed of operation is essential since the light beam may be broken for only a fraction of a second. The K42 cells do not change their resistance instantaneously when the illumination changes but have a time constant of about one tenth of a second. Thus the relay used must be sensitive and of the high-speed type.

In burglar alarm systems the alarm once set off by the breaking of a light-beam must continue to sound even when the beam is made again. Thus the single-shot working in which the relay cuts off its own power supply is essential; this also ensures that the alarm sounds if the power supply to the relay fails.

When controlling shop-lighting or any other high-power system it is essential to have heavy duty contacts on the relay. The light-contacts commonly found on P.O. relays rapidly deteriorate when used to switch high voltage and power.

There are cadmium sulphide photo-conductive cells which will operate a.c. relays direct from the mains, but these are larger and more expensive and the K42 will not do so. Some d.c. power supply must always be provided, either batteries or rectified a.c. The latter need not be well-smoothed, and a simple power supply to drive 12V relays is shown in Fig. 9.

The reader will notice that so far no provision has been made in the circuitry for adjustment of the sensitivity of the K42 control circuits. This is because optical adjustment by means of masks over the K42 is far easier, less wasteful of power and more reliable than electrical control.

The sensitivity of the K42 is proportional to the sensitive area exposed to light, and by placing masks over the glass window the sensitivity may easily be controlled.

Any opaque material may be used for masking and the writer has found black p.v.c. tape most useful. To make the K42 sensitive to light from one direction only it may be placed at the end of an opaque tube facing in that direction.

Part 2 next month

RO. 10

A.T. 5

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R. 45

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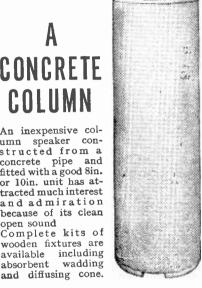
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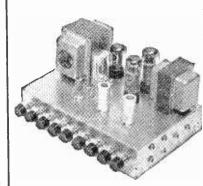
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# BOOKS REVIEW

STEREOPHONY, by N. V. Franssen. Published by Philips Technical Library and distributed in the U.K. and Eire by the Cleaver Hume Press Ltd. 86 pp., 6in. x 9in., 64 illustrations. Price 21s.

MHIS book is rather different from most on the subject. It concerns itself mainly with the actual mechanism of hearing and offers many theories on this.

I found the book in no way practical, and rather heavy going, somewhat reminiscent of certain

textbooks on psychology.

For the expert or someone who wants another facet of stereophony to examine then this is undoubtedly the book. If however, you are practically minded, or if you like your theory complete with diagrams and circuit values then it is not possible to recommend this volume to you.

The inside front cover assured me that certain principles would be made clear in a very readable and non-technical manner. Yet before I had gone 12 pages I was beseiged by 14 graphs, informed that . .

 $\triangle t = 0.24$  (a + Sin a) and also that  $\psi(\triangle L, \triangle t) =$ 

 $\psi(0, \Delta t) + \psi(\Delta L, 0)$ There are only three chapters excluding the introduction and two appendix. To give an idea of the theme, chapter two is headed "The Faculty of Auditory Perspective", and is divided into various headings such as "The theory of intensity ratios";
"The theory of difference in timbre"; "Binaural frequency analysis" etc.

As may be judged by the above, the book is theoretical and somewhat specialised in its outlook. The curious will probably enjoy a browse through such a work, and the knowledgeable might perhaps find interest in the various theories contained therein. To the layman, beginner, and average radio enthusiast however, it is doubtful if there will be much of value offered by this book-D.J.G.

WIRELESS FOR BEGINNERS, by C. L. Bolz. Published by George G. Harrap & Co. Ltd. 232 pp., 73in. x 5in., boards. Price 18s.

RE you a newcomer to the world of wireless? Do you come into the category of a novice? Would you like to read a book which will enlighten you without boring you?

If the answer is "yes" to these three questions, and your bank balance stands at 18s. or more, then purchase of the above book is recommended.

Everyone, no matter how clever, must always at some time or another have been a beginner. Intelligent reading of technical journals helps in the education of a particular subject, but the author of a technical magazine must, of necessity, limit his contribution to reasonable dimensions and omit many obvious points. Obvious to him and to more knowledgeable readers, but not to the poor novice. The reading of a good basic book, therefore, is a decided asset. In Wireless for Beginners a great number of the basic facts are presented in an easily digested form.

A criticism of the book would be that one or two statements in it are dogmatically alarming if not actually untrue. This is mentioned in all fairness to any beginner buying a copy after reading this review. One sentence on page 104 states that Valve triode detectors are now never used at all ". This is not strictly true as readers of PRACTICAL Wireless will know! Again, page 172—speaking in terms of 3-30 Mc/s the author says a station in Edinburgh would probably not produce any signal which could be picked up in London, yet the working of Scottish stations by London amateurs between 3 and 30 Mc/s is quite

One haffling part of the book is a sentence on page 174 which leads us to believe that f.m. is useless unless a limiter is used, and five pages further on assures us that a ratio detector can give good results without a limiter.

Other than these few small points, the book would appear to be a good "buy" from a beginner's point of view, especially to those who prefer "easy" reading.—B.S.A.

RADIO SERVICING MADE EASY, by Leonard C. Lane. Two volumes. Published by Gernsback Library Inc. 191 pp. each volume, 81 in. x 51 in. Price 20s. each.

MRST impression to be gleaned from a reading of these two volumes is that the "C" in the middle of the author's name stands for "Chatty". In a free and easy manner that must be envied by the British technical writer, accustomed to squeezing quarts of information into his publisher's pint pot, Mr. Lane spreads himself over and around his subject, omitting nothing.

Some indication of his confident approach can be given by a quote: " ... vou'll be able to look any radio set right in the face and say: See here. No nonsense out of you or else . . ."

The irony of this is that, provided the reader can stomach the brashness, a real, working knowledge of radio sets, their circuitry and the servicing procedure that can unravel their faults, is contained in these twelve chapters.

Mr. Lane begins with transistors, the first chapter explaining the semi-conductors and their characteristics, with a venture into basic circuitry. while the second chapter goes into printed circuit boards and transistor testing. Only after sixty pages do we meet the question of servicing techniques. This book is worth buying for this chapter alone, and for the trouble-shooting charts, a feature of several transatlantic books that has been slow to catch on in this country.

Chapters 4 and 5 deal with auto-radios, emding with a few pages on the troubles that can crop up from the mechanical and electrical systems of the car itself. Chapter 6 takes us into Volume 2, and to a.m. receivers, valve-operated, that is. Next, we

meet f.m. sets, then a.m.-f.m. tuners, and so to the "good" stuff, to use the author's phraseology-the communications receiver.

Chapter 10 goes even further, dealing with marine receivers, while the mobile systems that are coming into more regular use are discussed in the next few pages. The final chapter covers miscellaneous receivers and a few special circuits.

At the end of each chapter a list of questions is given. These are carefully chosen-even provocatively chosen—to test the reader's attention to the foregoing text. These, in conjunction with the trouble-shooting charts, would be of help to the reader who wishes to use a work of this nature as a reference book. The comprehensive index at the end of each volume is also a helpful point. Despite a few insultingly childish illustrations, the drawings and photographs that are generously scattered throughout these pages do much to underline the author's points.

Given a tolerance of the patronising air which assumes the reader knows nothing, and an ability to discount some shocking doggerel and worse naivety, the casual reader might profit from these volumes. Whether he would be able to "jump right in with both feet" and earn a living by servicing radio receivers is another matter entirely.

-H.W.H.

HOW TO READ SCHEMATIC DIAGRAMS, by HOW TO READ Donald E. Herrington.
Published by W. Foulsham 8
128 pp., 6in. x 9in. Price 188. Donald E. Herrington. Published by W. Foulsham & Co. Ltd.

THE art of mastering the languages of different countries is practised by many people and these are usually referred to as linguists. A person referred to as a radio, wireless or electronics enthusiast also has to master a language—that of circuit diagrams.

A good map reader can win or loose a motor rally and so too the electronics hobbyist can make very little headway in the field of radio until he

"read" circuits.

If you are unable to follow circuit diagrams or are floundering then you can be saved! Mr Donald Herrington has thrown you a life-belt labelled

"How to read schematic Diagrams'

Each chapter is not content merely to show a component and the symbol for it, but describes its construction, function and use. There numerous photographs of the different components which will assist in identifying the actual article, together with many symbols of the same component which are likely to be encountered.

One small point is that there is a photograph on page 40, Fig. 4.1., which depicts two coils wound, according to the text, on phenolic coil formers. These are referred to as "air cored coils". To me an air cored coil is one which is self supporting, i.e. the core is air. The text states "as long as this form is not capable of being magnetized, the effect is the same as if no form were employed.

However, there assuredly is a difference, especially on short waves between winding a receiver or v.f.o. coil on cardboard and the same coil wound

The book is completely successful in accomplishing what it sets out to do-teach how to read schematic diagrams, and can be confidently

recommended at the reasonable price asked.-

ELECTRONICS DATA HANDBOOK, by Martin Clifford. Published by Gernsback Library Inc. 158 pp., 8½in. x 5½in. Price 23s.

THE formulas which form the basis of this book are many, and all of course, in some way relate 1 to the subject of electronics. Now this might lead the average reader to expect a formidable mass of unintelligible equations with meaning only to an Oxford don. This is not the case however, as most of the formulas are arranged to follow on from one another in logical sequence with explanatory text between each. More than this, the author illustrates how formulas or groups of formulas are used to solve various problems.

For the serious amateur radio enthusiast then, this work of reference will be of use, for even the simplest circuit is subject to the basic laws which can also govern the operation of a computer.

