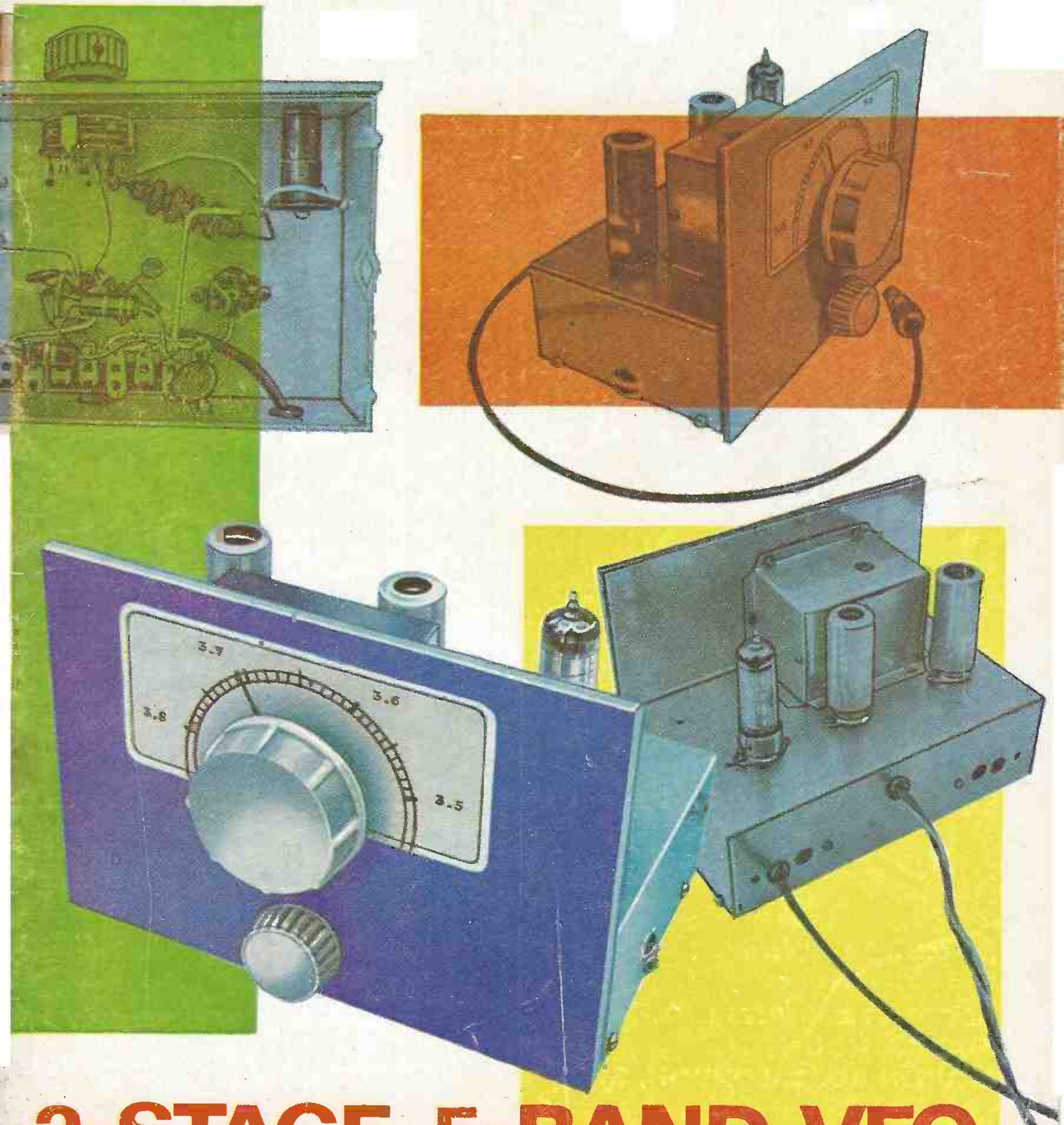
PRACTICAL WIRELESS

OCTOBER 1965

2/-



2-STAGE 5-BAND VFO

BENTLEY ACOUSTIC CORPORATION LTD.

Suppliers to H.M. Government. 38 CHALCOT ROAD, LONDON, N.W.1 Telephone: PRIMROSE 9090

NEAREST UNDERGROUND: CHALK FARM. ALL GOODS LISTED BELOW ACTUALLY IN STOCK
ALL GOODS ARE NEW, BEST QUALITY BRANDS ONLY, AND SUBJECT TO MAKERS' FULL GUARANTEE, PLEASE NOTE THAT WE DO NOT SELL ITEMS FROM USED EQUIPMENT NOR MANUFACTURERS' SECONDS & REJECTS, WHICH ARE OFTEN DESCRIBED AS "NEW AND TESTED" BUT HAVE A SHORT AND UNRELIABLE LIFE

OA2	4/6
OB2	6/-
OZ4GT	4/3
1A3	2/6
1A4	12/6
1A5	5/-
1A7GT	7/6
1C1	4/-
1C2	8/-
1C3	6/6
1C5	5/-
1C6	10/6
1D5	6/6
1D6	9/6
1FD1	8/-
1FD9	3/3
1G6	6/-
1H5GT	7/6
1L4	2/3
1LA4	17/6
1LA6	16/10
1LD5	4/-
1LN5	4/6
1N5GT	8/6
1P1	6/-
1P10	4/9
1P11	5/-
1R5	4/-
1S4	5/-
1S5	3/3
1T2	29/-
1T4	2/3
1U4	5/6
1U5	5/3
2A7	12/6
2C26	2/9
2D13C	7/-
2D21	5/-
2X2	3/-
3A4	3/9
3A5	6/9
3B7	5/-
3D6	3/9
3Q4	5/3
3Q5GT	6/9
3S4	4/9
3V4	5/-
4D1	3/9
5R4GY	8/6
5T4	7/-
5U4G	4/6
5V4G	8/-
5Y3GT	4/9
5Z3	6/6
5Z4	7/6
6/30L2	8/9
6A6G	3/9
6A8G	5/9
6AB7	4/-
6AC7	3/-
6AG5	2/6
6AG7	5/9
6AJ5	8/6
6AK5	4/9
6AK6	6/-
6AK8	5/9
6AL5	2/3
6AM5	2/6
6AM6	3/-
6AQ5	5/9
6AR6	20/-
6AT6	3/6
6AU6	5/9
6AV6	5/6
6B5G	12/6
6B8G	2/6
6BA6	4/6
6BE6	4/3
6BH6	5/3
6BJ6	5/6
6BQ5	4/6
6BQ7A	7/6
6BR7	8/3
6BR8	8/-
6BS7	25/-
6BW6	7/6
6BW7	5/-

6BX	4/3
6C4	2/3
6C5	4/-
6C6	3/-
6C8	3/-
6C9	10/9
6C10	8/-
6C12	5/9
6CD6G	18/-
6CH6	6/6
6CW4	24/-
6D1	1/6
6D3	9/6
6D6	3/-
6E5	9/6
6F1	9/6
6F6G	3/9
6F6GT	7/6
6F7G	5/-
6F8	5/-
6F11	17/9
6F12	3/-
6F13	3/9
6F14	23/3
6F15	6/9
6F16	6/6
6F17	12/6
6F18	13/5
6F23	9/3
6F24	10/6
6F32	3/-
6F33	3/6
6G6	2/6
6H6	1/6
6J5G	3/-
6J5GT	4/3
6J6	3/-
6J7G	4/6
6J7GT	7/-
6K6GT	5/6
6K7G	1/3
6K7GT	4/-
6K8G	3/3
6K8GTM	8/6
6K25	24/-
6L1	10/-
6L5G	12/6
6L6GT	7/3
6L7GTM	5/6
6L18	10/-
6L19	19/-
6LD3	6/6
6LD13	7/-
6LD20	6/6
6N7GT	7/-
6P1	9/3
6P25	6/6
6P26	9/-
6P28	11/6
6Q7G	4/-
6Q7GT	7/9
6R7G	5/3
6R7GT	11/-
6SA7GT	7/-
6SC7	4/9
6SG7	7/9
6SG7GT	4/9
6SH7	3/-
6SJ7	4/6
6SK7	4/6
6SL7	4/9
6SN7	4/-
6SQ7	5/-
6SR7	12/6
6SS7	2/-
6U4GT	8/6
6U5G	5/-
6U7G	7/-
6V6G	3/6
6V6GT	5/6
6X4	3/9
6X5	5/3
6Y7G	12/6
6Z4/84	5/-
6Z5G	15/-
7A7	12/6
7B6	12/6

7B7	9/6
7C5	8/-
7C6	6/9
7C7	5/-
7D3	15/-
7D5	14/6
7D6	14/6
7H7	5/9
7R7	12/6
7V7	5/-
7Y4	5/-
8D2	2/6
9BW6	9/6
9D2	3/-
9D7	7/6
10C1	9/9
10C2	12/-
10D1	7/-
10D2	11/8
10F1	10/-
10F9	9/9
10F18	9/9
10LD3	6/3
10LD11	9/6
10P13	12/-
10P14	11/6
11D3	17/6
11D5	17/6
11E3	17/-
12A6	2/3
12A8	16/6
12AC6	8/6
12AD6	9/6
12AE6	8/-
12AH7	5/-
12AH8	10/9
12AT6	4/6
12AT7	3/6
12AU6	5/9
12AU7	4/6
12AV6	5/9
12AX7	4/6
12AY7	9/9
12BA6	5/3
12BE6	4/9
12BH7	6/-
12E1	16/9
12H6GT	1/6
12J5GT	2/6
12J7GT	7/3
12K5	10/-
12K7GT	3/6
12K8GT	8/6
12Q7GT	3/6
12SA7GT	6/9
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7	3/-
12SQ7	8/-
12SR7	5/-
12U5G	7/-
12Y4	2/-
13D1	5/-
13D3	5/6
14H7	9/6
15D2	6/-
18	12/6
19	10/6
19AQ5	7/3
19BG6G	20/5
19H1	6/-
20D1	10/-
20D2	21/-
20F2	11/6
20L1	12/-
20P1	12/6
20P3	12/-
20P4	13/-
20P5	11/6
25A6G	7/6
25L6	4/9
25U4GT	14/7
25Y5	7/9
25Y5G	7/9
25Z4G	6/6

25Z5	7/3
25Z6GT	8/-
27SU	23/3
28D7	6/9
30C1	6/6
30C15	10/-
30C17	11/9
30C18	9/3
30F5	7/3
30FL1	9/3
30L1	5/6
30L15	10/3
30L17	11/6
30P4	12/-
30P12	7/6
30P16	5/3
30P19	12/-
30PL1	9/6
30PL13	10/6
30PL14	11/3
30PL15	9/6
35/51	12/6
35A5	20/9
35L6GT	6/-
35W4	4/6
35Z3	16/2
35Z4GT	4/6
35Z5GT	5/9
40SUA	6/6
41MTL	8/-
41STH	10/-
42	5/-
43	10/-
45	17/6
45Z6GT	15/-
50A5	21/10
50B5	6/6
50C5	6/6
50CD6G	40/9
50L6GT	6/-
52KU	14/6
53KU	14/6
72	6/6
77	5/-
78	4/9
80	5/3
83V	8/-
85A2	6/6
90AG	67/6
90AV	67/6
90CG	42/-
90CV	42/-
90C1	16/-
150B2	16/6
150C2	4/6
161	13/-
185BT	34/11
215SG	6/6
220B	10/6
301	20/-
302	15/-
303	15/-
304	15/-
305	16/6
306	18/-
956	2/-
1203A	7/-
1622	12/6
2101	12/6
4033	15/-
4687	71/-
5763	7/6
6067	10/-
7193	1/6
7475	2/9
9002	4/6
9003	6/-
A1834	20/-
ACO44	9/-
AC2HL	10/6
AC2PEN	11/6
AC2PEN/DD	12/6
AC5PEN/DD	23/3
AC6PEN	4/9
AC/PEN	

(5)	17/6
AC/PEN (7)	17/-
AC/SG	22/6
AC/SG/VM	12/-
AC/TH1	10/-
AC/TP	18/-
AC/VP1	12/-
AC/VP2	12/-
ATP4	2/3
AZ1	8/6
AZ31	9/6
AZ41	6/6
B36	4/9
B339	4/6
B719	5/9
BL63	10/6
C1	12/6
CK506	6/6
CI4	19/6
CL33	11/6
CV6	2/6
CV63	10/6
CV85	14/6
CV271	12/6
CV428	19/-
CY1	16/4
CY1C	6/6
CY31	5/9
D1	1/3
D15	13/6
D42	10/6
D63	5/-
D77	2/3
DAC32	7/6
DAF91	3/3
DAF96	6/-
DCC90	6/9
DD4	12/6
DD41	10/6
DDT4	7/6
DET25	7/6
DF33	8/6
DF66	15/-
DF72	30/-
DF91	2/3
DF96	6/-
DF97	10/-
DH30	15/6
DH63	4/-
DH76	3/6
DH77	3/6
DH81	23/3
DH101	25/-
DH107	16/11
DK32	7/6
DK40	15/6
DK91	4/-
DK92	8/-
DK96	6/6
DL33	6/9
DL35	5/-
DL63	5/3
DL68	15/-
DL72	15/-
DL75	30/-
DL92	4/9
DL94	5/-
DL96	6/-
DL810	10/6
DM70	5/-
DM71	9/9
DW4/350	8/6
DW4/500	8/6
DY86	6/6
DY87	7/6
E80F	24/-
E83F	24/-
E88CC	10/-
E180F	19/6
E1148	1/9
EA50	1/6
EA76	6/9
EABC80	5/9
EAC91	3/3
EAF42	7/9

EB34	1/-
EB41	4/9
EB91	2/3
EBC3	20/6
EBC33	6/-
EBC41	6/6
EBC81	5/9
EBC90	3/6
EBC91	5/6
EBF80	5/9
EBF83	7/3
EBF89	5/9
EBL21	10/3
EC52	4/3
EC53	12/6
EC54	6/-
EC70	4/9
EC90	2/3
EC91	4/-
EC92	6/6
ECC31	7/3
ECC32	4/-
ECC33	29/1
ECC34	21/7
ECC35	4/9
ECC40	7/-
ECC81	3/6
ECC82	4/6
ECC83	4/6
ECC84	5/6
ECC85	5/9
ECC88	8/9
ECC189	11/6
ECC804	8/9
ECC807	15/-
ECF80	7/3
ECF82	6/3
ECF86	11/6
ECF804	24/-
ECH3	23/3
ECH21	9/-
ECH33	22/8
ECH35	6/-
ECH42	8/-
ECH81	5/9
ECH83	6/6
ECH84	9/6
ECL80	5/9
ECL82	6/6
ECL83	8/9
ECL86	8/-
EF6	20/6
EF9	20/6
EF22	6/6
EF37A	7/-
EF39	9/-
EF40	8/9
EF41	6/6
EF42	3/9
EF50	2/6
EF54	5/-
EF73	5/-
EF80	4/3
EF83	9/9
EF85	4/6
EF86	6/6
EF89	4/-
EF91	3/-
EF92	2/6
EF97	10/-
EF98	9/9
EF183	7/3
EF184	6/6
EH90	9/6
EK32	5/9
EL2	19/6
EL32	3/6
EL33	6/6
EL34	9/9
EL35	10/-
EL36	8/9
EL37	12/3
EL41	7/-
EL42	7/9
EL81	8/3
EL83	6/9
EL84	4/6

EL85	7/6
EL86	7/3
EL91	2/6
EL95	5/-
EL360	27/-
EL820	16/4
EL822	22/6
ELL80	13/6
EM4	17/9
EM34	11/6
EM35	12/-
EM71	15/6
EM80	6/3
EM81	7/-
EM84	6/-
EM85	8/9
EM87	7/6
EN31	10/-
EN91	5/6
EY51	5/6
EY81	7/3
EY83	9/3
EY84	9/6
EY86	5/6
EY88	8/9
EY91	3/-
EZ35	5/3
EZ40	5/3
EZ41	6/3
EZ80	3/9
EZ81	4/3
EZ90	3/9
FC2	14/6
FC4	8/9
FC13	14/6
FC13C	17/-
FW4/500	6/6
FW4/800	8/6
GT1C	9/9
GU50	55/-
GZ30	7/6
GZ32	8/-
GZ33	17/6
GZ34	10/-
GZ37	14/6
H30	5/-
HABC80	9/3
HL2	7/6
HL13C	4/-
HL23	12/6
HL23DD	5/-
HL41	3/9
HL41DD	12/6
HL42DD	12/6
HL133DD	9/6
HN309	25/-
HVR2	8/3
HVR2A	8/9
1W3	5/6
1W4/350	5/6
1W4/500	6/-
KBC32	20/5
KF35	12/6
KL35	11/6
KLL32	21/7
KT2	5/-
KT8	15/-
KT32	4/9
KT33C	6/-
KT36	29/1
KT41	6/6
KT44	5/-
KT61	6/9
KT63	3/9
KT66	12/3
KT74	12/6
KT88	28/-
KTW61	4/9
KTW62	5/6
KTW63	5/6
KTZ41	5/6
L63	3/-
LN152	5/9
LN309	9/6
LN319	9/6
LP2	9/6
LZ319	6/6