Grouped under appropriate headings, formulas are easy to locate with complete information, lacking only practical examples which would have

helped considerably in clarifying the equations. In his introduction, the author says "A knowledge of elementary algebra and trigonometry and some skill in handling algebraic functions will be of considerable help." This recommendation should not deter the non-mathematical reader however, as there are several important chapters dealing with nothing much more complicated than impedance calculations. But Mr. Clifford is per-haps being optimistic if he expects an elementary knowledge to carry the reader through the higher maths which appear towards the end of the book.

Besides the numerous formulas the book includes a host of tables and useful information which will be found, for once, really useful, its presentation being clear and complete and not the usual jumble appended to many technical publications.

With the warning that this is an American publication (which of course means language difficulties) it must be considered a valuable library addition, containing facts and figures in one volume which would only otherwise be found scattered throughout a host of electronics textbooks.—P.R.R.

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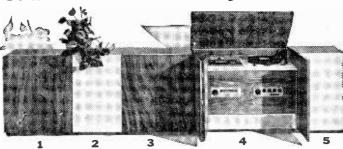
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# A BAND II Preamplifier

for a boosted f.m. signal

#### by J. D. Benson

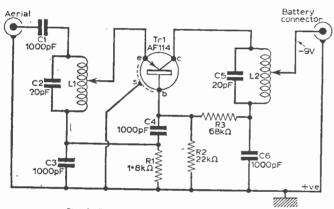


Fig. 1: The single-transistor preamplifier circuit.

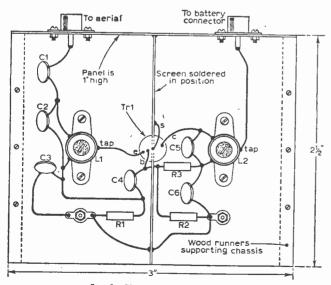


Fig. 2: The main wiring diagram.

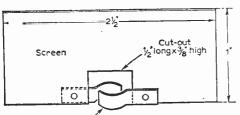
TIME experimenter who is in search of high-quality reproduction must invarably turn to the BBC f.m. transmission on Band II. The medium and longwave stations with their very restricted bandwidth leave much to be desired even with the best ecuipment. One of stumbling blocks in the reception of f.m. is the fact that, if good reception is to be enjoyed, it is necessary to feed the receiver from an efficient aerial system. The answer to this problem is obviously an outdoor aerial, but, this in itself raises a problem, as most chimney stacks are already festooned with TV aerials and any addition greatly increases the risk of collapse during stormy weather, A strong signal is necessary in order to reduce the signal-to-noise ratio so that reception is free from man-made interference and the annoying background which a weak sigal produces. The problem may seem insurmountable, but fortunately it can be overcome by amplifying the signal before it is fed into the receiver.

#### Positioning the Aerial

In most houses access to the roof is possible, and it is then quite easy to install an aerial of either professional or homemade construction. In positioning a roof aerial, care should be taken that it is located away from water tanks or any piping that may be there. The preamplifier which is about to be described can be fitted adjacent to the aerial and its power supply fed through the down-lead cable. The amplifier is designed around the AF114 Mullard transistor, but any other similar transistor can be used, provided it is of first-class quality, an inferior transistor will add to the background noise and ruin reception.

#### **Amplifier Construction**

In construction, the amplifier is straightforward, provided the design is adhered to, and good quality components used throughout. The chassis is a simple Lshape, and is preferably made of



Strips of springy brass shaped to hold transistor

Fig. 3: Details of the screen.

copper. A screen is fitted which provides rigidity and also serves as a holder for the transistor. The shortest possible connections should be made throughout, especially to the transistor and, here a word of caution, a heat shunt—a pair of longnosed pliers-must be used when making the transistor joints or it may be ruined. It will be noted that both aerial and output coils are tapped. The coils should be wound and made a tight fit on the formers and then cemented in position to prevent any change in inductance by movement or vibration. When thoroughly dry, the enamel can be carefully removed from the wire with a sharppointed knife and the tapping soldered on. In the case of the output coil, a little experimenting is called for to find the best position for the tap. Starting from the collector end of the coil, a point will be found where the amplifier becomes unstable; this can be recognised by a sudden change in current, if a milliammeter is used, or by a rushing noise if connected to receiver. When either of these conditions obtain, the tap should then be moved back towards the collector end until the circuit is stable. The tapping wire should be attached to a piece of nonconducting material to eliminate unwanted capacities whilst the best position is being found.

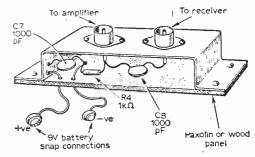


Fig. 4: Details of the battery connector.

During the locating of the tap, the dust core should be screwed in until level with the top of the former. Tuning should be carried out from the output coil first and then peaked for maximum by tuning the aerial coil, returning to the output coil and so on, until best results are obtained. A further refinement, an on/off switch, could be fitted to obviate the removal of aerial and receiver plugs each time the preamplifier is used. The total battery consumption is better than 2mA.

#### Outdoor Installation

If an outdoor aerial is to be used, then the preamplifier will be subjected to large changes in ambient temperature, from which the transistor must be protected in order to preserve the correct working conditions. The amplifier must be connected as close as possible to the aerial connection. A gain of 14-15 dB can be obtained from an amplifier of this type. The difference in reception with it is well worth the time and patience put into its construction. The battery connection fitting shown in Fig. 4 can be made to fit on top of the particular battery chosen and held in position by elastic bands.

#### COMPONENTS LIST

Resistors: RI I-8k $\Omega$  R2 22k $\Omega$  R3 68k $\Omega$  R4 Ik $\Omega$  AII  $\pm 10\%$   $^{\frac{1}{4}}$ W carbon

Capacitors: C5 20pF 1000pF 1000pF Č2 C6 20pF C7 1000pF C3 1000pF **C8** 1000pF C4 1000pF All ceramic.

#### Inductors:

LI 5 turns 22s.w.g. enamelled copper wire, spaced by diameter of wire. Tap at one turn from CI end.

L2 5 turns 22s.w.g. enamelled copper wire, spaced by diameter of wire. See text for tapping.

#### Miscellaneous:

Trl AFII4 transistor.

Two 7mm coil formers with cores (Alladin). Length of 22s.w.g. enamelled copper wire. Two battery connectors. Copper for chassis and screen. Springy brass for transistor clip. Four coaxial sockets.

#### A MODEL CONTROL TRANSMITTER

-continued from page 746

fully unscrewed, the coil has too many turns A turn or so should then be removed, or turns should be spaced farther apart. Alternatively, if TC1 is screwed down to full capacity, without 27Mc/s being reached, more turns are needed on the coil, or turns should be closer to each other.

For good range, a self-supporting vertical aerial about 8 ft. 6 in. long, is satisfactory. If the receiver is sensitive, and maximum range not required, a shorter aerial can be fitted. For moderate range, a 3 ft to 5 ft aerial will often suffice. The aerial can be telescopic, or made from interlocking rods, or may be of wire, supported by a thin bamboo, or by an insulator and string to an overhead point.

Tuning is slightly modified by the aerial, so the transmitter must be re-adjusted with the wavemeter, after the aerial is fitted. When testing and tuning, the key or switch wired to the "key" terminals should be closed, or these terminals should be connected together with wire. Though the transmitter can be battery operated, it should not be overlooked that the cathode takes 20 seconds or so to heat up.

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FROM RCS Products Ltd., comes a range of battery eliminators suitable for almost any transistor radio, battery record player, amplifier etc. All these mains units are completely isolated from the mains by a double wound mains transformer giving the highest safety factor.

Also available at 35s, retail is an eliminator for BBC-2 625-line booster units requiring a 12V or 18V d.c. supply. The eliminators are available with

either a single or double d.c. output.

The range is as follows: single output units, 4.5V, 6V and 9V, at 29s, 6d, retail and the size,  $2\frac{1}{2}$ in, x 3in, x  $1\frac{2}{8}$ in; two separate output units, 4.5V, 4.5V, 6V, 6V, 4.6V, 9V, 9V, all at 4.2s, 6d. retail, all 3in. x 3in. x 2in.

The makers claim that these units are the cheapest of their kind, available with double wound mains transformers, currently available on the British market. Messrs RCS Products (Radio) Ltd., 11 Oliver Road, Walthamstow, London, E.17.



One of the battery eliminators available from R.C.S Products Ltd.

#### Electrician's Tools

ROM the Continent come four new servicing aids. Griptou is a three-pronged trigger-operated gripping tool. It is 285mm long and the prongs open to 10mm; this makes the instrument particularly suitable for placing or retrieving objects in inaccessible places. The handle and trigger are of plastic, and the arm, which is flexible is made of polyamide. The powerful action of the return spring enables this tool to lift objects of up to 44lbs.

Dynatest is a mains circuit tester incorporating a pilot light inside the handle. It is rated for

voltages of 120/220, and insulated to 10,000V.

Pick-fil is a brass pointed contact tester for printed circuit work, insulated to 10,000V. It can be supplied with a flexible extension lead, insulated for h.t. work to fit all standard testing apparatus. This lead can also be used with the Dynatest.

A rubber-headed mallet-a flexible, well insulated tube with a small rubber head-can be used by an electrician to locate faults with a gentle tap. Henri Picard & Frere Ltd., 34-35 Furnival Street, London, E.C.4.

#### Grampian Cardioid Microphone

DEVELOPED for users to whom overcoming background noise and acoustic feedback is a serious problem, the Cardioid Microphone type GC.1 is useful for many kinds of p.a. work.