LZ329	6/6
MHD4	7/6
MHLD6	12/6
ML6	5/9
MS4B	20/5
MSP4	12/-
MU12/14	4/6
MX40	8/9
N37	10/6
N78	26/-
N108	26/2
N339	25/-
P41	3/6
P61	2/6
PABC80	6/9
PC86	9/9
PC88	9/-
PC95	6/9
PC97	6/9
PCC84	5/6
PCC85	6/9
PCC88	10/6
PCC89	11/6
PCC189	10/-
PCF80	6/6
PCF82	6/-
PCF84	8/6
PCF86	8/6
PCF801	10/-
PCF802	10/-
PCF805	9/3
PCL82	6/6
PCL83	9/6
PCL84	7/6
PCL85	8/6
PCL86	8/9
PCL88	12/6
PEN40DD	34/-
PEN45	7/-
PEN45DD	12/-
PEN46	4/-
PEN383	10/3
PEN453DD	10/6
PENA4	7/-
PEN/DD 4020	17/6
PFL200	20/5
PL33	9/-
PL36	9/-
PL38	16/-
PL81	6/9
PL82	5/-
PL83	6/-
PL84	6/3
PL500	15/9
PM84	9/3
PT15	10/-
PX4	9/-
PX25	8/6
PY31	6/9
PY32	8/9
PY33	8/9
PY80	4/9
PY81	5/-
PY82	4/9
PY83	5/6
PY88	7/3
PY800	5/9
PY801	7/6
PZ30	9/6
QP21	5/-
QP22B	12/6
QQV03/10	35/-
QS7520	10/6
QS150/15	9/6
R10	15/-
R12	5/6
R16	29/-
R17	17/6
R18	9/6
R19	6/9
R52	7/6
RG1/240A	

	54/-
RK34	7/6
S130	22/6
SP4B	19/6
SP13C	12/6
SP41	2/-
SP42	12/6
SP61	2/-
SU25	27/2
T41	9/-
TDD2	12/6
TDD4	7/6
TH4B	10/-
TH21C	10/6
TH30C	14/6
TH41	10/-
TH233	6/9
TP22	5/-
TP25	5/-
TP2620	7/6
TY86F	11/8
UABC80	5/-
UAF42	6/9
UB41	10/6
UBC41	6/3
UBC81	6/3
UBF80	5/6
UBF89	6/3
UBL21	10/9
UC92	6/3
UCC84	8/-
UCC85	6/6
UCF80	8/3
UCH21	8/-
UCH42	8/-
UCH81	6/6
UCL82	7/3
UCL83	9/3
UF41	6/9
UF42	4/9
UF80	6/3
UF85	6/9
UF86	9/-
UF89	5/6
UL41	7/-
UL44	23/3
UL46	8/6
UL84	5/6
UM4	17/6
UM34	17/6
UM80	8/3
UR1C	6/6
UU5	7/-
UU6	11/-
UU7	7/6
UU8	14/-
UU9	5/3
UU12	4/3
UY1N	10/3
UY21	7/9
UY41	5/-
UY85	4/9
U10	9/-
U12/14	7/6
U16	15/-
U17	5/-
U18/20	6/6
U19	48/6
U22	5/9
U25	8/6
U26	7/6
U31	6/6
U33	13/6
U35	16/6
U37	29/-
U45	15/6
U47	8/6
U50	4/9
U52	4/6
U76	4/6
U78	3/9
U101	19/6
U107	17/6
U191	9/6
U251	9/-
U281	8/9
U282	12/3

U301	11/-
U329	9/-
U339	9/6
U403	9/9
U404	6/-
U801	15/-
U4020	6/6
VMP4G	11/9
VMS4B	12/-
VP2	3/6
VP2B	9/6
VP4	14/6
VP4A	14/6
VP4B	12/-
VP13C	7/-
VP23	2/6
VP41	5/-
VP133	9/9
VR75	21/-
VR105	5/6
VR150	4/9
VT61A	7/-
VT501	3/-
VU111	5/-
VU120	10/-
VU120A	10/-
VU133	7/-
W21	5/-
W42	12/-
W61M	24/6
W63	10/6
W76	8/6
W77	2/6
W81M	5/9
W101	26/2
W107	10/6
W729	17/6
X14	7/9
X18	8/-
X24	16/6
X41	10/-
X61	6/-
X63	5/9
X64	5/6
X65	5/6
X66	7/3
X76M	8/6
X78	26/2
X79	27/-
X81M	29/1
X101	23/6
X109	26/-
X118	9/9
X119	6/6
X142	8/-
Y63	5/-
Y65	5/-
Z63	4/6
Z66	7/3
Z77	8/-
Z152	4/3
Z729	6/6
Z749	9/3
Z759	36/-
Transistors and diodes	
AA120	4/6
AA129	4/6
AC107	14/6
AC113	8/-
AC114	8/-
AC127	9/6
AD140	25/-
AF102	27/6
AF114	11/-
AF115	10/6
AF116	10/-
AF117	5/6
AF118	20/-
AF124	11/-
AF125	10/6
AF126	10/-
AF127	9/6
BY101	8/-
BY105	7/-
GD3	5/6
GD6	5/6

GD14	10/-
GET103	7/-
GET104	10/-
GET106	17/6
GET111	12/-
GET113	6/9
GET114	6/6
GET116	17/-
GET873	9/3
GET874	9/6
GEX13	3/6
GEX35	3/-
GEX36	10/-
GEX45	6/6
GEX64	11/6
GEX66	15/-
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
OA5	6/-
OA10	6/6
OA70	3/-
OA73	3/-
OA79	3/-
OA81	3/-
OA85	3/-
OA86	4/-
OA90	3/-
OA91	3/-
OA95	3/6
OA200	5/-
OA210	9/6
OA211	13/6
OAZ202	5/6
OAZ203	9/6
OAZ204	9/6
OAZ210	7/6
OC16W	35/-
OC19	25/-
OC22	23/-
OC23	57/-
OC25	12/-
OC26	8/-
OC28	23/-
OC29	16/6
OC35	9/6
OC36	21/6
OC41	8/-
OC42	5/-
OC43	12/6
OC44	4/9
OC44PM	8/3
OC45	3/6
OC45M	8/-
OC65	22/6
OC66	25/-
OC70	6/6
OC71	3/6
OC72	8/-
OC73	16/-
OC74	8/-
OC75	8/-
OC76	8/6
OC77	12/-
OC78	8/-
OC81	4/-
OC81D	4/-
OC81M	8/-
OC82	10/-
OC83	6/-
OC84	8/-
OC139	12/-
OC140	19/-
OC170	8/6
OC171	9/-
OC200	10/6
OC201	29/-
OC203	14/-
OC204	10/6
OC206	10/6
OCP71	27/6
ORP12	12/6
TS2	12/6
TS3	15/-
V10/15A	12/-
XA103	15/-

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF VALVES, LOOSE OR BOXED, BUT MUST BE NEW

METAL RECTIFIERS. DRM1B 13/-. DRM2B and DRM3B 15/6. LW7 21/-. LW15 26/-. RMO 7/11. RM1 5/3. RM2 6/3. RM3 7/9. RM4 12/9. RM5 17/6. 14A86 17/6. 14A97 19/6. 14A100 23/-. 14A124 26/6. 14A163 35/6. 14B130 31/-. 14B261 11/6. FC101 16/9. 16RC.1.16.1 8/-. FC31 21/-. 16RD.2.2.8.1 11/-. 16RE.2.1.8.1 8/6. 18RA.1.1.8.1 4/-. 18RA.1.2.8.1 11/-. FC116 6/-. FC124 12/6. SB3 10/6. C2D 9/-. C2H 5/9. C2V 9/-. C3D 11/-. C3B 14/8. C3V 11/-. R3/2D 4/3. Q3/4 3/7.

ELECTROLYTICS. Can types: 32 x 32/450v. 6/-. 50 x 50/350v. 6/-. 64 x 120/350v. 9/-. 60 x 250/275v. 9/6. 100 x 400/275v. 12/6. 100/275v. 3/-. 200/275v. 4/-. 100 x 200/275v. 8/6. Tubular types: 8/450v. 1/9. 16/450v. 2/9. 32/450v. 3/9. 8 x 8/450v. 3/-. 16 x 16/450v. 4/-. 32 x 32/350v. 4/-. 8 x 16/450v. 3/9. 32/350v. 3/-.

Midget silicon rectifiers. Types BY100. Output 250 volts ½ amp. No larger than a shirt button, 6/6 each. Series limiting resistance 1/6.

EXPRESS POSTAL SERVICE! ALL ORDERS DESPATCHED SAME DAY AS RECEIVED

Terms of business—Cash with order or C.O.D. only. Post/Packing 6d. per item. Orders over £5 post free. C.O.D. 3/6 extra. All orders cleared day of receipt. Any **parcel insured against** damage in transit for 6d. extra. We are open for personal shoppers 9.00—5 p.m. Sats. 9.00—1 p.m. Complete list of modern and obsolete **valves, resistors,** condensers, transformers potentiometers, microphones, etc. with terms of business. 6d. Please enquire for any item not listed with S.A.E.

1. **6 VALVE 15 WATT PUSH-PULL AMPLIFIER,** 15 x 7 x $1\frac{1}{2}$in. A.C. Mains 200-250 volts. 4 inputs with controls for same and bass and treble lift controls. Tapped for 3 and 15 ohm speakers. Extra H.T. and L.T. for F.M. Tuner supplies etc. Built and tested. **7 gns.** P. & P. 13/6.

2. **CYLDON A.M. F.M. PERMEABILITY TUNERS FOR ALL TRANSISTOR OPERATION.** Size $2\frac{1}{2}$ x $2\frac{1}{4}$in. approx. By famous manufacturer. A.M. I.F. 470 Kc/s. F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1620 Kc/s-525 Kc/s. F.M. coverage 108 Mc/s-88Mc/s. Circuit diagrams 2/6. FREE with Tuner, 1st, 2nd and 3rd A.M. I.F.'s, 1st, 2nd, 3rd and 4th F.M. I.F.'s V.H.F. Osc. choke, A.M. I.F. trap. All the above are the R.F. end of an A.M./F.M. receiver car radio etc. The above items, £2.10.0.

3. **AMPLIFIER KIT.** 3 to 4 watt Amplifier Kit. Comprising chassis $8\frac{3}{4}$ x $2\frac{1}{4}$ x 1in. Double wound mains transformer, output transformer, volume and tone controls, resistors, condensers etc. Valves 6V6, ECC81 and metal rectifier. Circuit 1/6, free with kit. 29/6 plus 4/6 P. & P.

4. **TRANSISTOR INVERTOR.** 50 v. D.C. Input. Output 240 v. A.C. 40 watts incorporating transformers, choke, condensers and 2 GET573. In solid 16 gauge aluminium case, size 15 x 6 x $2\frac{1}{4}$in. by famous manufacturer, 19/6, plus 7/- P. & P.

5. **FLUORESCENT LIGHT FITTING.** Twin 40 watt 200/250 v. less tubes. 39/6. P. & P. 7/-.

6. **OSCILLOSCOPE for D.C. and A.C. APPLICATIONS.** Push-pull X amplifier; Fly-back suppression; Internal Time-base Scan Wave form available for external use; pulse output available for checking TV line O/P Transformers, etc. Provision for external—I/P and C.R.T. Brightness Modulation. A.C. mains 200/250 v., £18 18.0. P. & P. 10/- **FULL 12 MONTHS' GUARANTEE INCLUDING VALVES and TUBE.**

7. **A.C. MAINS MOTOR.** Can be used for a variety of purposes, silent running, satisfactory in every way. 230/250v. A.C., 9/6. P. & P. 3/-.

8. **POCKET MULTI-METER.** Size $3\frac{3}{4}$ x $2\frac{1}{2}$ x $1\frac{1}{4}$. Meter size $2\frac{1}{2}$ x $1\frac{3}{4}$in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts. 0-15, 0-150, 0-1,000. D.C. current 0-150 mA. Resistance 0-100k Ω. Complete with test prods, battery and full instructions, **42/6.** 1. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

9. **CHANNEL TUNER I.F.** 16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—PCF80 and PCC84 (in series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker, 10/-. P. & P. 3/-.

10. **POWER SUPPLY KIT** in metal case, size $3\frac{3}{4}$ x $2\frac{1}{2}$ x 2in. incorporating mains transformer, rectifier and condensers. 230/250 A.C. mains Output: 9v., 100mA. 10/6 plus 3/- P. & P.

11. **B.S.R. MONARCH UA14 WITH FULL FI HEAD,** 4-speed, plays 10 records, 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour brown. Dimensions: $12\frac{1}{4}$ x $10\frac{3}{4}$in. Space required above baseboard $4\frac{3}{4}$in., below baseboard $2\frac{3}{4}$in. Fitted with Full Fi turnover crystal head. £5.19.6. P. & P. 7/6.

12. **50 MICRO-AMP METER** movement by world famous manufacturer, Size 3 x $2\frac{3}{4}$in., 25/-, plus 2/- P. & P.

13. **8-WATT 5-VALVE PUSH-PULL AMPLIFIER & METAL RECTIFIER.** Size: 9 x 6 x $1\frac{1}{2}$in. A.C. Mains, 200-250v. 5 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent total distortion. Separate bass and treble lift controls. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. £3.19.6. P. & P. 8/-.

14. **40W. FLUORESCENT LIGHT KIT** incorporating GEC Choke size $8\frac{1}{2}$ x $1\frac{3}{4}$ x $1\frac{3}{4}$in. 2 bi-pin holders, starter and starter holder, 11/6. P. & P. 4/6.
Similar to above: **80W Fluorescent Light Kit** incorporating GEC choke size $11\frac{3}{4}$ x $1\frac{3}{4}$ x $1\frac{3}{4}$in. 2 bi-pin holders, starter and starter holder 17/6. P. & P. 5/6.

15. **FIRST QUALITY PVC TAPE**

$5\frac{3}{4}$in. Std. 850ft.	9/-	5in. L.P. 850ft.	10/6
7in. Std. 1200ft.	11/6	3in. T.P. 600ft.	8/-
3in. L.P. 240ft.	4/-	5in. T.P. 1800ft.	20/6
$5\frac{3}{4}$in. L.P. 1200ft.	11/6	$5\frac{3}{4}$in. T.P. 2400ft.	27/6
7in. L.P. 1800ft.	18/6	7in. T.P. 2600ft.	37/6

P. & P. on each 1/6. 4 or more Post Free.

16. **FIXED FREQUENCY SIGNAL GENERATOR.** Crystal controls in metal case, size 10 x 6 x 6in. Incorporating two FC13 valves, mains transformer, metal rectifier, choke, indicator, lamp, crystal and numerous components. Modulated and unmodulated output socket. Originally used for I.T.V. frequencies. Brand new, 39/6, plus 7/- P. & P. A.C. mains 200-250 volts.

SILICON RECTIFIERS. 250v. P.I.V. 750 mA. Six for 7/6 post paid.

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

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Terms: C.W.O. or C.O.D. No C.O.D. under £1. Postage 2/9 extra under £2. 4/6 extra under £5. Trade Supplied. S.A.E. with all enquiries please. Personal shoppers welcomed at any of the branches below. Open all day Saturday.

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DERBY 26 Osmaston Rd., The Spot (Half-day Wed.) Tel: 41361

DARLINGTON 13 Post House Wynd (Half-day Wednesday) Tel: 68043

EDINBURGH 133 Leith Street, (Half-day Wed.)

GLASGOW 326 Argyle Street, Tel: CITy 4158 (No Half-day).

HULL 51 Savile Street (Half-day Thursday) Tel: 20505

LEICESTER 32 High Street (Half-day Thurs.) Tel: 56420

LEEDS 5-7 County (Mecca) Arcade (No half-day) Tel.: 28252

LIVERPOOL 73 Dale St. (No half-day) Tel: CENtral 3573

LONDON 238 Edgware Road W2 (Half-day Thursday) Tel: PADdington 1629

MANCHESTER
60A-60B Oldham St. Tel: CENtral 2778 (No half-day) New large store.

MIDDLESBROUGH (Half-day Wednesday)
106 Newport Rd. Tel: 47096

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

JASON FMT1 V.H.F./F.M. Radio Tuner design. Total cost of parts including valves, tuning dial, escutcheon, etc. **£6.19.6**

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner (specially suitable for use with our Amplifiers). Delayed A.V./C. Controls are Tuning, W/Ch. and Vol. Only 250v. 15mA H.T. and L.T. of 6.3v. 1 amp. required from amplifier Size approx. 9 x 6 x 7in. high. Simple alignment procedure. Point-to-Point wiring diagrams, instructions and priced parts list with illustrations, 3/6. Total building costs £5.5.0. S.A.E. for leaflet.

TRANSISTOR SALE Mullard OC71 2/11, OC45 3/11, OC44 3/11, OC72 2/11, OC81 2/11, OC171 8/9, AF117 6/9. Ediswan XA101 3/9, XA112 3/9, XC101A 3/9. Postage 6d. for up to 3 transistors.

EX GOVT. SELENIUM RECTIFIERS 12v 15 AMP (BRIDGE) F.W. ONLY 19/9

Ex. GOVT. SMOOTHING CHOKES. 200mA, 3-5 H, 50 ohms, Parmeko 8/9; 150mA. 10H, 50 ohms 9/9; 120mA, 12H, 100 ohms 8/9; 100mA, 10H, 100 ohms 6/9; 60mA. 5-10H, 250 ohms, 2/11.

TANNOY RE-ENTRANT LOUDSPEAKERS. For outdoor or Factory use, 8 ohms, 8 watts. Only **27/6**

EX. GOV., 2V ACCUMULATORS, 16 A.H. Size 7 x 4 x 2in. Brand new, 4/9 each. Three for 12/6, carr. 5/-.

HI-FI 10 WATT AMPLIFIERS

BRAND NEW EX-GUITAR AMPLIFIERS **8 Gns.** Carr. 6/6
Manufacturers' discontinued Model. Push-pull output. Latest high efficiency valves Dual separately controlled Inputs for 'Mike' and gram. Separate Bass and Treble Controls. High Sensitivity. Output for 3 or 15 ohms speaker. Guaranteed tested and in perfect working order.

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

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

TOP SHROUDED DROP THROUGH
250-0-250v. 70mA, 6.3v. 2a, 0-5.6.3v. 2a 17/9
350-0-350v. 80mA, 6.3v. 2a, 0-5-6.3v. 2a 21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a .. 21/9
250-0-250v 100mA, 6.3v. 3.5a, C.T. .. 19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 28/9
300-0-300v. 130mA, 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier 35/9
300-0-300v. 100mA, 6.3v 4a, 0-5-6.3v. 3a 28/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 28/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 37/9

FULLY SHROUDED UPRIGHT
250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a Midget type 2½ x 3 x 3in. 18/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v 3a 29/9
300-0-300v. 100mA, 6.3v. 4a, 5v. 3a .. 29/9
300-0-300v. 130mA, 6.3v. 4a, C.T. 6.3v. 1a, for Mullard Amplifier 36/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 38/9
425-0-425v. 200mA, 6.3v. 4a, C.T. 5v. 3a 57/9
425-0-425v. 200mA, (6.3v. 4a Twice), 5v. 3a 59/9
450-0-450v. 250mA, 6.3v. 4a, C.T. 5v. 3a 69/9

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

MIDGET MAINS TRANS 2½ x 2½ x 2½in.
250v. 60mA 6.3v. 2a 13/9
250-0-250v. 60mA. 6.3v. 2a 14/9

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

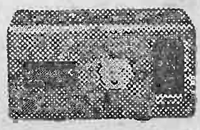
SMOOTHING CHOKES
60mA, 10H 400 Ω 4/11. 100mA, 10H, 200 Ω 8/9
80mA, 10H 350 Ω 5/9. 150mA, 10H, 250 Ω 11/9

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

AUTO (Step up/Step down) TRANS.
0-110/120-230/250v. 50-80 watts, 13/9; 150 watts, 27/9; 250 watts, 49/9; 500 watts 99/9.

MIKE TRANSFORMERS 120:1 8/9.

R.S.C. BATTERY CHARGER and KITS



for A.C. Mains 200/250v. 50c.s. *ASSEMBLED* 4 amps 6/12v. Fitted Ammeter and variable charge rate selector Also selector plug for 6v. or 12v. charging. Louvred steel case with stoved grey hammer finish. Fused and ready for use with mains and output leads and battery clips. **59/9** Carr. 4/6. Terms: Deposit 12/- and 5 monthly payments of 12/- (Total £3.12.0).

HEAVY DUTY CHARGER KIT 6/12 v. 6 amps., variable output. Mains transformer 0-200-230-250v. F.W. (Bridge) Selenium Rectifier, Ammeter, Variable Charge Rate Selector panels, Plugs, Fuses, Fuse-holder and circuit, 59/9. Carriage 4/6.

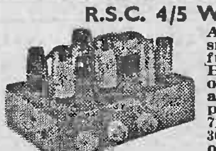
SELENIUM RECTIFIERS
F.W. (BRIDGED) TYPES
6/12v. 1a. 3/11 6/12v. 6a. 15/3
6/12v. 2a. 6/11 6/12v. 10a. 26/9
6/12v. 3a. 9/9 6/12v. 15a. 35/9
6/12v. 4a. 12/3

COMPLETE POWER PACK KIT
Consisting of Mains Trans., Metal Rectifier, Double electrolytic smoothing choke chassis and circuit. For 200/250 v. A.C. mains. Output 250v., 60mA, 6.3v., 2a. **19/11**

ARMSTRONG, TRUVOX, LEAK, QUAD, ROGERS, LINEAR, W.B., FANE, WHARFEDALE, GOODMANS GARRARD, GOLDRING, GRAMPIAN, LUSTRAPHONE, SHURE, RESLO, TANDBERG, FERROGRAPH Products stocked. Usual credit terms available.

SCOOP PURCHASE OF HIGH QUALITY RECORD CHANGERS
Brand new Garrard 3000 LM. Very latest model. Normal Retail price approx. £12.15.0. Heavy Turntable and light-weight pick-up arm. High fidelity Stereo/Mono cartridge. Fully guaranteed. **10 GNS.** Carr 5/6

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



A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest High-fidelity Pick-up heads in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 dB down 15 dB of Negative feedback is used. H.T. of 300v. 25mA and L.T. of 6.3v. 1.5a. is available for the supply of a Radio Feeder Unit or Tape-Deck pre-amplifier. For. A.C. mains 200-230-250v. 50 c/s. Output for 2-3 ohms speaker Chassis is not alive. Kit is complete in every detail with fully punched Gold Hammer finished chassis, point-to-point wiring diagrams and instructions. Exceptional value £4.15.0, or assembled ready for use 25/- extra, plus 3/6 carr., deposit 22/6 and 5 monthly payments of 22/6 (Total £6.15.0) for assembled unit.

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

GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2/3 ohm speaker. For 200-250v. A.C. mains. Size 11½ x 2½ x 2½in. Controls: Vol. and Tone with Switch. Only **59/6**

COMMUNICATION RECEIVERS
RX 60 DE LUXE 4 BAND

220/240v. 50/60 c.p.s. A.C. mains operation. Frequencies covered 1600 Kc/s to 30 Mc/s continuous. Incorporates 5in. speaker. Slide rule tuning dial 'S' meter. Internal ferrite aerial for medium wave. Telescopic whip aerial 58in. 10 section for short waves. Fitted sockets for optional outdoor aerial. Headphones, external speaker socket. Other features are electrical bandspread tuning. Noise limiter, A.V.C., B.F.O., stand by switch Size approx. 12½ x 5¾ x 8¾in. Handsome crackle finished metal cabinet. Brand new with full instructions manual. Usual guarantee **19 Gns.** Carr. & pkg. 10/-.

VACANCIES FOR PERMANENT STAFF AT VARIOUS BRANCHES

R.S.C. 4 WATT GRAM. AMPLIFIER KIT. Complete set of parts to build a good quality compact unit suitable for use with any record playing unit. Mains isolated chassis. Separate Bass and Treble controls. Output for 2-3 ohm speaker. For 200-250v. A.C. **59/9**

R.S.C. BABY ALARM or INTER-COMM KIT. Complete set of parts with diagrams, etc. Housed in two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250v. A.C. mains. Fully isolated. Controllable at both units. An intercomm. of this class would normally cost £20-£30. Only 89/6. carr. 5/-. Ready for use, 6 gns.

R.S.C. BATTERY TO MAINS CONVERSION UNITS. Type BMI. An all-dry battery eliminator.

Size 5¼x4¼x2in. approx. Completely replaces batteries. supply 1.4v and 90v where A.C. mains 200-250v. 50 c/s is available. Suitable for all battery portable receivers requiring 1.4v and 90v. Complete kit with diagram 39/9 or ready for use 46/9

PRACTICAL WIRELESS

OCTOBER 1965
VOL 41 NO 704

DIG THAT DX

THE newcomer to DX listening is at first thrilled to receive almost any station outside Europe on his short wave set, particularly if this is a home built piece of equipment. Then, as listening experience grows, the commoner stations begin to pall and the search is on for others further and further afield. Some enthusiasts are prepared to accept the feat of having heard all parts of the world and sit back to extract what enjoyment they can from the programmes being heard—or the QSO's between the amateur stations concerned.

Others—and these are in the majority—feel a restless urge to proceed further. Even those who do not log DX just for the sake of it are not proof against the itch to find new stations, hear new sounds, log new countries. It is, of course, the almost limitless possibilities, the likelihood of the unexpected, which keeps the hobby of DX listening from stagnating. The final fulfilment of hearing a station for which one has been searching for days, weeks, or even months, is the type of thing that gives the unique zest to DX work.

After reasonable success has been achieved, and a working experience of the bands has been gained, the more thoughtful will start asking themselves that eternal question "what *is* DX ". Distance certainly enters into it, but there are other factors, too, such as the power used and the frequency of the transmitter.

This is the turning point which can divide the true DX-ers from those who want things the easy way. For there is no credit in being blasé about the hundreds of stations logged on the easier band when nothing has been done to pull in the hard ones, nearer home on the tougher bands.

Are *you* digging the real DX—or only the top layer?

CONTENTS

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world. **The NOVEMBER ISSUE WILL BE PUBLISHED ON OCTOBER 7TH.**

Wrap-around Radio Sets

HENRY'S comment on flexible printed circuits "genuinely flappable copper-clad laminate that could be bent and shaped without cracks in the foil appearing" tempts me to add something to what he has already said. Might we see wrap-around radio receivers in the future to suit all tastes. The bowler hat with the built-in wrap around transistor set, ladies handbags shaped from copper-clad laminate, leather jackets outdated by the "fab new copper-clad laminates". I would like to see Henry devoting a session to it.

D. Walsh.

Co. Tipperary,
Ireland.

Bottling Acid

MR. I. M. HUTCHINGS points out in your News and Comment section (August, 1965, issue) that in this day and age polythene bottles would be more easily obtainable and cheaper for storing hydrofluoric acid. May I point it out to him, that in the industry, we never use anything else but polythene bottles for this purpose and every person dealing with this acid should follow this practice. This particular type of container also has the advantage that it does not break when dropped and so acid is not sprayed over anyone standing in the vicinity.

T. E. J. Toth.

London, S.E.18.

Two-pin Plug-in Coils

I HAVE in my possession a few of the very old type two-pin plug-in coils. Rather than throw them out, I would prefer to give them to anyone who may find them useful. The coils are numbered 200, 150, 75, 60 and 30.

I will send them on receipt of name and address and ample postage. First come, first served.

R. W. Walker.

10 Eden Vale,
Sunderland,
Co. Durham.

NEWS AND...

INTERNATIONAL RADIO COMMUNICATIONS EXHIBITION

At the Radio Communications Exhibition to be held from 27th—30th October, 1965, at the Seymour Hall, Seymour Place, London, W.1, the stage presentation will all be of R.S.G.B. design. The Organiser's Silver Plaque will be altered to a £25 voucher this year as it is thought that entrants would prefer this to winning the Silver Plaque outright which was designed for a permanent achievement.

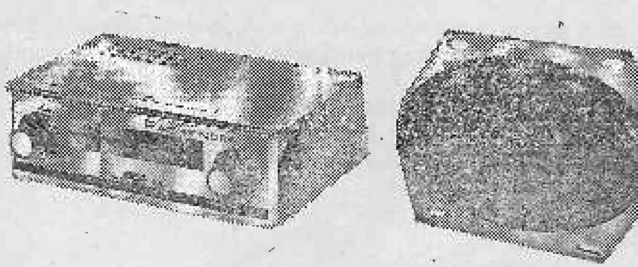
One of the ten new awards to be presented this year is for the most outstanding home-constructed transistor equipment component.

Overseas visitors will be invited to the new Conversation Night on Friday, 29th October, in the restaurant, and closed-circuit TV will introduce them to the visitors at the Show.

TUNING DIAL POINTER FOR THE DIRECTION FINDER

Jackson Bros. (London) Ltd., Kingsway, Waddon, Croydon, Surrey, announce that they supply a ready manufactured dial pointer for the Direction Finder for Small Craft (page 342, P.W. August issue). The price is 1s. 4d. including postage.

AJAX CAR RADIO



The Ajax Pathfinder car radio employs six transistors and covers both medium and long wavebands. The power output is $3\frac{1}{2}$W and the speaker is 7in. x 5in. elliptical. It is supplied complete with speaker and fixing brackets at $12\frac{1}{2}$ guineas, and is available from all leading motor accessory and radio and electrical stores.

BBC TO USE S.T.C. MICROPHONES FOR WORLD CUP SERIES

The BBC have purchased another 200 noise cancelling microphones from Standard Telephones and Cables Ltd. They will be used by the BBC and overseas commentators during the World Cup soccer series in 1966 at a dozen different grounds throughout the UK.

Since its introduction, the 4104 microphone has become highly popular with broadcast commentators due to its good discrimination between voice and background noise—the average figure is better than 20dB. It uses a pressure gradient transducer, a ribbon, for which the low frequency response rises more rapidly than the middle and high frequency response as the sound approaches the microphone. The 4104 has a flat response to a close sound source at a controlled distance so that frequencies below about 1,000c/s of any more distant sources are considerably attenuated. Since frequencies below 1,000c/s form an important part of background noise, good discrimination is obtained between wanted and unwanted sounds.

..COMMENT

HAM MOONBOUNCE

KP4BPZ, the amateur transmitting station near Arecibo, Puerto Rico, which helped to make history last summer when the first trans-atlantic contacts were made by moon-reflection on 432Mc/s recently provided opportunities for a repeat performance.

The hemispherical reflector at the Cornell University Ionospheric Laboratory, Arecibo was used in a moonbounce communication with amateurs while the moon was within range. Initial reports include reception reports by two or three amateur stations in the UK, and an unconfirmed report of two-way working from Zurich.

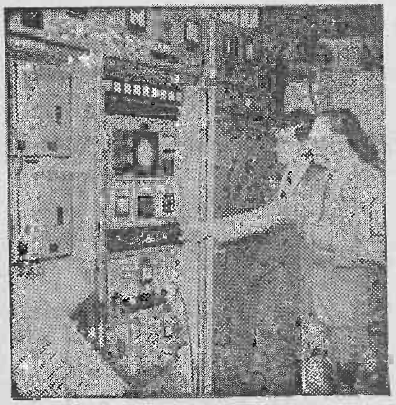
PORTABLE TAPE RECORDER IN THE CAR

An accessory for Philips models EL3300 and EL3301 pocket tape recorders is a car mounting unit which allows operation in the car from the car battery and also through the car radio speaker and amplifying system.

The unit is finished in dark grey hammered effect with matt silver escutcheon.

The Car Tape Recorder kit comprising cassette-loaded tape recorder type EL3301, car mounting unit and 4 tape cassettes costs 40 guineas. The car mounting unit on its own is available at £12 10s.

ARGENTINIAN TELEVISION CHIEF VISITS MARCONI'S



Seen here in the High Power Test Section of the Marconi Company's Chelmsford works, is Mr. O. Dietrich, (right) Director and Chief Engineer of Mar del Plata Television in Argentina.

Mar del Plata, the principal seaside resort and one of the largest cities in Argentina, will soon have one of the most modern television broadcasting stations in the country.

Mr. Dietrich is inspecting the final testing of the television transmitter that his company has ordered. He also saw the associated 1kW sound transmitter.

The transmitting station will have a single Marconi 5kW Band 3 vision transmitter and a Marconi 1kW frequency modulated sound transmitter. The high gain directional aerial system, mounted on a 150 metre mast, will also be provided by The Marconi Company together with the transmission feeders and associated equipment.

RADIO STATION OPENED IN SOMALIA

A radio station, built with Soviet assistance, was inaugurated in the Somali capital on 7th July. It has a capacity of 50kW, and will broadcast to Somalia and all African countries.

The transmitter and aerials have been installed as a Soviet gift to the people and government of Somalia. In addition to the radio station, a radio studio will be built with Soviet assistance in the near future.

more News and Comment

C.W. Standards

Mr. Taylor in his letter in the August issue of Practical Wireless, stated that the standard of C.W. operating had deteriorated. This is not so. Before a British subject is issued with a callsign, he or she must pass a Morse test of 12 w.p.m.

As a professional operator and keen amateur who operates only on Top band where the majority of new callsigns are heard, I know that the standard of operating is satisfactory as far as amateur radio is concerned.

Mr. Taylor may, or may not know that operating is not the only aspect of amateur radio. The amateur must be aware of what he or she is doing when tuning or adjusting a transmitter or receiver. Hence reducing interference to a minimum.

The R.A.E. theory examination is a basic exam in radio theory and the formulae required to be known are essential for the basic understanding of the theoretical work. Any person who is unable to pass this examination is rightly unsuitable, in their present state to be let loose on the amateur bands.

R. F. C. Alban, GW3SPA.

Penarth, Glamorgan.

Panel Lables

Recently, whilst making a mains power-pack, I found that using the labelling machine (situated at most large railway stations) made admirable panel escutcheons, especially on a wooden background.

Fixing is accomplished by using impact adhesive.

I. R. W. Brown.

Burghmuir, Perth.

We Goofed

With reference to the "Solar-powered Pocket Receiver" featured in your August edition.

I would be interested to know how it works whilst in one's pocket!

A. Howe.

Blandford, Dorset.