As its name implies, this microphore has a heart-shaped polar response pattern with a frontto-back discrimination of approximately 15 to 20db over the mid-frequency range. The effective res-

ponse of the GC.1 extends from 40c/s to 12kc/s with a gradually rising tilt towards the higher frequencies.

The non-metallic diaphragm is protected by a perforated steel plate, is non-hygroscopic and is resistant to temperature changes, corrosion and acoustic and mechanical shock.

The new Cardioid microphone developed by Grampian Reproducers Ltd. to overcome background noise and acoustic feedback.

The alloy easing of this unit is finished in Old Silver Polyurethane enamel and a Melamie primer and is fitted with a chrome plated bezel ring, The microphone is less than 6in, long and weighs less than 12ozs.

Cardioid microphones are available in four impedances from  $25\Omega$  to  $50k\Omega$  and are supplied complete with swivel holder, connector and detachable 18ft length of screened lead. Grampian Reproducers Ltd., Hanworth Trading Estate, Feltham, Middlesex.

#### Antex Lightweight Soldering Iron

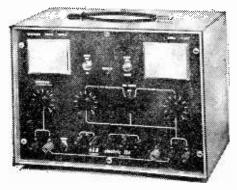
HE lastest addition to the Antex range of soldering irons is model C240N. It is fitted with "Ferraclad"-the new type bit which is claimed to last at least five times longer than ordinary nickel plated bits. The construction of the iron makes the bit instantly interchangeable, and with a low leakage current all risk of damage to transistors when soldering is virtually eliminated. Antex Ltd., Grosvenor House, Croydon, Surrey.



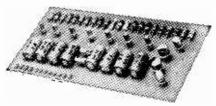
The latest Antex soldering iron, model C240N.

#### Regulated Power Supply

FROM K.L.B. comes the P.300 regulated power supply, with facilities for working on either conventional valve circuitry where it will provide 0-400V d.c. at up to 150mA or 0-50V d.c. for operating transistor equipment. Two meters are incorporated which offer comprehensive monitoring of both voltage and current. In addition, the P.300 provides the usual heater voltages and a low current negative bias supply. The K.L.B. P.300 is priced at £47. K.L.B. Electric Limited, Whitehorse Road, Croydon, Surrey.



K.L.B.s P.300 regulated power supply unit.



The new Sinclair 10W transistor amplifier, available in kit form or ready-assembled.

#### 10W Transistor Amplifier

ANNOUNCED by Sinclair Radionics Ltd., is their 10W integrated amplifier. This amplifier uses the pulse-width modulation principle, permitting a large reduction in the power dissipation in the output transistors, so that no heat sink is required and small high frequency transistors can be used in place of the conventional l.f. power transistors.

The circuit embodies 11 transistors and has a

transformerless output feeding into a 15 $\Omega$  speaker. The overall size of the "X-10" unit is 6in. x 3in x 3in., and its weight is less than 5 ounces. The price is £5 19s. 6d. in component form, or £6 19s. 6d. built and tested.

A mains power pack, providing 12V is available at a price of £2 14s. Technical Suppliers Ltd., (sole distributors) Hudson House, 63 Goldhawk Road, London, W.12.

#### ON THE SHORT WAVES

-continued from page 765

the only non-G heard so far was a UT5. However this was with a 20m dipole with the feeders strapped.

A thought for those wishing to try 10m and haven't much space for elaborate antennas is that a ground-plane is quite a compact aerial for this band and also is omni-directional.

Another point of interest for those learning or wishing to learn morse is a special slow morse transmission (3-4 w.p.m. up) between 28.100 and 28,300 by G3JDG (St Albans) on Sundays at 11.00 (120W to a dipole running NW/SE).

#### GENERAL NEWS

Items of general interest gleaned over the past month include the gen, that there are two DXpeditions afoot: VQ8AMR on Rodriguez Island and PY1CK on Trinade Island. But if you really want something unique to listen for, search on 2m for the call-sign K2QHZ, he drives a tractor in the

Baltimore district and has the rig on board complete with a five element beam (honest it's the truth).

Top band addicts please note the M.C.C. run by the Short Wave Magazine takes place this year on the weekend 14th and 15th November. There are two four-hour periods from 17:00-21:00, one on each day.

H.F. enthusiasts might like to be reminded of the 21/28Mc/s telephony contest on December 5th and 6th. Just gives you time to make up that

ground-plane referred to earlier?

Incidentally, if you hear a Cyprus station (call sign 5B4), from now on it will either be a pirate or an illegal transmission anyway as all 5B4 licences have been suddenly and mysteriously withdrawn for some strange reason not yet made

I would be very pleased to hear from any reader who listens or works the amateur bands 1.8—30Mc/s, just address to G3JDG, Amateur Band DX, c/o Practical Wireless, Tower House, Southampton Street, London, W.C.2.

That just about wraps it up for this month, time to hang up the headphones and go Q.R.T. to B.E.D. ... well perhaps just a quick listen round on forty, perhaps that 9M2 ...!

#### KEEP AN EYE ON THE FUTURE WITH PRACTICAL TELEVISION

The December issue of "Practical Television" speculates on the future of TV Receivers and reviews the situation of Indoor Aerials today.

The December issue of P.TV is on sale 20th November.

#### Don't Miss These Bargains

Transistor ferrite rod aerial with medium and long wave colls with circuit, 7/8. Oscillator Goil and set of 3 LF, transformers for transistor set with circuit, 12/8. Tuning condensor to suit, air-spaced with trimmers 9/1.

Ditto but sub. min. 7mm., 10/- the set; two gang condensers to smt, 8/6. (Request sub.

Condenser with trimmers to transmiss. Price 9/2.
Prish-Pull Transformer, Sub-induiature 3/6, 
Push-Pull Transformer, Sub-induiature 3/6, 
9005 mid. Single Tuning Condenser. Solid 
dielectric jin. spindle for transistor of 
Crystal set. with spindle tapped 6 BA, 2/6, 
46 Sets (Receiver/Transmitter pack set). 
Unused sets complete except for crystals, 
Packed with parts and easily rebuildable into 
other gear. 19/6 each. Post 3/Battery Charger Kit. Comprises 5 amp. transformer, 5 amp. rectifier. metal case and meter 
to charge 6 or 12 volt batteries up to 5 amps. 
With variable charge rate. 38/6 cach. Post 
and insurance. 3/6. 
Mains Transformer, 250-0-250 at 80 mA. 
6.3 volts, 3a (normal mains input). 12/6 each.

With variable charge rate, 397e cach. Fost and insurance, 376.
Mains Transformer, 250-0-250 at 80 mA, 63 volts, 3a (normal mains input), 127e cach. Carriage 276, Output Transformer. Standard pentode matching type, 476 cach, 487- per doz. Silde Switch. Sub-uniniature but dpdt, 27-cach, 137- per doz.

T.C.C. or Dubilier Tubular Condensers. 10/- doz. 7/6 doz. .25 mf 500 v.

.25 mf 350 v. .05 mf 500 v. 6/- doz. 5/- doz. .01 mt 500 v. 5/- doz. 5/- doz. 6/- doz. .0001 inf 1,000 v. .0001 mt 1.000 v. .001 mf 1.000 v. .002 mf 1.000 v. .005 mf 1.000 v. :: 7/6 doz. 9/- doz. .02 mf 750 v. .01 mf 1.000 v. .02 mf 750 v. 8/6 doz. .01 mf 1.000 v. 10/- doz. Battery Charger Rectifier—sclenium 12-15 v.

Battery Charger Rectifier—sclenium 12-15 v. 5 amp. 9/6.
Metal Chassis—punched for Mullard 510
Amplifier, complete with Inner screening sections and stove enamelled, 12/6 set.
Filament Transformer. 6.3 v. 1; amps. 6/6.
Neon Lamp—unityte wire ended, Ideal mains tester, etc. 2/s. Ex. Govt. 1/6.
Philips Trimmers—0.30pf 1/r es., 8/r doz.
Tax Panels. Ideal for constructors, experimental circuits, etc. 3 of each of 12 different types. 5/r.
Stylick Panel Wompling Europe in the constructors.

Slydlok Panel Mounting Fuses with carrier, 5 amp. 2/- each. 15 amp. 2/6 each.

5 aup. 2/- each. 15 amp. 2/6 each.

Meial Rectifer, 250 v. 60-80 milliamps ideal
for mains set or instrument or to replace that
expensive valve, 4/6.

Plano Key Type Switches. 3 key type 3/-,
1 key type 3/8, 5 key type 4/6, post and packting 1/- regardless of number ordered.
500 MW Amplifier. Uses 3 transistors. 2 of
which are in Glass B push-pull for battery
economy. Ideal little unit for baby alarm,
record player, intercount, etc. etc. 14/8.

economy. Ideal fittle unit for baby alarm, record player, intercom. etc., etc. 19/6. Speaker 12/6 extra.

Speaker 12/6 extra.

Condenser—Bargain, Subministure type 50 m.f.d. 6v. made by T.C.C.
7/6 per dozen amnimum quantity supplied).

Transistor Set Cases, Finished in two-tone with handle and back. Size 10 ½ 7 ½ x 3

15/- each pins 2/6 Carriage and Insurance.

#### **THERMOSTATS**

Type 'A' 15 amp, for controling room heaters,

Typs 'A' 15 amp. for controlling room heaters, greenhouse, ainns cupboard. Has spindle or pointer knot, quickly adjustable from 30-80°F, 9/6 pins 17-post. Suitable box for wall mounting, 5/-, P. and P. 1/-.
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post and memerata or fire anarm. 8/6 plus 2/6 post and memarace. Type 'C' is a small porcelsin thermostal as fitted to electric blankets etc. 14 amp. setting sajustable by screw through side. 8/6, P. and P. 6d.