On reflection, so would we.—Editor.

on page 504

COVER SUBJECT

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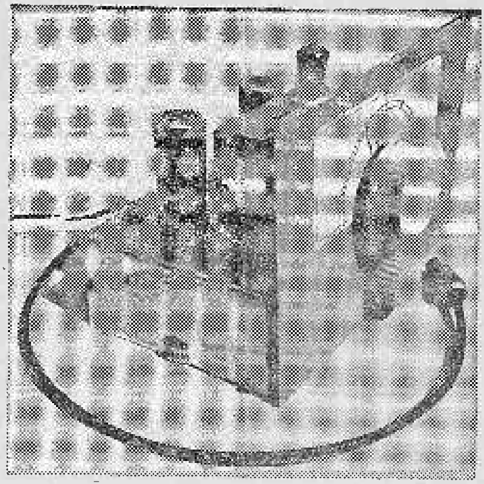


TWO - STAGE V.F.O.

by F. G. Rayer G3OGR

THIS variable frequency oscillator can be used with most transmitters of the crystal controlled type by feeding its output into the crystal oscillator stage. This allows working on any frequency in the amateur bands without crystals.

The circuit (Fig. 1) employs a Clapp-type oscillator, which is well known for its stability. Large capacitors (1,000pF) are connected from control grid to cathode and from cathode to earth line and there is a further capacitor (2,000pF) between anode and earth.

As a result small changes in inter-electrode capacity in the valve are swamped. The oscillator anode voltage is also stabilised by the OA2 regulator.

Output from the oscillator is taken from its cathode to the control grid of the buffer/multiplier. This effectively isolates the oscillator from tuning and loading effects of later stages. The buffer V2 has a two-way switch to select either the r.f. choke or L2. For working on the 80 and 40m bands the r.f. choke is used. When working on 20m or a higher frequency band L2 is in circuit. L2 is broadly resonant at 7·1Mc/s, thus boosting output for 14, 21 and 28Mc/s bands.

The v.f.o. is intended for use in the 3·5Mc/s and higher frequency bands but can easily be converted to cover 1·8-2·0Mc/s if wanted.

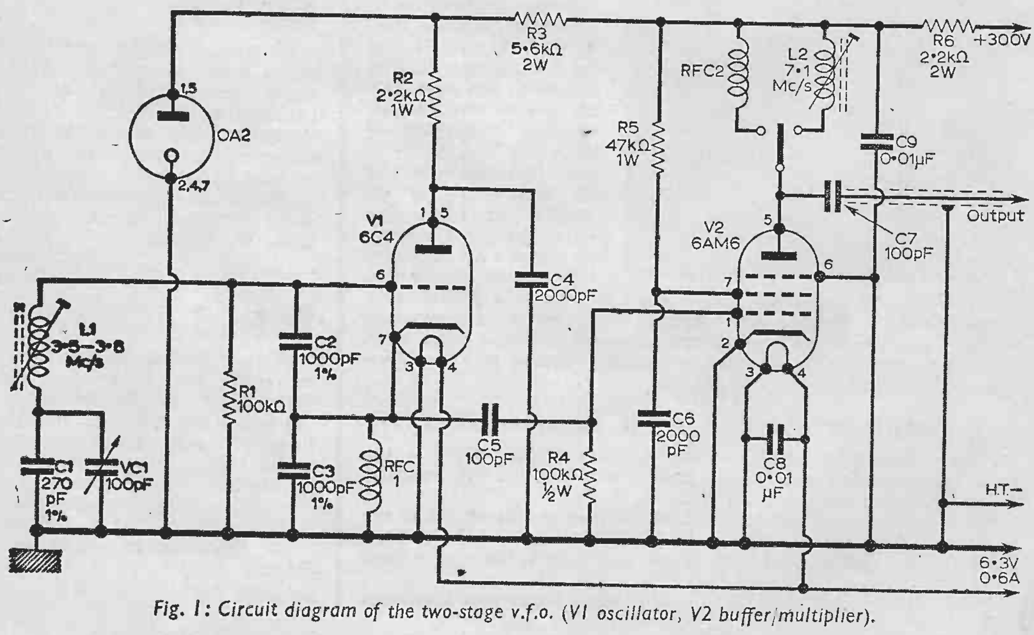


Fig. 1: Circuit diagram of the two-stage v.f.o. (V1 oscillator, V2 buffer/multiplier).

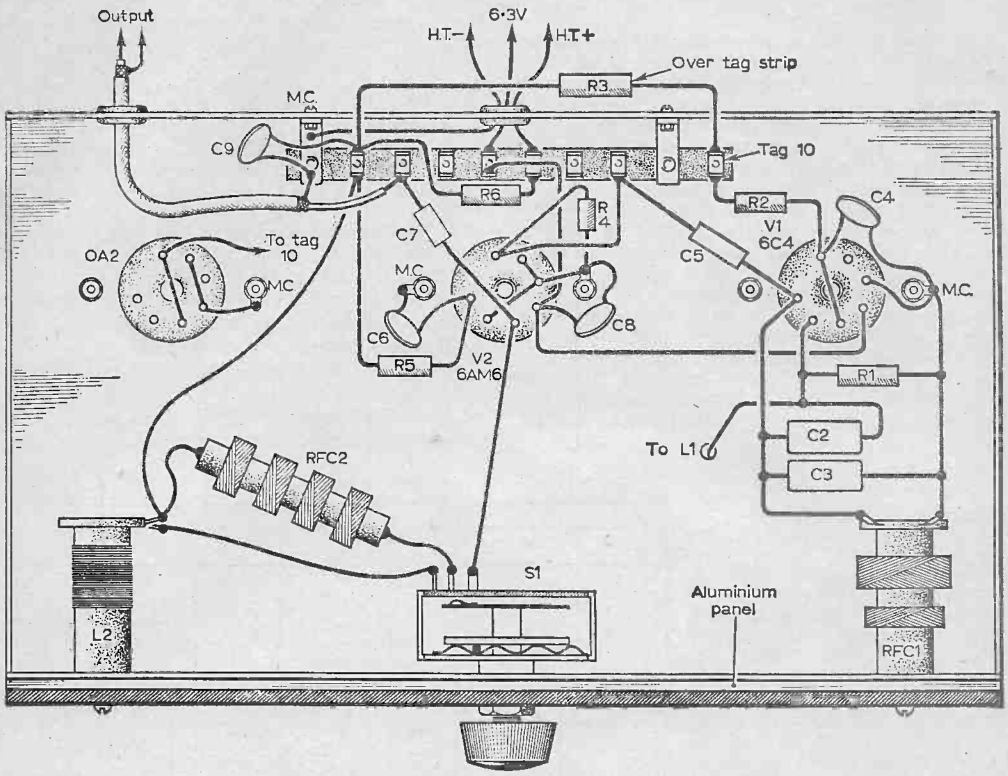


Fig. 2: Wiring of the v.f.o., underside of chassis.

V.F.O. Coil

L1 should have its turns cemented in place as any movement will change the frequency. Coverage is 3·5-3·8Mc/s and this can be obtained with a wide range of values for VC1 with the inductance of L1 adjusted to suit. But it should be noted that if the total capacity of C1 and VC1 is too low V1 will cease to oscillate. This is normal for this type of circuit.

So that 10kc/s points may be filled in equally between 100kc/s markings full band coverage is best obtained with a little less than 180° rotation of VC1. With a 100pF capacitor for VC1, L1 may be 22 turns of 32s.w.g. enamelled wire, closely wound side by side on a ½in. diameter cored former. This type of former is easily obtained.

The turns are wound at the top end of the former and painted with coil dope or shellac. Initially place the core in a middle position.

C1 can be a 270pF 1% silver mica capacitor or can be made up from fixed and preset capacitors (say 200pF fixed and 100pF preset). If a preset capacitor is provided, band coverage can be adjusted by means of L1 and the preset capacitor. If C1 is fixed set VC1 nearly open and adjust the core of L1 until the v.f.o. signal falls on 3·8Mc/s as heard with a receiver. VC1 should then reach 3·5Mc/s when nearly closed.

Buffer Coil

This also employs a ½in. diameter former with adjustable core and has 33 turns of 32s.w.g. enamelled wire, side by side, near the top of the former. When the v.f.o. is put into use set it to 3·55Mc/s and adjust the core of L2 for maximum grid current in the final transmitter amplifier. L2 is thus tuned to about 7·1Mc/s and is left at this frequency. Retuning L2 is not necessary for normal band coverage.

Resistor R6

The normal regulation current of the OA2 is 5-30mA, with up to 75mA while valves are warming up, so R3 may be 5·6kΩ 2W, allowing a normal operating current of about 20mA for the OA2 and V1. In these circumstances and using a 300V h.t. supply R6 can be 2·2kΩ 2W.

If a supply of about 230-250V is available from the transmitter power pack R6 can be reduced in value or omitted. If a higher voltage is available instead R6 is increased, so that V2 receives about 230 to 275V. If necessary the voltage and OA2 current can be checked with a meter when first testing the v.f.o.

Construction

The tuned circuit incorporating L1 should be screened and removed from sources of heat (valves). C1 could be made up from a combination of positive and negative temperature coefficient capacitors, but this does not seem justified. The layout in Fig. 2 allows ample screening. The holders for V1 and V2 should be skirted so that cans may be placed over the valves.

All wiring should be rigid. Fig. 3 shows under-chassis wiring and a tagstrip is fitted to provide anchorage for the power supply leads and other items. Radio frequency output is taken by means of a short length of coaxial cable.

It may be preferred to keep the v.f.o. as a separate unit with flexible leads. Or it may be bolted to the transmitter chassis and permanently wired. A ball drive, panel mounted drive or similar reduction drive is recommended for h.f. band working but is not essential for the l.f. bands.

Calibration

This is best done with a receiver and 100kc/s crystal marker or with a heterodyne frequency meter or crystal calibrator. Couple both the crystal marker and v.f.o. signals to the receiver. Check the band coverage of VC1 as mentioned, then seal the core of L1 in place.

The v.f.o. dial is then calibrated at 3·5, 3·6, 3·7 and 3·8Mc/s by tuning it to zero beat with the crystal marker harmonics, and the dial readings are noted, or the scale is marked directly with these frequencies.

To secure calibration at 3·55, 3·65 and 3·75Mc/s tune the receiver to 7·1, 7·3 and 7·5Mc/s, picking up the crystal marker harmonics. Then tune the v.f.o. so that its second harmonic gives zero beat on these frequencies and note the 0·05Mc/s readings. The 0·01Mc/s marks can be inserted by equally dividing the spaces between the existing calibrations.

Frequencies on the h.f. bands are multiples of those obtained, so no further calibration is required. This is an advantage of the single band v.f.o.

A disadvantage lies in the fact that only part of the 3·5-3·8Mc/s range is required for h.f. band coverage, e.g. 3·5-3·6Mc/s on the v.f.o. provides 14-14·4Mc/s in the 20m band. With an efficient reduction drive on the v.f.o. actual tuning is not particularly difficult, however.

For h.f. band coverage only v.f.o. tuning can be 3·5-3·6Mc/s by reducing VC1 to about 35pF and increasing C1 until 3·5Mc/s is found with VC1 almost fully closed.

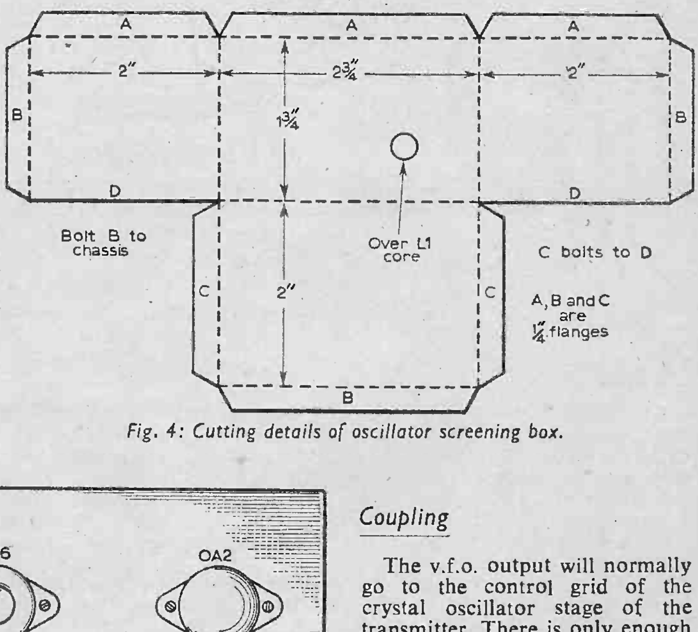


Fig. 4: Cutting details of oscillator screening box.

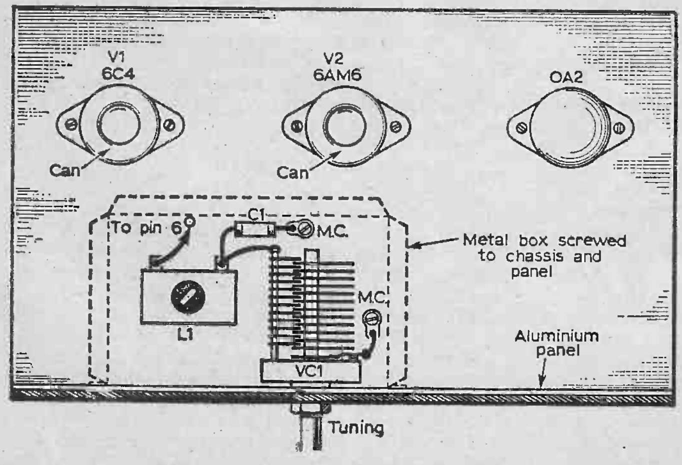


Fig. 3: Topside components on the chassis.

Coupling

The v.f.o. output will normally go to the control grid of the crystal oscillator stage of the transmitter. There is only enough output from V2 to drive the power amplifier direct if the transmitter is low powered.

The crystal oscillator stage may have capacitors from cathode to grid and earth with a r.f. choke from cathode to earth line. If so these items are no longer required. Or the r.f. choke can be shorted and the grid capacitor disconnected for v.f.o. working. If some use is still to be made of crystals a two-way switch for crystal/v.f.o.

—*continued on page 518*

PRINCIPLES OF AUDIO

by G. D. Howat

PART TWO

Hi-Fi

Much has been written about the frequency response which a hi-fi system should have in order to attain "true fidelity". The frequency response of a system is the range of frequencies over which it has a more or less constant gain, within certain limits. It is written as (e.g.) 40c/s–15kc/s ±3dB, this meaning that over the range 40c/s–15kc/s the gain will not vary by more than 3dB.

From a purely theoretical point of view, it can be seen from Fig. 10 that for an orchestra playing at the "100dB (peak) level" sounds in the range of 30c/s–15kc/s can be present, which is more or less the entire audible spectrum. However the same orchestra playing at the 70dB level uses only a much smaller range. Even so, if the hi-fi system is to be capable of treating any normal sound intensity, the specifications must be those of the most extreme care and the frequency response must extend from 30c/s to 15kc/s within narrow limits.

It is mainly this evidence which supports the arguments of the extreme enthusiast who insists that nothing inferior to 30c/s–15kc/s is good enough, and 20c/s–20kc/s is preferable. Unfortunately, what these people usually seem to forget is that there are virtually no sound systems widely available which will yield any outputs above 15kc/s and few which can produce an output above 12kc/s.

Anything which is produced above 12kc/s is usually composed mainly of harmonics introduced by non-linear systems, and hiss. Surely it is better to deliberately remove this by using a restricted frequency response, than to allow it to be heard?

Of course, a fairly good high-frequency response is preferable in order to prevent distortion of transient and pulse waveforms which have been mentioned previously. In the end, the best that can be done is to reach a compromise between removing unwanted material and allowing such genuine high-frequency signals which may be present, to pass.

The low frequency response is determined by the design of the sound systems in a similar way to the high frequency section. Music deficient in bass (ie. low frequencies) has a lack of "body" and, if the excess is marked, may be "tinny". There are fewer sources of unwanted low-frequencies than there are of the higher ones. A well-designed system will have a negligible hum level and any extraneous bass is usually caused by mechanical defect such as rumble on gramophone turntables.

Desirable Range

A number of tests have been carried out to determine desirable frequency ranges by allowing human audiences to listen to musical items with varying frequency responses.

The first of these tests was carried out by Chines and Eisenberg and came up with the alarming result that only 12% of listeners preferred classical music played with a response of 35c/s–10kc/s ±3dB. The remainder preferred a restricted range of the order of 70c/s–6·5kc/s ±3dB.

Subsequent tests have shown that probably a reason for these surprising results was the presence of distortion in the sound system used for the tests. Using purely acoustical filters and a live orchestra, most people preferred an unrestricted frequency range.

From this evidence, what can be said about the "ideal" hi-fi system as regards frequency response? Undoubtedly, a wide response is desirable, say 30c/s–15kc/s ±5dB, but provision should be made for ending the response fairly sharply at lower frequencies. A steep-cut filter is sometimes fitted to more expensive amplifiers for just this purpose.

Tone controls of the type which accentuate or attenuate the ends of the frequency spectrum to an infinitely variable extent, one useful for making minor adjustments to suit individual tastes. These should not be made to have too great an effect, since mis-adjustment of tone controls can easily nullify the effect of a good amplifier.

Distortion

Distortion occurs when the output waveform of an amplifier or similar instrument differs from the input waveform in some respect. There are various forms of distortion, all of which must be absent if a system is to show good fidelity. It will be possible here only to outline the various forms of distortion and comment briefly on them.

Non-linear distortion (a misleading name) occurs when the transfer characteristic of an amplifier is not a straight line. The transfer characteristic is only a fancy name for the graph of input versus output as seen in Fig. 11.

The line (1) shows the characteristic of a perfect amplifier in which output voltage is a direct function of input voltage. (The slope of the line is a measure of the gain of the amplifier). Lines (2) and (3) are not straight and represent non-linear systems. Any amplifier having such a non-linear shape will show two forms of distortion.

The first is harmonic distortion—the appearance in the output of harmonics which were not present in the original signal. As was shown earlier, many harmonics produce discords when sounded with their fundamental frequency and so ruin the performance of the system. Harmonic distortion must be eliminated to avoid unpleasant "jamming" of music. A tentative suggestion for maximum tolerable harmonic distortion is 1·25% but at this level the effect is quite audible.

To a discerning listener, the maximum harmonic distortion which is not perceptible is much lower and may be 0·4–0·7%.

The second result of non-linear distortion is the intermixing of two or more tones in what is called intermodulation distortion. Two separate frequencies if applied to a non-linear system will beat together to form sum and difference products—in effect forming some completely new frequencies. Also, one frequency may amplitude-modulate the other giving a highly peculiar and very displeasing sound.

When more than two frequencies are affected, the resulting intermodulation effects can be almost painful to listen to. Clearly this is another reason why non-linearity is a feature to be avoided in any form of sound system.

Frequency distortion in any system is the phenomena where signals of different frequency are amplified to different amounts. Some discussion on the subject has already been written and there is little to add to this.

Two final forms of distortion should be briefly referred to: transient distortion and phase distortion. Transient distortion is the inability of a system to reproduce short pulses accurately. Mathematical analysis shows that transients contains very high frequency components which are well beyond the audible range—it is for this reason that an extended frequency response is desirable. Some care is needed to prevent the formation of "hang-overs"—a prolonging of the duration of a short pulse.

Phase distortion occurs when the phase angle between a fundamental and one of its harmonics is altered. Whether or not phase distortion affects fidelity is a subject of some discussion. Certainly a constant tone is audibly changed when one of the harmonics is altered in phase with respect to the others. However it is not certain whether or not such a change would be noticeable in a varying mass of sound as in an orchestra.

As little is known about the subiect with certainty

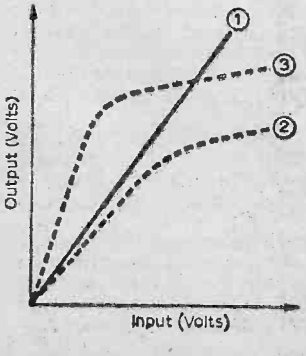


Fig. 11

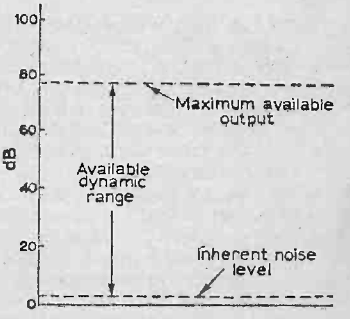
it is best to reduce the phase distortion to the lowest possible value. Phase distortion can have a serious effect on the reproduction of transients.

Dynamic Range

The dynamic range of a system is a factor which is frequently overlooked but which is of considerable importance. It has been previously stated that the dynamic range of an orchestra is of the order of 80dB or one hundred million times.

It is unfortunate that few types of recording equipment have dynamic ranges of this magnitude, a few examples being: a.m. Radio 40–50dB, f.m. radio 50–60dB, L.P. records 45–55dB. The limiting factors in determining the range are, on one hand, the maximum available output power, and on the other, the noise level inherent in the apparatus. This point is shown diagrammatically in Fig. 12.

Fig. 12



In order to "squeeze" an 80dB signal into a system having a dynamic range of 50dB it is necessary to use a volume compressor. This, as its name implies, is simply a device which makes the quiet passages louder and the loud passages quieter. In the "ideal" hi-fi systems a dynamic range of 80dB would be preferable, but in practice it is almost impossible to achieve this.

When a recording is played back at a lower volume than it was originally performed, a weak sound is produced, which lacks bass and treble. This is the effect of scale distortions and is a result of the unlinearity of the human ear.

In order to prevent it, the sound produced by the recording equipment must be of the same loudness as the original. It is possible to construct compensated volume controls which automatically boost bass and treble when the loudness is reduced, but these tend to be somewhat complex.

To provide a normal volume in an ordinary room, an amplifier having a power output of 5W is normally ample, although some people prefer to use units providing up to 10 or 15W in some cases.

Hum and Hiss

Up till now only the pre-existing sounds have been considered in this discussion. In addition to presenting a near-perfect replica of the original signal at its output, a hi-fi system must have the added condition that it should add nothing extra to that signal. Extraneous sounds formed in a system, apart from those originating from mechanical defects, are of two kinds—hum and hiss.

Hum results from pick-up of stray magnetic fields surrounding any wires carrying 50c/s a.c. It is not difficult to screen wires and components and reduce hum to very low levels. (Hum may also result from interval circulation of a.c. via hum loops. This is a problem solved by changing the mechanical layout of the circuits.)

A good system will have no audible hum, the maximum level of hum being determined by the available power output. For a 10W amplifier, a level of 65–70dB below the 10W output level is inaudible and thus satisfactory.

Hiss is a more complex business. It is caused by the fact that an electric current is quantised and small random fluctuations occur in the number of quanta (electrons) passing through a wire in a given time. The randomness increases with increasing frequency so hiss becomes more of a problem as the upper frequency response is increased.

It is impossible to make an amplifier entirely free from hiss although modern designs manage to reduce it to very low levels. The existence of hiss is another reason against having an exceptionally extended high frequency response. The problem tends to be acute in tape recorders where a great deal of treble boosting is applied to compensate for losses in the tape head at high frequencies.

Stability

The ability to withstand considerable mis-matching both at the input and output ends of an amplifier constitutes the need for stability in this item. If long loudspeaker leads are used, the capacitance across them may be quite high and this, of course, appears across the output terminals.

If the amplifier tends to be unstable, such a shunting effect may cause it to oscillate violently. Stability is therefore another feature to be sought after in a good amplifier.

Practical Limitations

These, then, are the qualities which should be present in any ideal recording/reproducing arrangement, and the question arises as to how nearly these ideals can be achieved in practice. For practical purposes, there are three systems to be considered: live radio broadcasts, tape recordings, and gramophone records.

Radio broadcasts differ from the other two in that there is no mechanical step between the performer and listener. Whichever mode of operation is used, the final stage will always be a power amplifier feeding a loudspeaker, so these items will be mentioned first.

It can be fairly said that a modern preamplifier-plus-power amplifier system, if well designed, will come quite close to the ideal specifications which have been laid down. Such amplifiers are, of course, expensive, but in terms of frequency response, absence of distortion and voice dynamic range, power output, etc., they will satisfy all but the most critical enthusiasts of hi-fi.

It is somewhat ironical, in view of this, that loudspeakers are the objects often looked upon as the weakest link in fidelity at present. A good "speaker" now consists of anything up to ten separate loudspeakers (or more!) each one responsible for a particular section of the audio spectrum and fed only this section by means of a complex system of filters. Such an arrangement is frequently most inefficient and even then has a tendency to distortion at the ends of the frequency range.

The equipment present in most broadcasting studios is of such quality that it is theoretically possible to transmit a signal of extremely good fidelity. It is unfortunate that the medium wave transmissions have a rather restricted bandwidth which results in some treble loss to the listener.

Also, medium and long wave transmission, which are a.m., are very prone to interference by other stations not to mention assorted electric railways, car ignition systems, vacuum cleaners and other appliances. These programmes do not represent very good fidelity.

A far better system is the v.h.f. frequency modulated type of transmission which now covers most of the country. Being f.m. this is not subject to interference like a.m. and can give really superb results if a good tuner is used.

Tape Recording

Tape recording can be expensive, but as in the case of f.m. radio, the results usually justify the expenditure. Good tape equipment will give excellent results provided it is used correctly. Of course, it is necessary to obtain a signal to record and this is frequently taken from the radio, although pre-recorded tapes are becoming increasingly popular. The combination of an f.m. tuner and a good-quality tape recorder may well provide the best high fidelity system available at the present time.

This statement would be rigorously denied by the makers of gramophone records and a large number of other people. It is true, however, that there are certain limitations imposed by the use of records. Records tend to have a higher level of harmonic distortion than tapes, simply due to their mechanical structure: a 10kc/s tone at the edge of a 12in. record revolving at $33\frac{1}{3}$ r.p.m. traces out a wavy pattern of wavelength only 0·005 cm.

Such very fine structures are inevitably "smoothed out" after a number of playings so the record loses its treble response and is said to be worn. Tape recordings get worn by other processes but less rapidly, so they tend to last longer. Despite all this, records give very good fidelity and are not likely to be abandoned for many years to come.

Stereo

Stereophonic recordings, more on records than on tape recordings, have been introduced recently. Without a doubt these greatly improve the scope of fidelity since they banish the "hole-in-the-wall" effect which often spoils a good mono set up.

It has been found that using stereo, a considerable reduction can be made in the specification of the system—equipment which plays stereo can have a far less extensive frequency range than similar equipment used for mono, and no serious falling-off in performance is noticed.

Of course, even stereo cannot re-create the atmosphere of a concert hall exactly and perhaps this is the biggest factor of all in preventing absolute fidelity.

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

FIRST of all this month a collective thanks to those who have sent in information, as space limitations preclude mentioning them all by name. Please keep up the good work.

Albania: *Radiodiffusion et Television Albanaise* (Rue Ismail Quemal, Tirana). English schedule is now 0100—0130 7,265; 0730—0800 7,256/7,090; 2100—2130 7,265/9,390; 2300—2330 7,265/9,390.

Denmark: *Radio Denmark* (Shortwave Department, Radio House, Copenhagen V). The following transmissions now on 15,165 will be on 9,520 from September 5th—1730—1810, 1945—2045, 2115—2145, 2145—2245.

Finland: *Oy Yleisradio Ab* (Unioninkatu 16, Helsinki). DX Allianses broadcasts fortnightly over Radio Finland for the last 15 minutes of the following English transmissions. Friday 1600—1700 9,555/11,805/15,185 and 2100—2200 6,120; Saturday 1215—1315 9,555/11,805/15,185. Three verifications (DXA, DX Club, Radio Finland) will be received if reports are sent to DX Allianses, Fin., P.O. Box Bromma 1, Sweden.

Holland: *Radio Nederland Wereldomroep* (P.O. B. 222, Hilversum). Now transmits in English as follows: 0700—0750 6,025/9,715 and 19m.b.; 1400—1450 6,020 and Bonaire relay in 31m.b.; 2000—2050 11,960/9,590/6,020 and Bonaire relay in 19m.b. (?15,290); 2100—2150 11,730 and 31m.b.; 0130—0220 31m.b. Bonaire relay. Changes have also been made in the following Happy Station programmes on Sundays: 1400—1520 15,425/6,020 and 16m.b. with 31m.b. relay from Bonaire; 1530—1650 15,425 and 31m.b.; 1900—2020 11,730 and 19m.b.; 2030—2150 11,950/6,020 and 31m.b. A news bulletin is reported at 1900 on 15,425/17,820. Full details given on QSL card.

Hungary: *Radio Budapest* (Budapest VIII). Gives full QSL. Has a programme for radio amateurs in its 1930 English transmission on Sundays and Tuesdays on 9,833/7,305.

Norway: *Radio Norway,* Oslo. From the beginning of this month the half-hour English broadcasts transmitted on Sundays will be on the following frequencies. At 1200 and 1400 on 25,900/21,730/17,825/15,175/11,850/6,130; 1600 on 25,900 / 21,730 / 17,825 / 15,175/11.850/9,610; 1800 on 21,730/17,825/15,175/11,850/6,130; 2000 on 17,825/15,175/11,850/6,130; 0000 (Monday) on 11,850/9,610/6,185/1,578; 0400 (Monday) on 11,850/9,610/6,185/6,130/1.578.

U.S.S.R.: *Radio Kiev* has English to Europe on Mondays and Thursdays at 1900—1930 9,760/7,210 and 2230—2300 on 1,241. On Tuesdays and Fridays there is English for North America at 0030—0100 on 11,790/9,810/9,680/9,660/7,180 and 0430—0500 on 9,680/9,660/9,610/7,180. On Sundays *Radio Vilnius* has English at 2300—2330 on approximately 11,800/9,750/7,300/7,190/7,125. Full QSL is given by *Radio Tashkent.*

Vatican: The 1815—1830 English transmission to Europe from *Vatican Radio* is on 11,740/9,645/7,250/1,529. The broadcast to the U.S.A. is at 0050—0110 on 9,645/11.740/7.250. On Mondays, Wednesdays and Fridays there is a transmission to the Philippines on 9,670/11,735 at 2230—2300. Transmissions for Australasia are at 1130—1200 on 9,600/11,785 and 2200—2230 on 9,670/11,735.

Algeria: *Radio Algerie* (21 Boulevard des Martyrs, Algiers), has an English transmission from 2200—2230 on 9,510/7,170/6,050/890. Full QSL.

Congo: *Radio Leopoldville* (B.P. 3171, Leopoldville), has been reported at 2030 on the new frequency of 4,725.

Congo (Republic): *Radio Brazzaville* (B.P. 108, Brazzaville), transmits at 1100—1200 on 11,970/15.445; 1100—1255 7,105/11,710/15,190/21,500; 1300—1400 17,720/21,520; 1730—2100 5,970/7,105/9,730/11,930/15,190. *Radiodiffusion Television Congolaise* (B.P. 2241, Brazzaville), has been heard in England on 4,843 at 2030.

Ghana: *Radio Ghana* (Broadcasting House, P.O. Box 1633, Accra). The 1445 English transmission on 21,545/17,910/6,070 has been extended to 1540.

Ivory Coast: *Radiodiffusion Television Ivorienne* (B.P. 2261, Abidjan.). The National programme on 4,940 has been heard in England at 2030.

Liberia: Radio Station ELWA (Box 192, Monrovia.). From 0500—0800, 1100—1830 (1930 Sundays) there is a transmission to Nigeria and the Near East with English at 0600, 1100 and 1630 on 11,975/21,535. On 15,155 there are English transmissions at 1545 (Congo), 1900 (Near East) and 2115 (North Africa). On Sundays times of transmissions are slightly different. Full QSL.

Niger: *Radio Niger* (B.P. 361, Niamey.). This rare African station can be heard around 2100 on 5.020.

Nigeria: Nigerian Broadcasting Corporation, Broadcasting House, Lagos. The National programme gives good reception around 2030—2100 on 4,990. Full QSL now given.

Senegal: *Radiodiffusion du Senegal* (B.P. 1765, Dakar). The 4kW transmitter on 4,950 may be heard around 2100. Date and time only on QSL.

The Amateur Bands—by David Gibson G3JDG

A SOMEWHAT mixed bag again this month. Some bands seemed quite lively but on the 3JDG receiver a rather subdued reception was the verdict. Ten metres which has been opening up in the past appeared to close again though listeners reports do show that the stations are there all right. Twenty and fifteen didn't appear too well but after reading Bob Garvey's report and log (see listeners reports) I am now checking to find the short which must be in my aerial feed!

The l.f. bands suffered worst of all and reports for the lower frequencies seem to be getting rarer and rarer. How about making it an l.f. month and listening on 1·8, 3·5 and 7Mc/s only? Point of interest, on eighty the British amateur is licenced between 3·5 and 3·8Mc/s but some other stations (i.e. Americans) are permitted up to 4Mc/s.

L.F. Bands

Topband brings a lonely but very interesting letter. BRS 26325 says 160 is buzzing with G, GW, GM, GI, and he also netted ZB2A, ZE1AZD, ZE3JO. Bob tells us that ZE3JO seeks SWL reports and is on 1870 between 0300—0400; KG1AG (Greenland) hopes to be on in September; there is an International 160 Society under the acting directorship of W3AZR which has a bi-monthly news letter and technical gen etc. (U.K. QTH is 20, Fleuchar Street, Dundee, Angus, Scotland.)

Eighty metres is totally deserted this month. G sideband nets and Europeans on key seem to be the main ingredients. Various periods of listening at the home QTH raised only DL, DJ, OK, YU, SP, UB5, YU etc.

Seven megs—the "roaring forties" literally! Your lowly scribe decided to have a go but my few hard earned DX rarities were all reported by SWL's.

B. Stephenson (Staffs)—BC455 125ft. longwire 25ft.—G, EW, GM, GI, LA8KK, MP4BBA, PXLEQ (Andorra), PAØ, ON, OH, SM, PY7AKT, PY70AT, W3QXB, ZD3BC, ZS5GU, ZD8HL, 5A2TR, 9J2WR. All s.s.b and around 2100 hrs.

BRS 26813 (Cheltenham)—HRO 90ft. longwire —CR4AB, PX1F, SL1CF (Sweden), VE2AQO, SV1BK, W3DCR, W8UEX, W8ZRY/MM, XE1PMC. All on c.w.

Twenty

The firm favourite again and many people appear to have deserted 21 in order to listen to the DX on this band. **B. Dale** (Cheshire), with a t.r.f. on a 60ft. longwire got CR9AI, DU1SA, FY7YL, KB6EPN, KH6CQK, KJ6DA, KØHGM/KS6, VK9NT, VU6AJ, XW8AZ, YA8AZ, 5W1AZ.