P. 6d.
Type 'D'. We call this the loc-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing, if a length of our blanket were (1d yds. 10/-) is wound around the pipes. 7/8, P. and P. 11.
Typ. 'E'. This is a standard refrigerator thermostat. Spindle adjustments over normal refrigerator temperatures. 7/6 pins 1/- post.

Where postage is not definitely stated add 2/all orders under £3.

#### Good Companion Mark IIIB

Mark IIIB
The 6 transistor set with the 3
transistor performance.
Incorporating all the latest requierements. Anyone who can
solder can make it. Many
thousands already in use all ove,
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x 3' Q.P.P. Output approx.
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Variable feet back gives excellent
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Plus 4/- post and insurance.

#### OUR BARGAIN OF THE YEAR



A complete kit of parts to build transistor 2 wave superhet receiver at only 39/6. Post & Ins. 3/6

2000

"CORONET" Mk. IV

It fully covers the medium wave-band and that part of the long waveband to bring in Blac. Light. The elecuti includes a highly enicient shab aerial and 25 P.M. speaker. Overall size ap-proximately 44 x 24 x 14in. Supplied complete with carrying case.

#### THIS MONTH'S SNIP

#### £5.10.0 Radio for only 37/6



Originally sold at £5.10.0, we now offer the "Pinpernel" 5 Transstor Pocket Radio at only 37/6. The sets are complete but are "line rojects" so there will be some small faults to thid. Components are all new and unused, and their retail value, even at today's lowered price, is over £4. Parts you will get bechule:—

even at today's lowered price, is over 24. Parts you will get include:—
Jackson "OO" Tuning Condenser, 9/-. Plessey Driver Transformer, 8/6. Goodman's or Plessey 3" speaker, 12/6. Morganite Volume Control with switch, 4/6. Philos RF Transistor 12/6. ST.C. unstehed output transistors and driver, 15/-. Plastic case with earrying handle, 7/6. 5 Electrolite Consenser, 7/6. 18 electrolite Consenser, 7/6. Perice Agents of St. Control of Consenser, 7/6. All this fine equipment offered this month at only \$7/6 plus 2/6, post and insurance.



#### **MULTI-METER** BARGAIN

Model number EPIOK, Extra wide Model number EP10K. Extra wide scase fitted currer was for compared. Scase fitted corner was for compared cases. Sensitivity 16,000 chims per volt A.C. and D.C. ranges D.C. voltage up to 1.2kV in 5 ranges. D.C. voltage up to 1.2kV or ranges. Compared to 1.2kV or ranges. Resistance up to 20 mg. Capacities 1005 to 1.5 mid and decibels. Complete with full instructions and test prods and battery for ohms range. A real bargain not repeatable once stocks cleared. Price 68/6. Carriage and Insurance 6/-.

#### THE STRAIGHT LINE AMPLIFIER



#### MAINS POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v—9 to 12 voits for up to 500ma (class B working). Takes the place or any of the following batteries. PP1-PP3-PP4-B6-PP7-PP9 and others. Kit comprises: mains transformer-rectule, smoothing and food resistor 5000 and 500 mfd condensers, zend diode and instructions. Real suip at mly 14/6 plns 2/6 post.

#### Infra Red Heaters

Make up one of these latest ty: Make up one of these latest type heaters, ideal for buth-room, etc. They are simple to make from our casy-to-follow instructions—uses silica enclosed elements designed for the correct mira-red wavelength (3 microns). Proc for 750 wavelength (3 microns) by the correct market 19/6, plus 2/6 post againstrance.

#### **Brayhead** Turret Tuner



Complete with Band 1 and Band 3 coils. New but rensoved from unused equipment. Less valves lb/- each, or with valves 25/- each. Post 2/6. Knobs 3/6 extra.

Waterproof Heater Wire 16 yds. length 70 watts, self regulating temperature control. 10/-, post free.

#### Fluorescent Light Kits

For pelmet lighting, etc. Kit consists of: super silent choke; 2 chrome clips to boil tube; 2 bi-pin holders for tute and starter with a starter holder. Kit 4 for 80 wat tube at 27/8, Kit 8 for 40 want tube at 19/8, Kit 8 for 40 want tube at 19/8, Kit C for 2 x 2 ft. 20 w lamp 25/s. Kit b for 1 x 2 ft. 20 w lamp 18/8, Post and Insurance 2/6 per kit.

#### Cabinet Snip

This fine cabinet as illustrated but ess control knobs is available this month at a special snip price of 12/6, plus 3/6 post and nsurance Size is 134in. x 9in. x 4in. and it is nicely covered in two tone fabric.



#### Siemens High Speed Relay

Twin 250 ohm cole adjustable tension change over contact plat points 7/6. Foet 1/-.

#### Five Core Cable

Idea, for switching circuits, intercoms, P.A. runs etc. each core flex copper with rubber (usulation, cores covered overest in tough rubber of P.V.C. 9d, per yd. or 30 yds. length 15/- plus 5/- post.

#### Making a Fan Heater

Miniature motor 2∤in. long x 1∤in. diameter, iammated poles. Operates off 20-30v. D.C. Originai cost at least £3



each. 8/C plus 1/6 postage and insurance Mains model 9/6, plus 2/6 postage and

#### Speaker Bargain

Highfidelity loudspeaker. High flux permanent magnet type with stand-ared 3 ohm speech coil,



ared 5 onn speech coil. Will handle up to 12 watts. Brand new, by famous maker, Price 27/6 p us 3/6 post and insurance.

#### **ELECTRONICS (CROYDON)**

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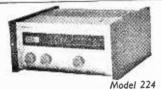
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#### TEST METERS



30,000 OHMS PER VOLT
MODEL 500. Reads, voltages up
to 1,000 Lat 30,000 ohms per
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to 1,000 lat 15,000 o.p.v.,
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to 2, internal buzzer for audible warning of direct shorts and blocking condenser for A.F. output measurements. Size × 6 5/16 × 21in. \$8.19.6,

2,000 OHMS PER VOLT MODEL TP-10, Reads A.C. and D.C. volts up to 1.000; D.C. current to 500mA; Resistance to 1 Meg.; Capacitance to 1µF; Decibels from —20 to +36; Output jack for Audio measurements. Size: 3½ × 5 × 1½ in. 28.19.6.

DOUBLE BEAM OSCILLOSCOPE TUBES Another purchaser of Type CV 1596 equivalent to Cossor O9D as used in Oscilloscopes by Cossor (339 series) and Hartley & Erakine (13 series) Listed £12. Brand new in Maker's 25 /-crates (Carriage 5/-),

HIGH FREQUENCY A.C. VOLTMETER. A First Grade Moving Iron tnatrument with 61m. Mirror Scale. resding up to 100v. A.C. at 400 and 1,200-2,400 cycles. In substantial Oak case with removable Ird overall size 8½ × 8½ × 5½m. Made for the Air Ministry by Everett Edgeumb and in perfect order. Brand New and Universely Content of the Content of

20,000 OHMS PER VOLT MODEL TP-58, Reads voltages up to 1,000 D.C. at 20,009 ohms per volt and A.C. at 10,000 o.p.v.; D.C. current to 500 mA; Resistance to 10 Mega; Cajacitance to 0.0,0 F; Decibels from —20 to +38 Size: 3½×5½×1½in. 25,18.8.

ing of generator. 3 testing voltages 100, 250 and 500, to measure up to 500 Megohms. Complete with leather carrying case and test leads. ONLY £17.10.0. Illustd. details on request

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FAREL METEKS
25 microsurps D.C. 24 in. Proj.
circular 59/8. 50 microsurps
D.C. 24 in. Flush circular, 59/6
100 microsurps. D.C. 24 in.
Flush circular 39/8. 40 sups.
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TRANSISTORISED INSULATION TESTER. One
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VARIABLE VOLTAGE TRANS-VARIABLE VOLTAGE TRANS-FORMERS, Fully shrouded, Input 230 v. A.C. 50/60 cycles, Output 0-260 v. 2.5 amps. type 25,17.5, 5 amps. type 26,10.0. Brand new inport, fully guaranteed, immediate delivery and service. Illustrated details on request. 20/- CONSTRUCTOR'S PARCEL. Assorted colours wiring wire, solder, resistors, condensers, volume controls, tag panel.

ALL NEW (post 2/6).

LINEAR AMPLIFIERS. LG34, 4 waits, size  $8\frac{1}{7} \times 4\frac{1}{7} \times 2\frac{1}{7}$  in, high, £5.5,0, L45A 5 waits, size  $7 \times 7 \times 5$  in, high, £5.19.8. Protective cover, 12/9, L5/55 5 watts stereopholine, size  $8 \times 6$  in, £12.12,0, cover with carrying handles 25 stereopholine, size  $8 \times 6$  in, £12.12,0, cover with carrying handles 25 to 21.2 L5.0 Cover with carrying handles 18/6. L7/10 10 watts Hi-Fi Ultra Linear Push-Pull, size  $9 \times 7 \times 6$  jin, high, £13.13,0, Cover with carrying handles, 19/6. Conchord on watts Hi-Fi Ultra Linear size  $12 \times 9 \times 7$  jin, high, £16.5, Cover with carrying handles,  $25/\epsilon$ , L50.50 watts Hi-Fi Ultra Linear, size  $14 \times 10 \times 8$  n, high, £23.20, Cover with carrying handles,  $25/\epsilon$ , L50.50 watts Hi-Fi Ultra Linear, size  $14 \times 10 \times 8$  n, high, £23.20, Cover with carrying handles, 32/6. All simplifiers for normal A.C. mains, and ex stock. Details on request.