A. G. Scott (Liverpool) HE80 and Joystick had these on s.a.b.: CE1FF, CN8BB, CP5AD, CR4AJ, CX2AAV, EL3CC, EP2KC, FG7XL, FM7WN, FP8CK, HC1DX, HC8FN (Ealapagos Is) HK3APC, HP1CC, HR2FE, HZ1AB, KH6EDX/MM, KZ5LC, OH2AM/OHØ, PJ2MI (St. Maarten), PX1EQ, PZ1AX, SVØWF (Rhodes), SVØWO (Crete), TG9EP, TI2CHV, UA9KTE, VP1XG, XE1OE, XW8AX, YA3TNC, YN3FP, YS1JJG, ZA1RR, ZE2KL, ZD8TV, ZP5KT, ZS6AZK, 5T5AD, 5U7AG, 5Z4ERR, 6O6BW, 6W8AG, 7Q7PBD, 9G1CC, 9Q5DO, LU6MR, PY1CAD, YV1AB, K6DXK, W6AWT, WA6EPQ, WB6NDC.

L. Dettman (Hull) uses a domestic receiver plus 19 set to produce a beat note, with a 240ft. longwire. Times between 1300—1715: CX2CO, EA3OJ, EP2KC, JA6NP (Japan), OX3LP, PY2PC, VE-1BFW; 3AUV/P, WA2GYC, WB2PND, W1KHG, W4UDF/MM, YV3DA, ZB2AO, 5A1TS. **B. Garvey** (Glos.) has the DX'est of DX by hearing on his HRO 5T and 90ft. longwire Gus Browning currently on another of his famous travels—AC1H, AC3H, AC4H, AC8H and ACØH—a fine collection! Other DX, all on c.w., includes: BY9SZ (China), CR4AE, 9AH; EL6E, EP2DS, F7GM/HZ, FP8CK, HC1NS, HP1BR, HZ1AD, JA1CIB, 2CMD, 6AA, 8BMK, 9RY; KH6ACC, KL7KQ, KZ5AY, LU6FA, 7AT; MP4BBA, OA4FM, OD5BZ, OX3UD, TF2WIL, 3IC; UAØKAD, VE8ML, VP2GL, VQ9HB, VR2DK, 4CR; VS6FF, 9MB, 9OSC; VU2JW, YV1AB, ZB2AK, ZP5LS, ZD8BC, 4S7WP, 4X4HF, 6W8BF, 7G1Q, 7X2ARA, 7X3HT; 9G1FQ, 9HIQ, 9M2CM, 9M4MU, plus many PY, VE, VO, etc. Does he never sleep?

Ten and Fifteen

On 15m, **D. Walsh** (Co. Tipperary) 8 valve domestic 60ft. longwire, managed the following on a.m.: YV5AAQ, SV1DL, PJ2CZ, KP4AXC, PZ1BE, VP9VP, K1DMG, EA8CL, 9Q5FV, 9J2DT, 5A1TK, CN8MI, 9H1R, 4X4GQ, CT1NY, K4SVQ. Desmond asks if there is any truth in the rumour that 40 is being closed and 160 shared more. We hope not!

BRS 26171 (Suffolk) with CR100 PR30X and groundplane had CX1PI, 8AW; GC2FMV, EA4FY, F2MM, 8RZ, 9BA; 9L1WA, HB9ACW.

More logs for ten than fifteen this month and although the band is supposed to be dead the following SWL's would disagree. **George Owen** (Bristol) 2V2 and Joystick: DJ, DL, DM, EA, F8, HB9, I1, OE, ON, OZ, 3M, 5A2TR, 5A5JK, 9G1FL, 9J2DT. **L. Morrison** (Lowestoft) CR100 PR30X 10 metre groundplane at 33ft. G, DJ, I1, GW, F2, OE, ON, UR2, UB5, YU, UQ, YO, CT1, EA5.

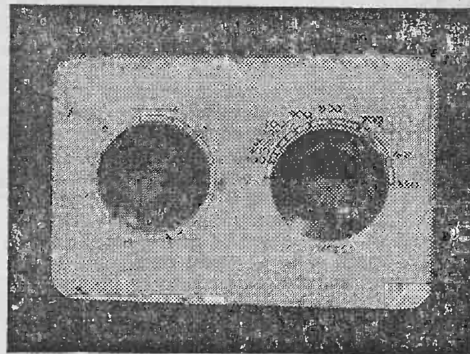
Oddments

Logs still come in from unorthodox aerials and these give a good pointer as to just how the signals are coming in on the bands. **R. Hill** (Stafford) with a CR66 used two RSGB badges with no feeder on 20 and still heard DJ6YH, DJ9BR, G3NIZ, I1LCC, SM7CRW! **B. Dale** (Cheshire) 4 valve t.r.f. home-brew and 1 coathanger raised s.s.b. CR6BX, EL2AI, EP2RW, HL9KT/P, HM1AX, KL7FDR, KR6EDX/MM,

—continued on page 526

Transistor Superhet Tuner

by R. F. Graham



A RADIO tuner allows radio programme material to be recorded or reproduced through an amplifier for personal enjoyment. The superhet type of tuner has the advantage of an adequate degree of sensitivity and selectivity and the design described here uses three transistors and is self-contained with internal ferrite rod aerial and dry battery. A suitable coaxial connector or jack is connected to the output lead and it is only necessary to plug this into the radio input or other appropriate socket of the tape recorder or amplifier.

Tuner Circuit

This is shown in Fig. 1. Tr1 is a self-oscillating mixer and the medium wave band is covered from approximately 1,500-550kc/s (200-550m). Tr2 and Tr3 are intermediate frequency amplifiers and automatic volume control bias is obtained from the diode D1 and applied to Tr2. VR1 is the audio gain control, allowing the output to be adjusted if necessary.

A circuit of this kind can be relied upon to give good results with a reasonable selection of stations.

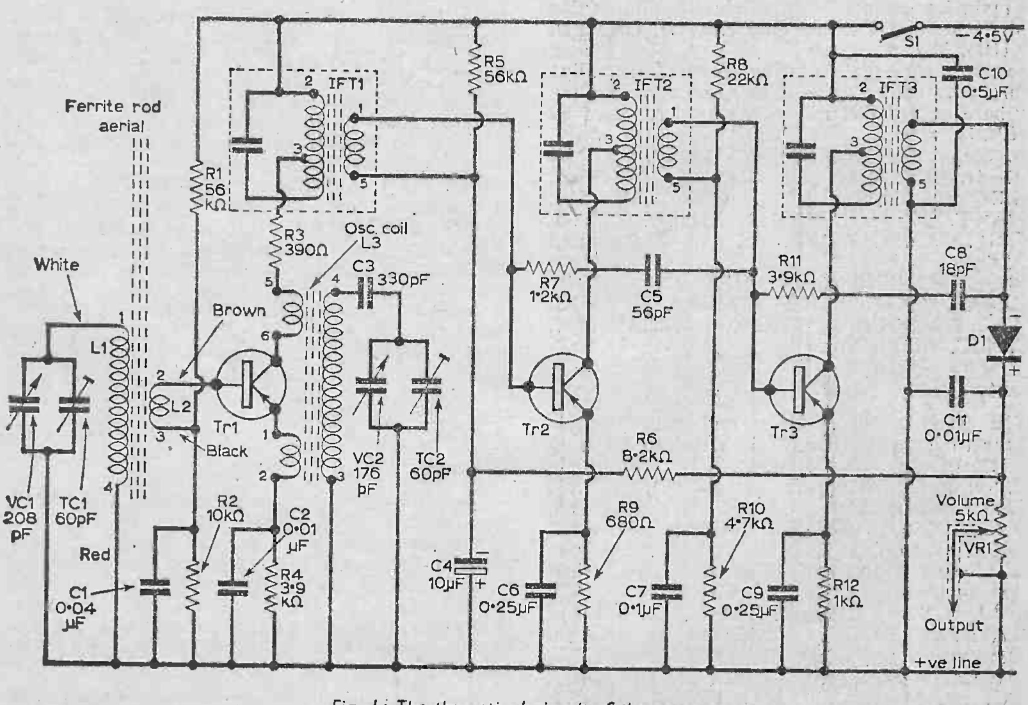


Fig. 1: The theoretical circuit of the tuner.

THE "VICEROY" 30 watt amplifier

Valves 2 x EL34, GZ34, EF86, ECC82, ECC83. Size 14 x 8 x 7½ in. high over cover. Complete with protective cover with carrying handles. High and low gain inputs. Front controls are: Vol. (low gain), vol. (high gain). Treble Step, Bass, Treble Slope and Mains Switch. For 3 and 15 ohm Speakers. Price £17.17.0 (carriage 10/-).

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Carr. 5/- each

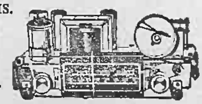
13 x 8in. LOUDSPEAKERS 49/6

Three ohm. Ceramic magnet of latest type. BRAND NEW. (post 3/6.)

HEATER TRANSFORMER

Mains input giving 6.3v. 2 amp. Size 2⅝ x 2 x 1in. (2½in. over winding). 5/6 ea. Less 10% for 12, or 20% for 50. P. & P. 2/- for 1 to 6, post free more than six.

SELF-POWERED V.H.F. TUNER CHASSIS. Covering 88-95 Mc/s. Mullard permeability tuner. Dims. 8 x 6 x 6in. high. Valves ECC85 and 2-EF89's and EABC80 with metal rect. Mains transformer. Fully wired and tested ONLY £8.17.6 (carr. paid). Room dipole 12/6. Feeder 6d. per yard.



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5in. Long play, 900ft.	10/-	3in. Double play, 300ft.	7/6
5¾in. Long play, 1,200ft.	12/6		
7in. Long play, 1,800ft.	15/-		

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The MICRO-6. Self-contained pocket radio, size only $1\frac{4}{5} \times 1\frac{3}{10} \times \frac{1}{2}$in. Truly amazing performance. All parts complete with earphone and detailed construction data. Mercury cell 1/11 extra (2 required). Can be built for 59/6.

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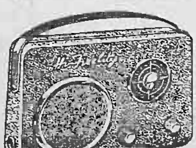
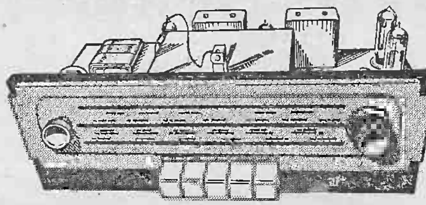
The X10. 10 watt power amplifier with integrated pre-amplifier. Requires only 1mV. for an output of 10 watts undistorted. Size only 6 x 3 x ¾in. Weight 5 oz. Circuit uses 7 M.A.T.s and 4 RF power transistors. Kit price £5.19.6.
Available ready built, tested and guaranteed £6.19.6 post free.
3 pots. for vol., Bass and Treble, 7/6 the 3 extra. Mains power pack, if required 54/-.



6-TRANSISTOR PORTABLE—Fully Built

The "SCALA" for only £5.19.6 carr. paid. 8½ x 2 x 5¼in. high. Choice of colours. Rexine. M.W. and L.W. Ferrite aerial. Battery 2/9 extra. Printed circuit. Nicely styled. A professional job 3½in. speaker. Fully tunable M.W. and L.W. Superhet circuit.

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



Chassis size 15 x 6¾ x 5¾in. high. New manufacture. Dial 14½ x 4in. in 2 colours, predominantly cream. 200-250v. A.C.only.
Pick-up. Ext. Speaker. Ae., E., and Dipole Sockets. Five pushbuttons—OFF. L.W., M.W., F.M., and Gram. Aligned and tested O.P. Transformer. Tone control. 1000-1900 M.: 200-550 M.; 88-98 Mc/s. Valves EZ80 rect.; ECH81, EF89, EABC80, EL84, ECC85, 3-ohm speaker required.
10 x 6in. ELLIPTICAL SPEAKER 25/- to purchasers of this chassis.

TERMS: (Chassis) £3.10.0 down and 5 monthly payments of £2.4.0. Cheap Room Dipole for V.H.F., 12/6. Feeder 6d. per yard.

ALTERNATIVE DESIGN. L.W. 1000-1900 M.; S.W. (9-15 Mc/s); M.W. 190-475 M.; V.H.F. 87-100 Mc/s.; Gram position. Otherwise similar to above chassis. Price £15.15.0 (carr. paid). TERMS: £3.10.0 down and 6 monthly payments of £2.4.0. Total H.P. price £16.14.0. Circuit diagram 2/6.

2-VALVE GRAMOPHONE AMPLIFIER
Price 37/6 (P. & P. 2/6)

Overall size 4in. wide x 5in. high x 2½in. Volume and tone controls. Mains lead. Screened lead input. With output transformer for 3-ohm. For series connection to Garrard and B.S.R. Autochangers and Players, having 90v. tapping.

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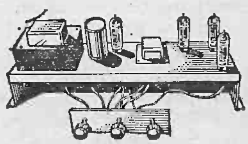

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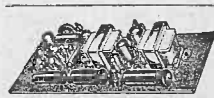

4 TRANSISTOR MINIATURE PUSH-PULL AUDIO AMPLIFIER HIGH IMPEDANCE

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CM21 CRYSTAL MICROPHONE

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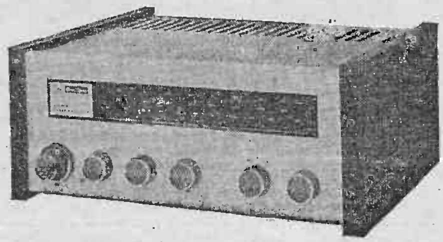

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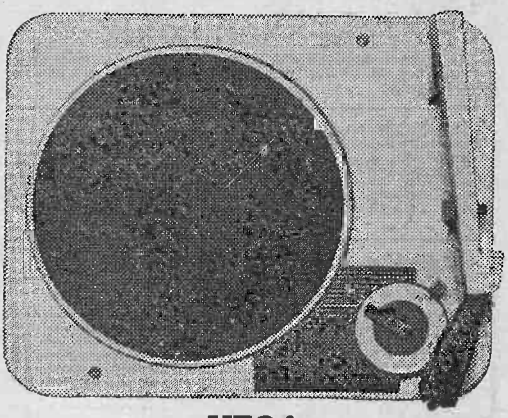

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R2	10kΩ brown-black-orange
R3	390Ω orange-white-brown
R4	3·9kΩ orange-white-red
R5	56kΩ green-blue-orange
R6	8·2kΩ grey-red-red
R7	1·2kΩ brown-red-red
R8	22kΩ red-red-orange
R9	680Ω blue-grey-brown
R10	4·7kΩ yellow-violet-red
R11	3·9kΩ orange-white-red
R12	1kΩ brown-black-red

Capacitors:

C1	0·04μF paper 150V
C2	0·01μF paper 150V
C3	330pF silver mica
C4	10μF electrolytic 6V
C5	56pF silver mica 2%
C6	0·25μF paper 150V
C7	0·1μF paper 150V
C8	18pF silver mica 2%
C9	0·25μF paper 150V
C10	0·5μF paper 150V
C11	0·01μF paper 150V

Semiconductors:

Tr1	OC44	Tr3	OC45
Tr2	OC45	D1	OA81
or			
Tr1	NKT152	Tr3	NKT154/25
Tr2	NKT153/25	D1	GD9

Miscellaneous:

L1, L2	Medium wave aerial on 5in. ferrite rod	Osmor Radio Ltd.
L3	Oscillator coil	
IFT1	470kc/s i.f. transformer (white spot)	
IFT2	470kc/s i.f. transformer (white spot)	
IFT3	470kc/s i.f. transformer (blue spot)	

VR1 5kΩ log. potentiometer with on/off switch, S1
VC1, VC2 208pF, 176pF twin-gang variable capacitor (Jackson '00' with screen)
TC1, TC2 60pF trimmer capacitors
Piece of 4in. x 6in. paxolin, $\frac{1}{16}$in. thick. 24 s.w.g. tinned copper wire. Two knobs. Lengths of 1mm sleeving, screened lead, thin flex. Solder tags, nuts, etc.

The ferrite rod aerial, oscillator coil and intermediate frequency transformers can be obtained in a set for use together. Either Mullard or Newmarket transistors can be employed as in the components list. Very inexpensive surplus transistors of unknown performance are *not* recommended.

Panel

The complete receiver is assembled on a 4in. x 6in. paxolin panel $\frac{1}{16}$in. thick. When finished it is inserted in a box. The case illustrated is a transparent lunch box easily obtained from Woolworths.

Fig. 2 shows the paxolin panel with the required holes. If the paxolin is placed under the diagram holes can be marked through the paper with a sharp-pointed tool. All the small holes for wires are made with a $\frac{1}{16}$in. drill. A $\frac{5}{32}$in. or $\frac{3}{16}$in. drill will do for most of the larger holes, for 4BA bolts and coil pins. If any of the larger holes are not accurately placed enlarge them with a small, round file until the parts fit easily.

The holes can be cleaned up with a slightly larger drill or any similar means. No components are mounted permanently until drilling is finished.

Mounting Components

Parts are on one side of the panel (Fig. 3), the transistors and aerial being left off until construction is otherwise finished.