"Tripletone" Convertible Amplifier, size  $10 \times 3 \times 4$ in, high. 4 watts output matched for 2.3 ohms, OR 2 amplifiers can be coupled together for STEREO 88 19 8 each.

wo.s.o.com... Triplatone" F.M. Tuner, size  $11 \times 6 \times 3$ in. high. Coverage 86-104 Mc/s. \$18.19.6 (unpowered), or \$15.14.6 (self powered). Details on request.

HETERODYNE FREQUENCY METERS TYPE LM14. Frequency range 125-20,000 kc/s in 2 band. This is the United States Navy Model of the well-known FC221 Frequency Meter, but has many additional feature which increase its usefulness. Voltage stabilisation circuits and Crystal control ensure extreme that usefulness and in addition it is littled with an Internal Modulation switch to allow accuracy and in addition it is littled with an Internal Modulation switch to allow ace as a Status Generator. Size only S½ × 8 × S½in. Full information on request.

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Please include carriage cost on ALL items Telephone TERminus 7937. Open until 1 p.m. Saturdays. We are 2 mins, from High Holborn (Chancery Lane Station) and 5 mins, by bus from King's Cross

# LIGHT-OPERATED SWITCH

BY P. LISTER

THIS device can be constructed cheaply and easily. The circuit is of hybrid design, working the transistor in a different mannar from usual.

#### Employing a Transistor

The prototype model was evolved to make use of an OC71 which had become chipped, the black paint being partially removed. This transistor is still in use in the original.

Any general-purpose transistor will do, provid-

ing it is of glass construction.

The first thing to do is to remove any light-excluding paint. After this has been carefully scraped off, the transistor can be tested for general light-sensitivity by measuring its photo-e.m.f.. This is done by joining the collector and emitter and taking the junction to the negative terminal of a milimeter (1mA f.s.d. is ideal) whish the base is taken to the positive terminal. If the transistor is now held near an electric light bulb (40W) there should be a deflection of 1mA or so. It will be found that the transistor is slightly more sensitive in some directions than others.

#### The Circuit

For its operation, the circuit does not rely on the transistor's property of developing a photoe.m.f., but on its photo-resistance property. The resistance between the emitter and collector varies with the light falling on the transistor, the greater the light, the lower the resistance.

Originally the idea was to apply the photo-e.m.f. to the grid of a valve. This was not practical however, as the eight of a volt or so would not give great enough anode current change to

operate an ordinary relay.

It was thus decided to use the photo-resistance property and to make this varying resistance the cathode resistance, this being used to make the cathode more or less positive. When dark the cathode is far enough positive, that with the grid earthed, this now negative potential is enough

almost to cut-off the anode current and so render the relay de-energised. When the resistance of the transistor decreases—with an increase in light—the negative grid voltage decreases until it is more or less equal to the voltage dropped across the included cathode resistor (Rc) can be varied to suit the valve or to vary the sensitivity. In the prototype an EF73 was used for VI but any moderately high gain valve will do, e.g. EF72, EF91, EF50, Z77.

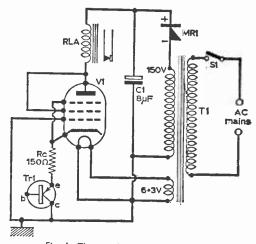


Fig. 1: The simple circuit of the device.

#### The Device in Operation

The prototype operated from a 40W lamp held at about 12. By the use of a lens and by experimenting to find the most sensitive spot on the transistor, this distance can be extended to several feet from a less powerful light source such as a torch.

A further refinement can be made by replacing the ordinary transistor with a photo-transistor, such as an OCP71 which has a built-in lens.

The power-pack can be any that will supply the required anode voltage and heater current; smoothing need not be great.

The uses of such a device are many, one of the most obvious being to operate garage doors from car headlights.

#### COMPONENTS LIST

VI. EF73, EF72, EF91, EF50, Z77, etc. TΙ Mains transformer to suit valve Trl Almost any general-purpose transistor RLA  $4,000\Omega$  to  $5,000\Omega$  relay CL 8μF electrolytic Rc  $\text{I}\,\text{50}\,\Omega\text{ see text}$ MRI Metal rectifier 15mA ST Mains on/off switch



ACTON, BRENTFORD AND CHISWICK RADIO CLUB Hon. Sec.: W. G. Dyer, G3GEH, 188 Gunnersbury Avenue, London, W.3. Whan members meet at the Club headquarters on 10th Novem-ber, they will hear a talk given by G31GM entitled "Radio Test Gase"

BATH SPA RADIO CLUB Hon, Sec.: G. C. Wynes G3TLV 14 Brook Road, East Twer-

Bath, Somerset.

With the recent move to new headquarters, this Club is now able With the recent move to new headquarters, this Club is now able to welcome local short-wave enthusiasts and visitors to any of its meetings at 7 Lambridge Mews, Larkhall, Bath. Meetings begin at 3 p.m. and are held every Monday and Thursday.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY Hon. Sec.: P. J. Holland, Field House, 19 Kingsley Road, Gt. Boughton, Chester, Cheshire.

During October, members of this Society heard lectures at each of the three meetings.

of the three meetings.

of the three meetings.

The first was on 13th October, when H. Morriss (G3ATZ) gave a lecture on "Antennae". This was followed a week later by G3OWY's talk on "Receiver Selectivity" and on 27th October, "Interference Detection" was the subject of the lecture. CITY OF BELFAST Y.M.C.A. RADIO CLUB Hon. Sec.: C.J. Rourke, G13IVJ, 63 Kirkliston Park, Belfast 5, Northern Ireland.

Northern Ireland.

This society's meetings are held every Wednesday and Saturday, beginning at 8 p.m. Visitors and new members will always be welcomed at these meetings. At the meeting for 7th October, members heard a lecture on "RTIT" by W. Kane (GI3GQB). NORTHERN HEIGHTS AMATEUR RADIO SOCIETY Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.

After discussions and preparations on the Cartesian Cabin, Ogden, After discussions and preparations on the Cartesian Cabin.

After discussions and preparations on 14th October, a group from this Society manned a station (G3MVH) over the weekend of 17—18th, during the Scout "Jamboree-on-the-Air".

Later in the month, on the 21st, members of the Society and visitors to it enjoyed a recorded lecture by the famous American amateur, W18B on "DXing on 160m.".

28th October was expense might and the 31st a party made a contraction.

amateur WIBB on "DXing on 160m.". 28th October was ragchew night and the 31st, a party made a visit to the International Radio Communications Exhibition in

London.
READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook
Road, Reading, Berkshire.
The October meeting of this Society was held on the 31st, when
the subjects under discussion were TVI and BCI.

#### PREPARING FOR THE R.A.E. See page 744

A NSWERS to Question 1 given in the first part-Refer to Fig. 9, page 631, last month.

1. First find the value of the parallel connected resistances. Let the  $4\Omega$  resistance be R1, and  $2\Omega$  $R1 \times R2$ be R2.

$$R = \frac{R1 + R2}{4 \times 2}$$

$$= \frac{4 + 2}{4 + 2}$$

$$R = 1.33\Omega$$

Total resistance in circuit will then be 1.33+6  $=7.33\Omega$ 

E=10V. R=7·33Ω.  
from I=
$$\frac{E}{R}$$
  
I= $\frac{10}{7\cdot33}$ 

Total current dnawn=1.36A



SPEN VALLEY AMATEUR RADIO SOCIETY

Or Ist Valley Amateur Radio Society

Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Leeds.
On Isth October, Spen Valley A.R.S. was host to a number of
visitors from other radio societies, and then on the 28th, Spen
Valley members were the guests of Northern Heights Amateur
Radio Society.

The lecture given at the meeting for 29th October was entitled "Radio Astronomy" and was delivered by W. J. Baggeley. Activities for October ended with a visit by a group of members

to the Radio Communications Exhibition.

UXBRIDGE RADIO SOCIETY

J. Batten, 36 Collingwood Road, Hillingdon Heath, Middlesex.

After the activity of the 17th and 18th October when the club participared in "Jamboree-on-the-Air", a surplus sale was held

on the 19th.

Current constructional projects include work on a club receiver and conversions on a transceiver to cover top band and 80m.

WELLINGBOROUGH RADIO CLUB Hon. Sec.: J. Baker, 34 Essex Road, Rushden, Northampton-

The first meeting of October was the Annual General Meeting, when the Club's affairs came under discussion.

when the Club's arians came under discussion.

The three following meetings were devoted to lectures given on the 15th, 22nd and 29th. The subjects and lectures were, respectively, "Basic Radio Components" by D. Lyne, "The Radio Valve" by P. Butler and "The Transmitter and Receiver" by K. Knibs. K. Knibs.

WESSEX AMATEUR RADIO GROUP Hon. Sec.: P. Cutler, G3MXF, 43 Langside Avenue, Wallis-

down, Poole, Dorset.

The Group's participation in the Scout "Jamboree-on-the-Air"

The Group's participation as a size near Brownsea Castle. was the operation of a station at a site near Brownsea Castle.

WEST KENT AMATEUR RADIO SOCIETY Hon. Sec.: H. F. Richards, 17 Reynolds Lane, Tunbridge Wells, Kent.

At the 9th October meeting, members were given a guide to the

At the 7th October meeting, members were given a guide to the communications receivers on the market, with off-air demonstrations and performance tests for illustration.

23rd October was "Audio Night" and two days later, a number of members visited the Decca Navigator Transmitting Station at East Hoathly.

From E = IR $E=1.36\times6$ Voltage across the  $6\Omega$  resistance will therefore= 8-16V

3. 
$$I=1.36A$$
.  $R=1.33\Omega$ . From  $W=1^3R$   $W=1.36 \times 1.36 \times 1.33$ 

Power dissipated by R1 and R2=2.47W
4.  $E=10V$ .  $I=1.36A$ . From  $W=EI$ 

 $W = 10 \times 1.36$ Total power dissipated=13.6W

5. First find voltage appearing across R1. Battery voltage = 10. Voltage across the  $6\Omega$  resistance =8.16. : voltage across R1 = 10 - 8.16= 1.84 V

E=1.84V. 
$$R=4\Omega$$
.

From  $I=\frac{E}{R}$ 
1.84
 $I=\frac{1}{R}$ 

Current flowing through 4\Omega resistance-0.46A

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#### AMERICAN LITERATURE

SIR,—Having read (with great pleasure) many technical publications from the U.S.A. I really cannot agree with your correspondent James Goodwin (October issue) that there is anything at all "difficult" in them.

Surely all your readers are aware that what we call a valve they refer to as a tube; our anode is their plate and earth becomes ground on the other side of the Atlantic, together with antenna for aerial.

Most of these changes seem to me to be self-explanatory—like their "A", "B" and "C" voltages for the power supplies l.t., h.t. and g.b. (grid bias).

The only real stumbling-block is in following the circuit diagrams as I personally much prefer the European idea of keeping the h.t. line "at the top of the page". However, the Yanks' method of keeping the power supplies at the bottom has one advantage—it is much easier to "follow" the a.c. signal through the circuit.

Talking of difficult circuit diagrams, how many readers have tried to unravel one in a French magazine—where the valves (or should I say tubes?) are all printed horizontally, probably the result of too much vin rouge?—D. BYRNE, G3KPO (Peterborough).

SIR.—Whilst I cannot help but endorse Mr. James Goodwin's praise of your book reviews in the October issue of Practical Wireless I must disagree with his criticism of American technical literature. I have read several books from the U.S.A. on radio and electronics and have experienced little or no difficulty in following the text. Anyone with a modicum of intelligence and common sense should be able to "interpret" all these terms in a few moments. Many are more descriptive than the corresponding term used in England—vacuum tube for valve, plate for anode. For those who do have any difficulty, some of the British editions of American books have forewords written especially for British readers.

As for the circuit diagrams and symbols, whilst hese look vastly different, on closer inspection the only real difference turns out to be the absence of a reference point in the form of a line repreenting chassis. Thus the whole diagram looks to be "falling apart".

The real difficulty is in obtaining American omponents in Britain at prices comparable with he British ones. Coils and transistors are the vorst in this respect. I have had to abandon

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 TELE-PHONE. If a postal reply is required a stamped and page iii of the cover.

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

several interesting circuits because of the high cost or total unavailability of the suitable components.

No, it is not the theory which causes the trouble but putting it into practice.—D. C. Brown (Leeds, Yorkshire).

#### COILS FOR THE SPECTREUPHON

SIR.—With reference to the above article in the October, 1964, issue of PRACTICAL WIRELESS. I should like to make the following comments: I found difficulty in obtaining the Denco coils suggested for use in the Euphon section of the unit. Having access to a commercial inductance bridge I wound the coils myself, the following being the details: 90 turns wound in two lavers each of 45 turns on a 11 in. diameter former with 18s.w.g. enamelled copper wire give the required inductance. I constructed the Euphon section and the results were extremely satisfying. The unit adds more depth to a mono recording and gives the impression that one is in the same room as the recording artist. The balance control proved to be very critical to adjust and requires adjustment on each record. The latter disadvantage is offset, however, by the amazing performance of the unit.—D. AMYES (Hull, East Yorkshire).

#### REGENERATIVE RECEIVERS

SIR,—With reference to the "High Compression Front End" P.W., September, 1964) by C. Leslie Thomson. This small regenerative receiver is a hot little thing, one curious fact about the SB Transistor series and the MATs being that although the latter are, on the whole, considerably better performers, they are inferior to SBs in circuits like Mr. Thomson's.

I have had lots of fun with regenerative receivers and I thought your author might like to hear of someone else who has also devoted quite some time (wasted, according to some!) to them.

In the 1961 Electronic Experimenters' Handbook there is a similar circuit by Alvin Mason. The transformer used in my circuit was the Ardente 1001.

In the Gernsback Series "Transistor Projects" there is an outstanding circuit by Edwin Bohr. This one uses an SB100, though others in the SB and MAT series were tried and all performed well. The advantage of this type of set is that the transformer is eliminated, though it is true that the size of an extra mercury cell is almost as much. Discounting in each circuit the usual turing arrangements, Bohr's circuit has three resistors and no capacitors, as against Mr. Thomson's five

resistors, three capacitors and an audio transformer (offset to some degree, it is agreed, by the absence of a second cell).

This little note on regenerative receivers would be very incomplete if mention were not made of what I have, so far, found to be the most extraordinary circuit, particularly in respect of audio quality. This is Wotton's "Amplified d.c. Transistor Receiver", described in P.W., February, 1961. Mr. Wotton's circuit is based on the 1961. Mr. Wotton's circuit is based on the original by Cleland in P.W., November, 1959, and merits the attention of all those interested in a really high quality receiver. I have built several versions and can honestly say that it is not overdifficult to build a sub-miniature set into a box smaller than the average matchbox. Naturally a mercury cell should be used.

Incidentally, replacing the first semiconductor with a MAT100 will, of course, improve the sensitivity, but there seems to be little point in doing so unless one likes to lie in bed at night and attempt to pull in some distant medium wave stations.

That this circuit is good has been testified by its inclusion in a well-known constructor's manual of transistor circuits. Apart from using different transistors the circuit, as far as 1 can see, is identical. The performance in so far as sensitivity and noise are concerned is better; but not because of circuit changes, rather component improvements.—H. A. L. WAGNER (Kuala Lumpur, Malaya).

REQUESTS FOR INFORMATION ARE INSERTED IN THIS COLUMN ON THE UNDERSTANDING THAT READERS USING THE SERVICE UNDERTAKE TO REPLY TO ALL OFFERS RECEIVED AND TO RETURN ALL DATA NOT REQUIRED. BECAUSE OF THE LARGE NUMBER OF REQUESTS RECEIVED, ILLEGIBLE WRITING WILL AUTOMATICALLY DISQUALIFY LETTERS FROM PUBLICATION. FOR THE SAME REASON, WE CANNOT GIVE SPACE TO REQUESTS FOR PAST ISSUES OF "PRACTICAL WIRELESS."

#### Sir-I would be grateful if any reader could sell or loan me . . .

covering 12-80m and manufactured by R.I. Limited.—J. M. Cranke, The Nook, 85 Castle Road, Newport, 1.O.W.

the circuit diagram for the Marconi receiver CR150 or CR150/2—H. Humphries, The Old Vicarage, Gazeley, Newmarket, Suffolk.

receiver.—A. D. Couchman, 3 Manor Grove, Sittingbourne,

pull.—I. R. Reynolds, 11 Bridge Street, Stowmarket, Suffolk.

the circuit diagram and any other information on the portable medium and long wave receiver PCR8.—D. Fitton, 80 Banastre Road, Southport, Lancashire.

Banastre Road, Southport, Lancashire.
... the circuit and any other details of the receiver B.34.—
A. J. Harris, 74 Bodmin Road, Whitleigh, Plymouth, Devon.
... the blueprints for anything between a 4+4 and 10+10
stereo transistor preamp. If required I will return data by registered mail and refund postage.—4235873 J/T Phillip, L., 114
M.C.R.U., R.A.A.F. Butterworth, Penang, Malaysia.
... information on the modifications of the R1155
receiver.—N. Hood, 1 Rectory Lane, Letchcombe Basset,
Wantage, Hertfordshire.

receiver.—N. Hood, 1 Rectory Lane, Letchcombe Basset, Wantage, Hertfordshire.

the Eddystone 640 Handbook.—J. Farman. 84

Blackburn Road, Padiham, Nr. Burnley, Lancashire.

any oscillator modification data for the R1392 v.h.f. receiver, or any other information.—V. Thomas, 8 Beaufort Crescent, Silverhill, St. Leonards-on-Sea. Sussex.

the base connections and or any other information regarding the cathode ray tube type CV960.—Philip Beet. 17 Firs Avenue Affreton, Derbyshire.

Avenue, Alfreton, Derbyshire.

... a service sheet or instruction book for Ex-government

radio set No. 62 Mk. 2 .- J. E. Pearce, 52 Cranford Lane. Heston, Middlesex.

the circuit of the Marconi HP112 transmitter/receiver, also the circuit of the 38 set.—W. Burke, 6 Belgrave Terrace,

the handbook and circuit for the R107 receiver and also any details of modifications.—R. WILD, 140 Nansen

and also any details of modifications.—R. WILD, 140 Feb. 14 Road, Ward End, Birmingham 8.

... the circuit of the Dynaport No. 55 Radio.—G. WILSON, 62 Russell Road, Tottenham, London, N.15.

... circuit or any other information on the 19 set Mark 3.—A. Sellwood, 151 Chestnut Drive South, Leigh,

Lancasnire.
...details and circuit diagram of the Cossor Ex-Govt.
Cathode Ray Indicator, Type 95, Ref. 10Q/16.—Flat 24, 4
Dryburgh Gardens, Dundee.

Type 49.—E. S. Webb, 6 Pond Hill, Halberton, Tiverton Devon-

#### CORRESPONDENTS WANTED

SIR,-I am 17 years old and interested in all aspects of radio. I would be grateful if any reader about my own age or older would correspond with me. I am studying electronics at home and another home studier would be most suitable because we could help each other.—GERARD WALLACE (Ballyvaughan, County Clare, Eire).