When securing the gang capacitor VC1/VC2 use very short bolts or extra washers so that the capacitor plates are not fouled. Place a 4BA soldering tag under the bolts (Fig. 4).

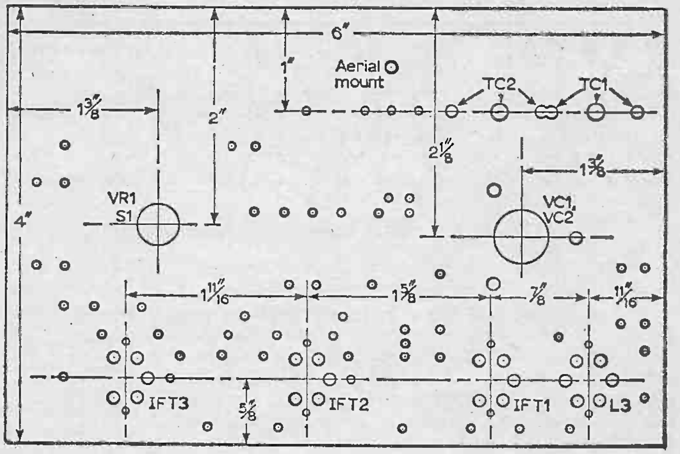
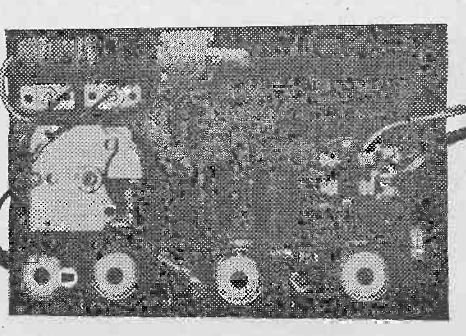


Fig. 2: Drilling details of the paxolin panel, and (below) a view of the components assembled on the other side of the board.



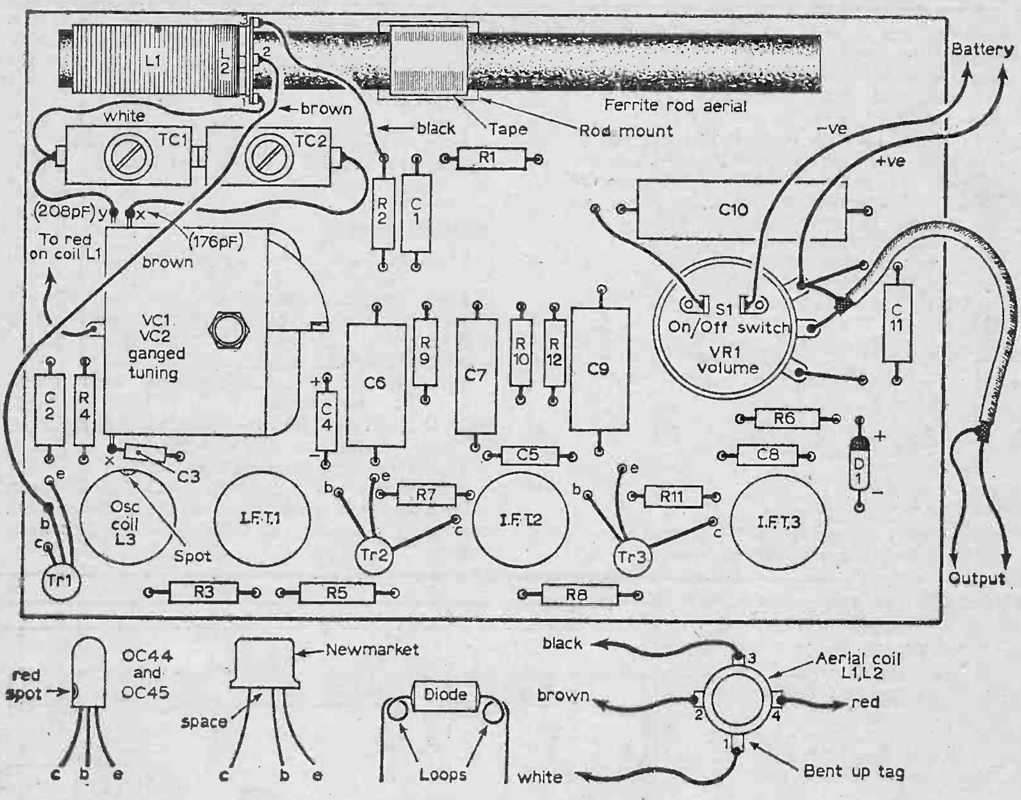


Fig. 3: Layout of the major components on the paxolin panel.

The oscillator coil has a red spot between pins 1 and 6 and this spot *must* face the gang capacitor as in Fig. 3. The intermediate frequency transformers i.f.t.1, i.f.t.2 and i.f.t.3 only have five pins, so cannot be fitted wrongly. Each screening can has small tags which are opened to hold the component.

C4 is an electrolytic capacitor with positive and negative ends and it must be placed as in Fig. 3. All the other fixed capacitors may be inserted either way round.

Resistors are colour coded, values and coding being given in the component list. All resistors should be 10% tolerance so have a silver band in addition to the colours listed.

The wire ends of resistors and capacitors should be bent just clear of the component body so that the leads pass through the holes. A very sharp bend immediately against the component should be avoided as it may fracture the lead.

The volume control VR1 (with switch) is held with a nut. TC1 and TC2 are trimmers, fixed by spreading their tags slightly. It may be preferred to connect a few components as they are inserted or all may be placed on the board, wire leads being spread so that resistors, etc., do not fall out afterwards.

Wiring

This is flat on the front of the panel (Fig. 4). Some 24s.w.g. tinned copper wire with 1mm sleeving will prove convenient. The sleeving is used wherever wires cross or are in danger of touching other joints, tags or pins.

A small soldering iron should be used with radio grade cored solder. If wires and tags are bright and clean, good joints can be made easily and quickly. Lengthy heating may damage components.

It may be found helpful to use red sleeving on the positive or "earth" circuit. All the following are connected to this circuit: Frame of VC1/VC2, red from aerial, trimmers TC1 and TC2, R2, C1, C2, R4, positive of C4, C6, R9, R10, C7, C9, R12, pin 5 of i.f.t.3, VR1, outer brading of output lead, pin 3 of oscillator coil, one can tag of the oscillator coil and all i.f.t.s and a flexible red lead for battery positive. VR1 bush is earthed by a lead round under the nut.

Black sleeving will identify the negative lead from the on/off switch. This circuit is connected to R1, R5, R8, C10 and pin 2 of each i.f.t. Yellow or any other colour can be employed for all other wiring.

Aerial

The ferrite rod mount is held with a 4BA bolt with two extra nuts so that the rod is about ½in. clear of the panel. If the medium wave winding is viewed from the tagged end one tag will be seen to be turned up as in Fig. 3. A lead from this tag goes to T1.

Tag 2 is connected to Tr1 base B. Tag 3 goes to the junction of R2, C1 and R1. Tag 4 is wired to the frame of VC1/VC2.

It is easy to identify leads if thin, coloured flex is soldered to the tags, as in Fig. 3, before placing the winding on the rod. Then put rod and winding in position and connect the coloured leads as shown. Adhesive tape round the rod and through the mount slot holds the rod in position.

Gang Capacitor

The 4BA tags in Fig. 4 provide connecting points to the frame. In Fig. 3 tag Y is VC1. This is the capacitor section near the panel and having most plates.

The two tags X are VC2 or section of the capacitor farther from the panel.

Transistors and Diode

The OC44 and OC45 Mullard transistors have a red or white spot to identify the collector lead (Fig. 3). The Newmarket transistors have extra spacing between collector and base leads.

A ½in. piece of sleeving is placed on each base lead and the wires are inserted as in Fig. 3. Wires are connected as in Fig. 4, sleeving being added where needed.

The transistor wires should be soldered rapidly and the iron is removed as soon as the joint is made. The leads are left quite long and this reduces any chance of damage. It is only necessary to hold the iron on the joint 2-3sec. Excess wire is snipped off.

The diode wires can be formed into small loops, again to avoid damage due to heat reaching the component while soldering. The diode polarity must be as shown.

Circuit Check

It may be found helpful to mark each lead with coloured pencil as it is soldered on. If this is done systematically a glance at the wiring plan will show if anything has been omitted.

The screened output lead inner conductor is soldered to the centre tag of VR1. The outer brading is undone with a sharp tool, twisted into a pigtail and soldered to VR1 positive tag (Fig. 3). A coaxial plug or jack plug to suit the equipment is connected to the lead. The inner conductor goes to coaxial plug centre pin or jack tip. The receiver can be tested with medium or high impedance headphones instead of an amplifier if this is more convenient. If so connect them to the inner wire and brading of the output lead.

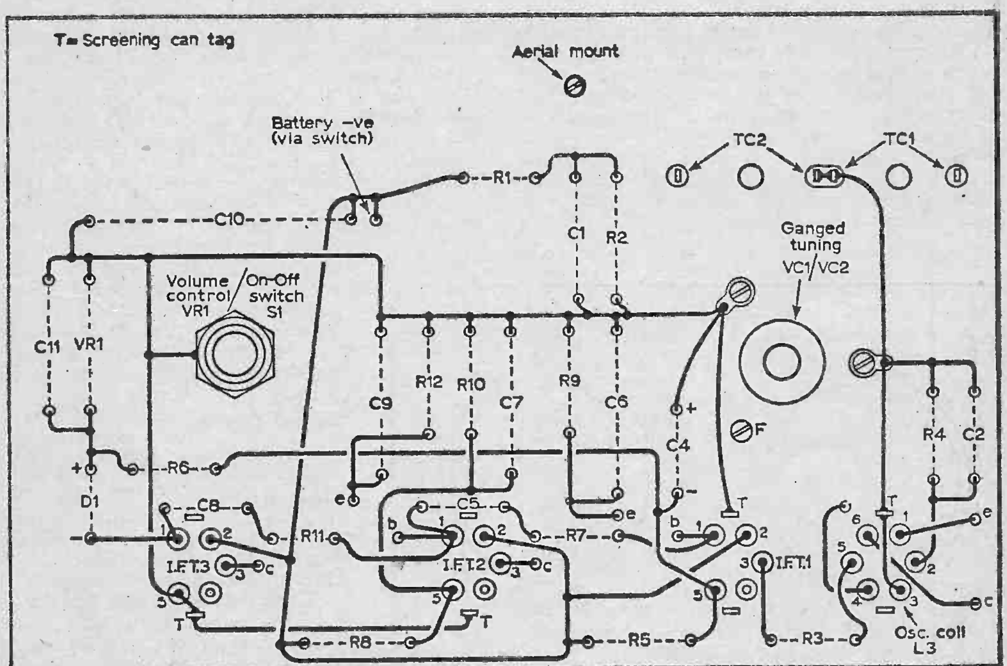


Fig. 4: Wiring connections on the reverse side of the panel.

Alignment

A test is best made before fitting the receiver in its case. Place the winding so that it is flush with the end of the ferrite rod. Unscrew T1 and T2 about halfway. Rotate the cores of the oscillator coil and i.f.t.s so that they are about level with the top of the screening cans.

A 4·5V supply is used and can be any three-cell dry battery. A 6V battery is also satisfactory. Over 6V should not be used. If a meter is to hand it should show about 2mA when placed in one battery lead with the tuner switched on.

It should be possible to hear the local station when the tuning capacitor is rotated. The cores of the i.f.t.s are then turned with a small tool for best volume. If the meter is connected this will correspond to *lowest* current (due to the automatic volume control circuit).

A station of low wavelength (say Radio Luxembourg, 208m) is tuned in and T1 and T2 adjusted for best volume. A transmission round 450-500m (say 700-600kc/s) is found and the winding is slid along the rod for best volume. The procedure is repeated with weak signals.

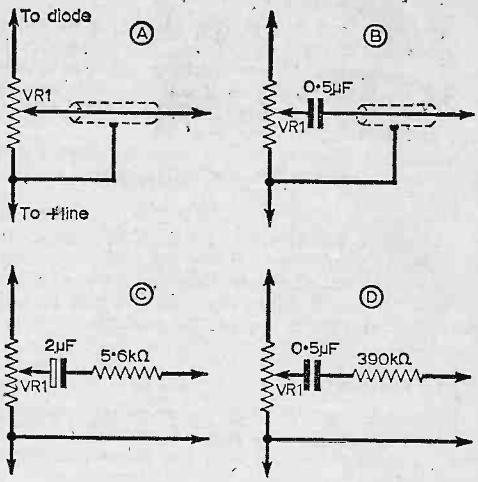


Fig. 6: Various tuner output connections.

Case

This was a clear plastic lunch box, drilled to take the bush of VR1 and clear the spindle of the tuning capacitor. A hole is also drilled in line with capacitor fixing screw hole F (Fig. 4).

The tuning and volume control scale in Fig. 5 was prepared to place on the inside of the case. The box is painted on the *inside* any required colour, leaving the area for the scale clear. The scale is held with adhesive.

The receiver is held in the box by an extra nut on VR1 and by a 4BA bolt into hole F, extra washers giving enough clearance between wired panel and case. Knobs to choice are fitted. The output lead issues from a hole. The battery is held by elastic through small holes.

The box purchased was strong but brittle and care is needed when drilling this kind of material. Various equally suitable coloured boxes with hinged lids can also be obtained.

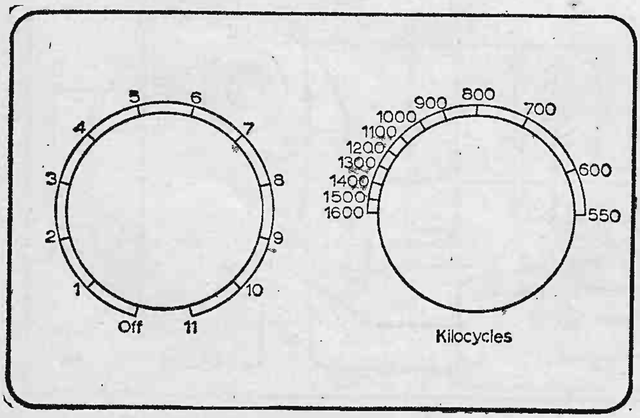


Fig. 5: Layout of tuning and volume scales.

Final Adjustment

Alignment can be checked after the tuner is in its case. If tuning dial indications are incorrect with the gang capacitor nearly closed, rotate the oscillator coil core until this is corrected and move the winding along the rod to maintain best volume. Should dial indications be wrong near the 1,500kc/s end of the scale adjust T1 and T2 to correct this. Repeat all adjustments a few times until there is no further improvement. If a whistle arises when tuning through stations see that the transistor leads are not longer than mentioned (e.g. about ½in. of lead between transistor and panel) and *slightly* unscrew the core of i.f.t.2 if necessary. The ferrite rod is directive but this can usually be ignored.

If a signal generator is available the i.f.t.s can be aligned at 470kc/s by injecting 470kc/s (modulated) at the base of Tr1 through an isolating capacitor. Trimming may be at about 1,400kc/s and the oscillator coil core and aerial winding position may be adjusted at 600kc/s. The generator may be coupled to the receiver by placing a two or three turn loop near the ferrite rod.

Output Circuits

For personal listening with a crystal earpiece, connections can be made as shown in Fig. 6a. For a magnetic phone or ordinary headphone a capacitor is included, as in Fig. 6b, to avoid shorting the a.v.c. through the phone windings.