SIR.—I am interested in radio and electronics and would like to correspond with people who are interested in exchanging radio parts for Indian curios and novelties or anything of equal value from my country. The reason for this request is that radio components are not easily available here or are unduly expensive. I am 18 years old.— CHAIANJIT SINGH (122/Narmada, Indian Institute of Technology, Madras 3, India).

SIR,-I am very keen on tape recording and would like to tapespond with anyone who shares my hobbies of C.W. and folk music, photography, sound effects and TV DX-ing. I have a two-track 3½ i.p.s. Fidelity Argyll with maximum spool size of 5½in.—IAN UDEN (7 Ash Road, Strood, Kent).

### AN EXPERIMENTER'S GALVANOMETER

-continued from page 752

straight wire was placed immediately in front of and in the middle of the lens,

#### The Scale

This was made from a strip of greaseproof paper with graduations on one side. The paper was held in position by a light balsa wood frame

These, (b) and (c), could be moved around unti a sharp image of the lens was obtained on the scale after reflection from the mirror of the galvanometer.

The suspensions are not ideal as they are rathe easily broken and sometimes do not quite return to zero after prolonged deflection, but they are quite satisfactory for many purposes. They are in fact, far better than the somewhat amateuris method of construction might lead one to expec-

The dimensions given are not intended to b exact but are a general guide to the construction The sensitivity is approximately 25mm/µA 2

a scale distance of one metre.

The total resistance of the galvanometer about 1002, the period 6sec., external critical damping resistance 3002.

# NEW - BY RETURN POSTAL SERVICE BY CONCORD - LEADERS IN RADIO KITS

AMA7ING CIGARETTE RADIO

Yes, a perfectly ordinary backet of cigarettes:—but watch your friends' astonishment hearing it fetch in testation in the station of control of the station of the station

MAKE 5 DIFFERENT TRANSISTOR RADIOS



NECESSARY. No Soldering. Only 8 contents of first radio to Clant 4 colour box, 1tt. 2ln. x 10lin. x 2lin. containing A.B.C. Plans, St. Tropez type Cabret. Solder and the containing A.B.C. Plans, St. Tropez type Cabret. Solder and the containing A.B.C. Plans, St. Tropez type Cabret. Solder and the colour containing A.B.C. Plans, St. Tropez type Cabret. Solder and the colour colour st. Cabret. Solder and the colour colour solder colour solder and the colour colour solder col

NEW RADIO

ANYONE CAN BUILD IN.2-3 HOURS



EVEN THE OLDER CHILDREN BUILD THEM!... no soldering—only 16 connections! then hear it reach out bringing in station after station, loud and clear. Palm-of-hand size 4i x 7i x 14in. Many Textimonials: M.H. of Bradford, writes: "... I have just completed one of your sets successfully, it is the first time! have ever tackled anything like a radio, and i must state here and now, I am amazed how a list of alguman like me. Your instructions it is to a layman like me. Your instruction is to a layman like with the most dim can follow that so that even the most dim can follow that so that even the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the most dim can follow that so that seen the seen the most dim can follow that so that seen the most dim can follow that seen the most dim ca

#### READ WHAT SATISFIED CUSTOMERS SAY-

R.C. of HARRINGAY writes Received with thanks Skyroma . Very pleased. Working

B.M. of HARROGATE writes you . . . It is a real bargain.

L.S. of LONDON W.8 writes ... given it a good cry out and I om very pleased with the results.

of SOMERSET S.B. of SOMERSET writes
... delighted with this radio
... glad if you could send ane more.

D.R. of GLASGOW writes . . . it is a lovely little thing and as clear as a bell.

of STEVENAGE writes I would just like to say how pleased my son is with this J.W. of BRIGHTON welless radio to many of my friends.

W.M. of MIDDLESEX writes Thank you for my descriptive radio. It is a real treasure to me.

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#### CAMERA



World shattering Purchase by oour FOREIGN AGENTS makes this exclusive scopy your for ONLY 19/6. This executing little 2 speed camera is not a top but a precision-made photographic instrument in chromed steel and the wind minute milli-Magnifying Lens—each 14mm. film takes 10 pictures—size 11 x 12 x 2im.—Only 11/6, FREE Leather Carry-case. ONLY 19/6 NO MORE TO PAY

mild this newly designe 4-STAGE



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TRANSISTOR **POCKET RADIOS** 



ONLY 28/6

BULK PURCHASE ENABLES US TO MAKE THIS FAN-OFFER WITH BACK GUARANTEE

The "SAN REMO" brings the voices of star entertainers and vocalists dra-matically to life— in your home, office

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Thin. Fits easily into your pocket, should last a lifetime, anyone can assemble it in an hour or two with our easy plan. Miniature speaker, carrying case—everything only 28/6, 1/6 P. & P. C.O.D. 1/6 extra, (Parts can be bought separately.) Limited period—so rush your order before it a too late. DEMONSTRATIONS DALLY.

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ornice of garden—over all medium waves including Luxembourg. Under 1d. per hour running cost. AN YONE can assemble it in one or two hours using our ample A.B.; plan. 25/c. (F. & P. 20.).

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Unbelievably small—outrageously cheap. You will be amazed at the fine quality of tons and volume of this great little radio. Only a fanastic 3½ x 2½ x 1½m, the MIAMI will bring you great entertainment for months on an 8d. battery. Simple assembly plan with each set. OMIX 17/8. YES 17/6, P. (C.O.D. 2/6 cutta). Satisfaction guaranteed. Demonstrations given daily. Parts available separately if required.

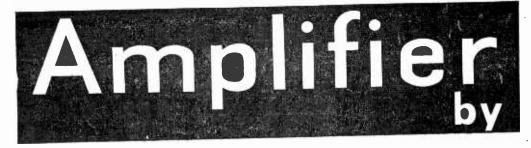
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# Be first to own the only amplifier of its kind in the world!

# FACTS YOU SHOULD KNOW ABOUT THE X-10

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Overall size— $6 \times 3 \times \frac{3}{4}$ in.

Input Sensitivity—ImV into IK $\Omega$ 

Suitable for all types of pick-ups, microphones, etc.

Total harmonic distortion
—Less than 0.1%

Output power-10 watts

Output efficiency—about 95% compared with about 60% for conventional Class B outputs

Frequency response—5-20,000 c/s ± 0.5dB

Speaker impedance—15  $\Omega$  Damping factor—Greater than 100

Quiescent consumption—75mA

Supply voltage—12 volts

FULLY GUARANTEED

# NEVER ANYTHING LIKE IT BEFORE — AND ITS PERFORMANCE IS FANTASTIC

The SINCLAIR-XI0 combined 10 watt amplifier and preamplifier (Pats. applied for) is so advanced in design that it outdates every type of amplifier ever made available to constructors, hi-fi enthusiasts, experimenters and industrial users.

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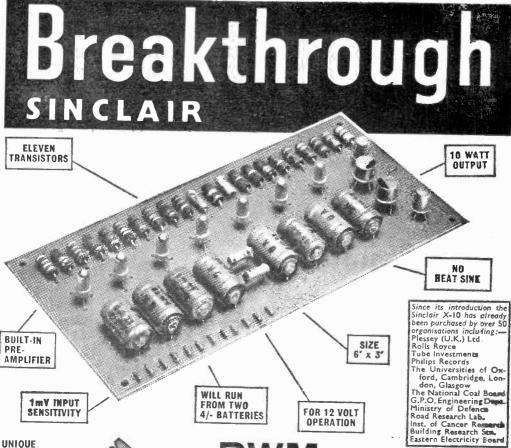
space AND COST. Furthermore, the Sinclair X-10 is so designed that with the aid of the manual included with each amplifier (built or in parts) the purchaser can select the tone control and input matching system appropriate to his requirements to make a hi-fi assembly for very little outlay. This is truly the amplifier of tomorrow—and it can be yours today!

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# SINCLAIR X-10

COMBINED 10 WATT AMPLIFIER AND PRE-AMP



# I is the answer!

Another Sinclair special feature-4 transisthese tors do not get hot even at full output because the circuit converts almost 100%

of the power from battery or mains unit into audio power for the loudspeaker.

Price, inclusive of

4 TRANSISTOR

**OUTPUT STAGE** 

all parts and Instruction Manual for building X-10 25-19-6

READY BUILT including Instructions Manual

Mains Power Supply Unit (A.C. 200/240V)

£2-14-N

The principle of PULSE WIDTH MODULATION used in the X-10 MODULATION used in the A-tu is briefly as follows: A square wave of constant voltage ampli-tude and with a frequency of 50Kc/s is applied to the terminals of the load. As the load has a high impedance at this frequency negligible current flows through the voice coil of the speaker.

In the absence of any input signal the mark space ratio of the square wave is unity—that is, the current flows for an equal period in each direction. When an input signal is applied the mark-space ratio changes with the result that there is a net current flowing through the voice coil which deflects the cone. When the input signal is at

any frequency up to 20Kc/s the net current is an exact replica of the input signal and is independent of the transfer character-istics of the output transistors. Thus the distortion figures can be

incredibly low.
The vital advantage of using P.W.M. is that the output transistors act as switches and therefore dissipate negligible power. Because of this we have been able to use 5Mc/s transistors in the output stage of the X-10. These transistors are small and require no heat sinks.

THE SINCLAIR X-10 MANUAL

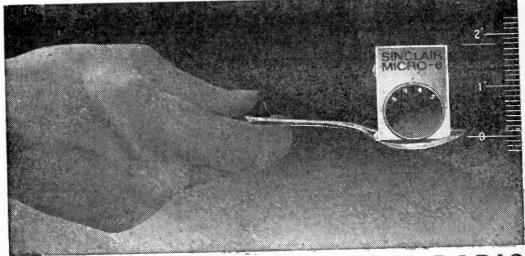
\$6-19-6 Supplied with every Sinclair X-10 (purchased built or in parts) the X-10 Manual explains how the amplifier functions and how to add the correct tone and volume control system to suit your the X-10 Manual explains how the amplified functions and how to add the correct tone and volume control system to suit your requirements exactly. A variety of systems is shown, none of which will add more than a few shillings to the original cost of your Sinclair X-10 amplifier, and because it is so simple to modify this part of the assembly, further matching is very easy should you change your type of pick-up or other input

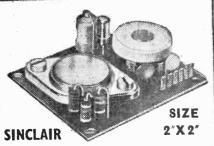
SINCLAIR RADIONICS LTD, COMBERTON, CAMBRIDGE

Comherton 682



# Have YOU built





#### TR750 POWER AMPLIFIER

Designed to be used with the Micro-6 or Slimline. Will make a car-radio, record player, etc.

> THE TR750 (for building yourself or available ready built) measures only  $2^{\prime} \times 2^{\prime}$  and includes volume control with switch. It will provide powerful loudspeaker reproduction from the Micro-6 or Slimline for use as a car radio or domestic or portable loudspeaker set. The TR750 also has many other applications such as record reproducer, intercom or baby alarm. An output of 750 milliwatts for feeding into a standard 25-30(2) loudspeaker requires only a 10mV input into 2kΩ. Frequency response 30-20,000 c/s  $\pm$  1dB. Power required—9 to 12 voles

All parts with instructions come to

Ready built and tested with instructions

# HE WORLD'S SMALLEST RADIO FANTASTIC POWER

THE SINCLAIR MICRO-6 continues unchallenged as the remarkable receiver of its kind ever made available to the public remarkable receiver of its kind ever made available to the public anywhere in the world and thousands have already been built lit has special 6-stage circuitry and is at the same time the smallesi set on earth. Everything except the lightweight earpiece is contained in the smart minute white, gold and black case which is appreciably smaller than a matchbox. With vernier-type tuning control bandspread over the higher frequency end of the medium waveband and powerful A.G.C. to ensure fade free reception of the mos distant stations, the Micro-6 provides remarkable standards o performance. Quality of reproduction is outstandingly good an again and again the set is reported to give excellent results when other sets cannot be used at all. The Micro-6 cannot be too highly recommended, both as an intriguing design to build and a mos recommended, both as an intriguing design to build and a mos practical radio to use.

SIZE— $1^4/_5$ in. x  $1^3/_{10}$ in. x  $1^1/_2$ in.

WEIGHT-UNDER Toz. INCLUDING BATTERIES

TUNING-OVER MEDIUM WAYEBAND WITH BANDSPREA FOR EASY RECEPTION OF LUXEMBOURG

#### MICRO-6 SINCLAIR

BUILD IT IN AN EVENING

Although designed to standards of compactness never before thought possible building is simple and straightforward. All parts including MAT transistors, diodes, printed circuit board, lightweight earpiece case and dial, and 8 page instructions manual come to

'TRANSRISTA' black nylon strap for wearing 7/6 the Micro-6 like a wrist watch

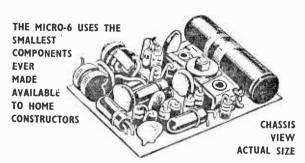
MERCURY MALLORY CELL Type ZM312 (2 required) each 1/11 Pack of 6 10/6

Telephone: COMBERTON 682



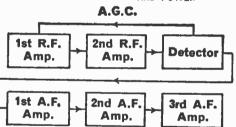
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# yours yer



The Micro-6 uses only 3 special Micro-Alloy Transistors in a completely new six stage circuit as follows:—Two stages of R.F. amplification are followed by an efficient double-diode detector which drives a high-gain 3-stage A.F. amplifier. Powerful A.G.C. applied to the first R.F. stage ensures fade-free reception from distant stations. Everything including ferrite rod aerial and batteries is contained within the elegant tiny case. The set is switched on by inserting the plug of the earpiece.

SIX STAGE CIRCUITRY AND POWER



#### SINCLAIR MICRO-INJECTOR An invaluable aid in fault tracing

Generates and injects a signal into any part of equipment at any fre-quency from 1 kc/s. to 30 mc/s. to locate fauits rapidly.

1.8in. x 1.8in. x 0.5in.
excluding probe. With full instructions.

Parts and ins-27/6 Ready 32/6 tructions come to

#### SINCLAIR SLIMLINE The extra-easy to build pocket receiver

Ideas for newcouners.

Has elf contained aerial, task standard PP5 batters. Measures only 21th, in.x 11th, in. x 1standard part batters. After power and quality. All particululing royal blue and gold case, earpiece and gold case, earpiece and instructions come to

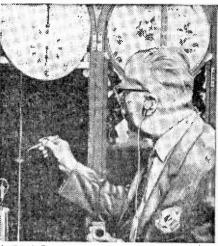


49/6

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If you are not completely satisfied with your purchase (we are confident that you will be delighted) your full purchase price will be refunded instantly and without question. Full service facilities olways available to Sinclair customers.

SINCLAIR X-10-SEE PRECEDING PAGES



Mr Frank E. Holmes is a watch and clockmaker of Oxton Birkenhead for whom precise time is vital. He uses his Micro-6 to check his standard clock against the Greenwich Time Signal—and no doubt fistens to the other programmes too.



HER MASTER'S CHOICE. Jane, the well-loved dog of the Beckingham family in Whitchurch, Hants. genuinely enjoys a session with the Micro-6 although we are not told what her favourite programme is. Mr W. W. Beckingham who sent the photo states that Jane is a Micro-6 emthusiast (as are the rest of the family).



From Mr Blair, of Stoke-on-Trent comes this photo which needs no explaining such is the contrast between the old and the new in radio listening.

10 SINCLAIR RADIONICS L	TD., COMBERTON, CAMBRIDGE
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Bew, comprising of the following very high
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1—Double Wire Wound Potentiometer.

1—Single Wire Wound Potentiometer 1800
ohms.

ohms.
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1—Tape Speed Meter Head only.
9—Double Pole Key Switches.
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The following wire wound resistances all

The following 6-1
+ or -5%:
1-600 ohms 7-15 ohms 5-22 ohm
3-56 ohms 1-52 ohms 5-88 ohm
This must have cost \$50 to make.

Carriage 8 5-68 ohms OUR PRICE £ 5 packing 10/-.

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These well made tuning units made for the American 19 T.X.-R.X. are housed in a metal case. size 4x 4x 10in, using a large precision calibrated scale, are an essential piece of equipment for the serious T.X. or E.X. operator. This unit will match an untuned wire or whip aerial to almost any short wave entering the serious properties of the serious control of the serious properties of the serious propertie uctions supplied.

#### PYE OR INVICTA LOUDSPEAKER UNITS

FIE UR INVICE MUUDSTEARES UNITS
Enclosed in a brown wooden cabinet and carrying
handle size, using a silver speaker mesh. Complete
with 40t. of lead and Jack Plug. A 10in. heavy duty
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Halls, P.A. work, etc. (made for any entertainment
use). BEAND NEW and BOXED Only \$2.15.0.
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88 T.X.-R.X. POWER UNIT

input to 90V, 7.5V, 1.4V stabilised output.

Also contains L.F. amplifier. These are sold BRAND

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"C" Core trans-

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Mains 110/230 voits
600 ohms of high
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Output 600 ohms.
Controls: On/Off
switch. Gain control. Indicator light.
Valve inspection panel. 19 x 7 x 7in. Brand
New in makers cartons. £4.5.0. Carr. 12/6.
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New type vibrator cute. Iron can be attery.
TELESCOPIC AERIAI. MASTS. Tubular
steel copperised, spray finish, ring can
locking on each section provides for full
or any height required. Suitable all fixings
and base locations. Bottom section 1in.

or any height required. Suitable all fixings and base locations. Bottom section 13in. diameter.

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34ft. (6 section) Closed on a section 575. Carr. 5/-.
Further height by adding 3-4ft. Whipsections 75. Carr. 1/6. Special price for quantities. (REED TELEPRINTERS. 7B Used condition, 212.10.0. Carr. 30/-.
TRANSWITTER. L75-16 Mc/s 3 waveband tuneable, grid modulation using 813. Used complete with all valves, circuit £7.10.0. Carriage 10/-.

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New valves—10D2 10LD11, 6F13, 6F15, 6F1, 6F12, 6L19, 6L18, 6L1920, SP41, SP61, T41, T441, U281, U282, UU6, 6F33, 25Z5, 25Z6, 43, 57, 58, 79, all 2/6 each, SP25, 6V6) 5/-P, & P. 6d., 6C9, U404, UU9 at 7/6 each.

Used Valves—EF80, 10F1, 6F1 1/6 each, ECL80, PY80, 6P25, 20P1, etc. 3/- each, PZ30 5/- each P. & P. 6d.

Many old Radio Valves available at 5/- each. Laminated copper 6 x 4in., 2/-; Transistor 3 ohm output transformers 2/6. Tuning Condensers 115 + 250pF with trimmers, 7/-on/toff. med., long wave miniature press switch 4/6. similar piano key switch 3/6, pax pannels with diodes, resistors etc. (not soldered in) 3/6, P. & P. 6d.

Huge parcel of condensers, resistors, trimmers, etc. (all new) 10/-, P. & P. 1/-.

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PRACTICAL WIRELESS, DECEMBER, 1964

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