Transistor amplifiers can be fed as in Fig. 6c, the 5·6kΩ resistor being taken to the base of the first audio stage. For a valve amplifier with a high impedance input the circuit in Fig. 6d can be employed. ■

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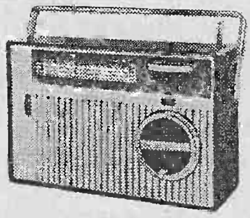

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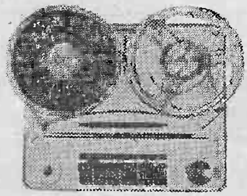

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5in.	Long play, 900ft., Acetate base	10	0
5in.	Standard play, 600ft. PVC base	8	6
5in.	Triple play, 1,800ft., Mylar base	35	0
5¾in.	Double play 1.800ft., Mylar base	22	6
5¾in.	Long play, 1,200ft., Acetate base	12	6
5¾in.	Standard play, 850ft., PVC base	11	6
5¾in.	Triple play, 2,400ft., Mylar base	45	0
7in.	Standard play, 1,200ft.. Acetate base	10	0
7in.	Standard play, 1,200ft., Mylar base	12	6
7in.	Long play, 1,800ft. Mylar base	19	6
7in.	Double play, 2,400ft., Mylar base	25	0
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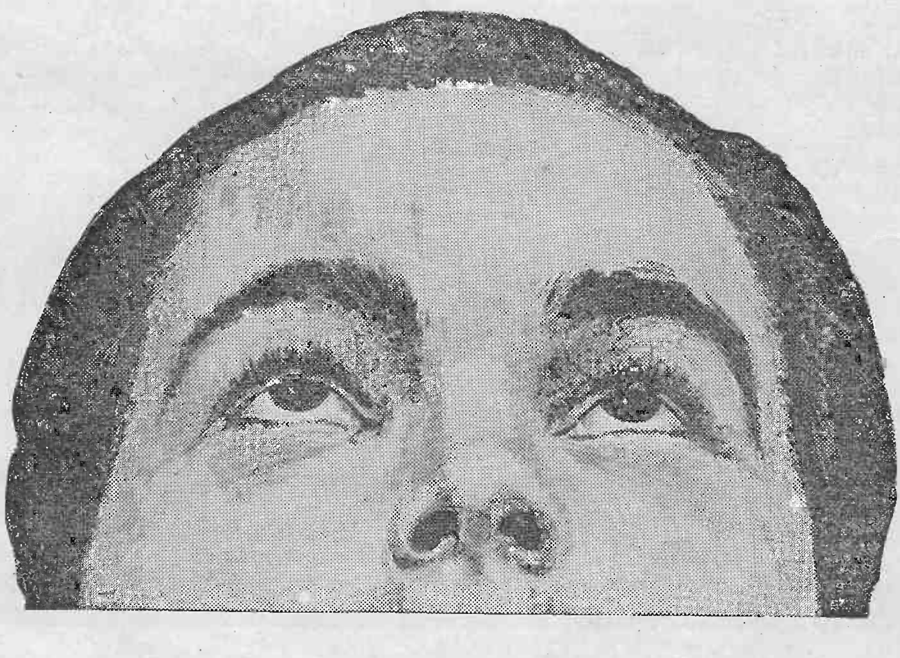

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12. PROPAGATION OF RADIO WAVES AND AERIALS—Part 2

12.1 Feeding the Dipole Aerial

It will be remembered that the voltage in a dipole aerial is minimum at the centre of the aerial and that the current is maximum at the same place. It can be seen therefore that the impedance of the dipole aerial will be smallest at its centre. In practice the impedance at the centre of a dipole aerial is of the order of 70Ω It is an easy matter to break the dipole in the centre and connect to it a 75Ω transmission line; this may be of a *twin lead* or *co-axial type*. (The gap in the centre of the dipole is of course bridged by a suitable insulator.) Fig. 104 shows how the transmission line is connected to the dipole. It is important to ensure that the transmission line to the dipole runs away from the aerial at 90° for as long a distance as possible so as to avoid the pick up of signals from the aerial itself, thereby causing uneven current distribution to occur.

The twin line or co-axial transmission line (or *feeder*) can be connected to the power output stage of the transmitter quite easily by means of a loop placed in close proximity to the tank coil of the output stage. The loop may consist of as few as two or less turns, depending on the frequency of operation. This method of connecting the aerial to the transmitter is shown in simplified form in Fig. 105.

12.2 The Folded Dipole Aerial

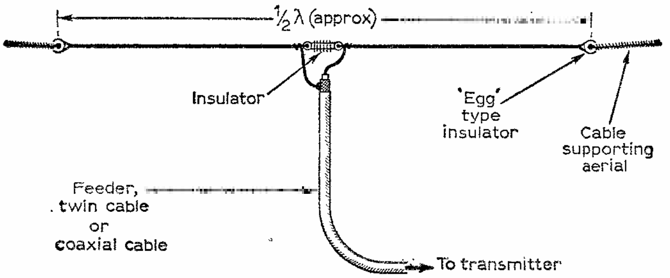
Another commonly used aerial, particularly at higher frequencies, is the *folded dipole aerial.* A typical method of construction is shown in Fig. 106. As can be seen the aerial is still physically the same length but only one of the two wires from which the aerial is made is broken. It is found that with this type of aerial the impedance at the point at which the feeder is connected is about 300Ω. 300Ω impedance twin lead is easily used as a feeder for the folded dipole. The disadvantage of the folded dipole is that the two wires making up the aerial have to be spaced so that they do not touch. The spacers will make the aerial heavier than a simple dipole type. For frequencies up to about 7Mc/s the spacing of the wires can be about 4 to 8in. but at 14 to 28Mc/s this can be reduced to 2 to 4in.

12.3 Artificial Aerials

For the purpose of tuning a transmitter an *artificial aerial* can be used. This is simply a high wattage resistance, generally carbon, and the output of the transmitter is fed directly to this. The resistance is chosen to have the same resistance as the impedance of the aerial system normally used with the transmitter. The efficiency of the power output valve of the transmitter can also be easily determined using an artificial aerial. One advantage of the artificial aerial is that it enables a station operator to "tune up" a transmitter without actually radiating a large signal.

12.4 Frequency Meters

The simplest possible form of frequency meter is called an *absorption frequency meter.* For its operation this type of frequency meter relies on absorbing a small amount of r.f power from the anode circuit of the p.a. valve in the transmitter. The meter consists quite simply of a tuned circuit consisting of a coil and capacitor, and in series with these is a small flashlight bulb. The instrument is held close to the p.a. tank circuit and the capacitance of the capacitor is varied until the



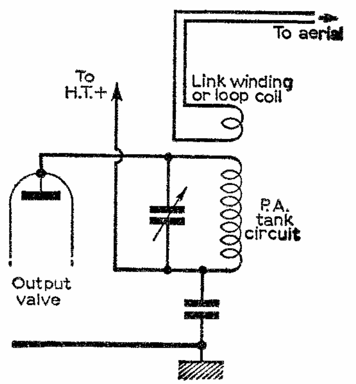
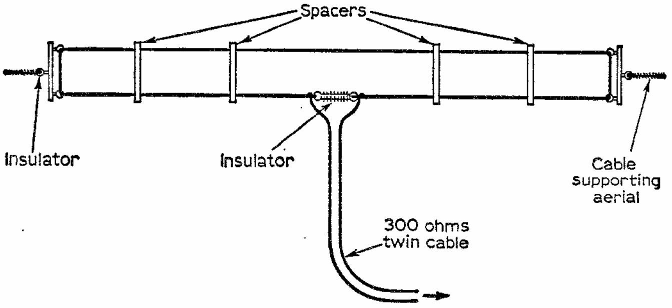
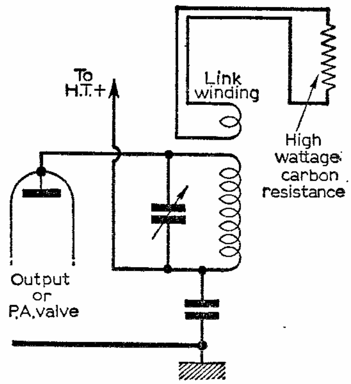


Fig. 104 (left): A simple dipole aerial, showing the method of connecting the feeder.

Fig. 105 (right): Connecting the aerial to the tank circuit by means of a link winding.

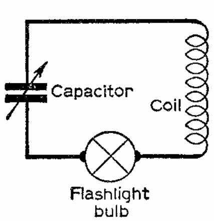
Fig. 106 (left): Construction of the folded dipole aerial.
Fig. 107 (right): Connecting an artificial aerial to the transmitter.





flashlight bulb lights. At this point the tuned circuit in the frequency meter is at the same frequency as that of the tank circuit and is consequently drawing the maximum power from it (thereby lighting the bulb). In practice the absorption frequency meter should be operated as far away from the tank circuit so as to avoid any detuning of same. The dial on the tuning capacitor of the frequency meter should have been previously calibrated against an oscillator of known frequency, it can then be used as a direct reading instrument. The accuracy of this type of frequency meter is not of a high order.

The absorption type frequency meter can also be operated without having a flashlight bulb in the circuit, the coil and variable capacitor only being used. As the frequency meter is tuned to the same frequency as the transmitter a slight upward reading will be noticed on the milliammeter measuring the anode current of the output valve. Once again, the further the frequency is away from the p.a. tank circuit the more accurate the reading.



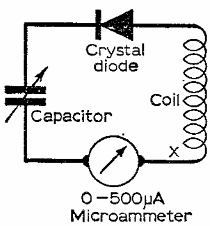


Fig. 108 (left): A simple absorption frequency meter using flashlight bulb.

Fig. 109 (right): A sensitive frequency meter using a microammeter.

As the absorption type frequency meter requires a fairly substantial amount of power to be transferred to it from the p.a. tank circuit in order to operate effectively it can only be used when very close to the tank circuit. The coupling required for accurate readings to be taken would be too loose for the proper operation of the meter. The frequency meter must therefore be made much more sensitive so that very loose coupling can be utilised. A simple way of doing this is to use a d.c. microammeter in the circuit instead of the bulb and to use a crystal diode to supply the rectified d.c. required to operate the meter. The sensitivity of the frequency meter is thereby greatly increased and the loose coupling essential for accurate readings can be employed. This type of frequency meter must also be calibrated using an oscillator of known frequency. A circuit diagram of the improved frequency meter is shown in Fig. 109 and it is worth mentioning that if the transmitter is modulated a pair of headphones can be inserted at the point X and the instrument used as a signal monitor, for it is in fact a simple "crystal receiver".

The most accurate method of measuring the frequency of a transmitter is to use a crystal controlled frequency meter or as it is often called a *secondary frequency standard.* This employs a highly accurate crystal oscillator which is generally operated on a frequency of 100kc/s. The harmonics of this oscillator are used to determine the frequency of the transmitter but to the nearest 100kc/s only. To take the measurement to the nearest 100kc/s the harmonic of the oscillator must be compared to some accurately known frequency, e.g. that of a broadcast station. If the strength of the harmonics of the oscillator is very weak at high frequencies a harmonic amplifier may have to be incorporated in the instrument. In order to take very accurate readings a variable frequency oscillator can be incorporated in the instrument so as to enable frequencies between the intermediate 100kc/s points to be accurately determined.

12.5 Power Input to the P.A.

The power input to the anode of a power amplifier is given by the product of the anode voltage and the anode current—power input = $E_a \times I_a$ (where E_a is in volts and I_a in amps). This will give the power input in watts. Therefore in order to measure the power input to the p.a. of a transmitter a milliammeter and voltmeter must be included in the anode circuit. Similarly the power input to the screen grid of a tetrode output valve would be the product of the screen voltage and screen current.

12.6 The Efficiency of the Output Stage

The efficiency of the anode circuit in a power amplifier is given by—

$$\text{Efficiency} = \frac{\text{Power output}}{\text{Power input}} \times 100\%.$$

If a valve had an anode power input of 50W and an output to the aerial of 25W the efficiency of the valve would be—

$$\frac{25}{50} \times 100\% = 50\%.$$

In this case 25 watts of power has been lost. This has been dissipated as heat by the anode of the p.a. valve. Care must be taken to ensure that the rated anode dissipation of a valve given by the maker is never exceeded. (N.B. in a tetrode output stage the screen dissipation is equal to the screen power input power as no power is delivered to the aerial by the screen grid.)

If the power input was 30W and the power output was 17·5W the power dissipated as heat at the anode would be 30 − 17·5 = 12·5W. If the power amplifier valve were a triode the meter used to measure the anode current could also be placed in the cathode circuit, the same reading being obtained as in the position shown in Fig. 111.

I hope that this series of 12 articles has been of use to those readers studying for the R.A.E. examination and that readers will bear with me in appreciating that of necessity the topics have had to be covered very briefly. As I said in the first article the function of the series was to give a broad outline of the work only and that a great deal of personal work would have to be done by the prospective candidate in order to satisfy the examiner.

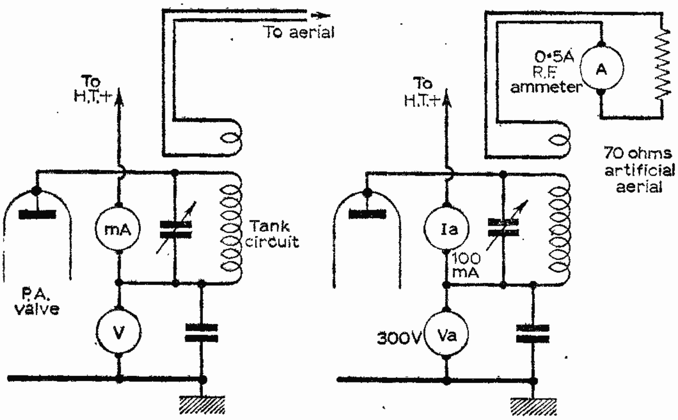


Fig. 110 (left): The connection of meters to measure the power input to the P.A. circuit.

Fig. 111 (right): Using an artificial aerial to find the efficiency of a P.A. and also to determine the anode dissipation.

Fig. 112 (below): Signal path with ionospheric deflection.

12.7 Using an Artificial Aerial to Determine the Efficiency of a P.A.

An artificial aerial can easily be used to determine the efficiency of the p.a. stage of a transmitter. A simple circuit is shown in Fig. 111 and the readings of the meters have been noted on the diagram. In Fig. 111 the power input to the anode is found from the product of the anode voltage and current—i.e.

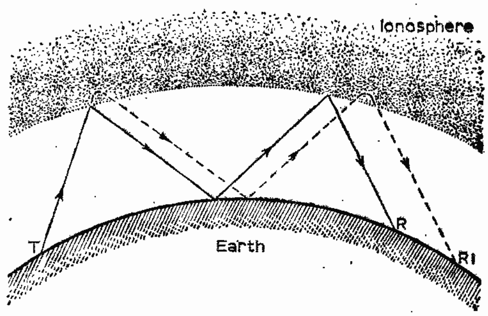
$$\text{Watts} = \text{Volts} \times \text{Amps}.$$
$$= 300 \times 0{\cdot}1 = 30\text{W}.$$

The power delivered to the artificial aerial can be found from the resistance of the aerial and the current flowing through it—i.e.

$$\text{Watts} = I^2 \times R$$
$$= 0{\cdot}5 \times 0{\cdot}5 \times 70$$
$$= 17{\cdot}5\text{W}.$$

The efficiency of the amplifier will be given by—

$$\frac{\text{Power output}}{\text{Power input}} \times 100\%$$
$$= 17{\cdot}5/30 \times 100\%$$
$$= 58{\cdot}33\%$$



Answer to Last Month's Question

The answer to last month's question is given in Fig. 112. As this is the last of the series of articles there will be no question this month. ■

AND NOW THE MORSE TEST!

Read next month's issue for some helpful tips on how to approach the question of getting your Morse up to the required w.p.m.

Practical Substitutes

by M. L Michaelis, M.A.

THE lists of parts for constructional articles are those found satisfactory in the prototypes. Queries which the Editor receives show that many beginners regard these lists as strictly binding down to the last detail.

It is the aim of these articles to help beginners make on-the-spot substitute decisions when their dealers do not have specific components on stock. The information should also help when replacing obsolete components and making use of junkbox parts.

PART THREE

A DISCUSSION of transistor substitutions is necessarily more vague than that for valves because the market is flooded with a profuse variety of different or apparently different types without any rigid standardisation. It is not even possible to give reliable lists of direct or near equivalents because transistors which may behave as direct equivalents in one circuit may be far from doing so in another.

TRANSISTOR CHARACTERISTICS

Most transistors now available are junction types in four sub-groups: germanium p-n-p, germanium n-p-n, silicon p-n-p and silicon n-p-n. Nearly all cheap transistors used in pocket radios are germanium p-n-p types. Silicon n-p-n types are becoming increasingly common for high frequency, high temperature and general electronic work.

Some silicon p-n-p types are marketed for use in critical stages of equipment otherwise using germanium p-n-p types and subject to somewhat higher temperatures. A common negative collector supply can then be used, whereas silicon n-p-n transistors require a positive collector supply (Fig. 12).

All junction transistors have one important property in common: the collector and emitter currents are very nearly equal under normal operating conditions. The slight difference is equal to the very much smaller base current.

The ratio of a resulting change of collector current to the change of base current producing it around a specified operating point is known as the *differential current gain* β at that operating point, which not only varies widely according to the d.c. operating point of the junction transistor but it is also strongly frequency dependent at higher frequencies, falling with increasing frequency.

Data tables often list a cut-off frequency at which β has fallen to unity for a specified operating point. The transistor may still be capable of amplification at higher frequencies according to the impedance relationships of the input and output circuits.

A p-n-p transistor normally uses an operating point where the collector is more negative than both base and emitter but the base is slightly negative to the emitter (or the emitter slightly positive to the base). These polarities are all reversed for n-p-n transistors whether the transistor is a germanium or a silicon type.

COMPARISON OF TRANSISTORS

If a transistor is to be further considered as a substitute for some other specified one the following characteristics of the two types should be compared in the data tables and should be found to satisfy:

(a) β: This should not be less than specified for the original at the adopted operating point. It should preferably not be greater to avoid problems of possible instability at the otherwise resulting increased gain. *Slight* differences either way are usually unimportant.

(b) Frequency dependence of β: The cut-off frequency should either be not less than that of the original transistor or it should be much higher than the highest actual operating frequency of the equipment for both transistors.

(c) Voltage and current ratings: It does not matter if these differ very greatly as long as the limiting ratings of the proposed substitute transistor definitely permit the actual operating voltages and currents involved.

(d) Power dissipation: It does not matter if the rated power dissipation of the substitute transistor is different from that of the original as long as it still allows the actual power dissipation which arises in the stage involved (chiefly collector to emitter voltage multiplied by collector current, which can be measured with a multimeter and compared with the maximum ratings).

Any transistor substitution which satisfies these four conditions and which does not involve a change of basic type (i.e. germanium to silicon and/or n-p-n to p-n-p) is likely to prove satisfactory regardless of type, function, operating frequency or power level.

GROUP SUBSTITUTIONS

Silicon transistors may often be substituted for germanium transistors provided that both are n-p-n or p-n-p and the conditions (a) to (d) are satisfied. It may be necessary to increase the base

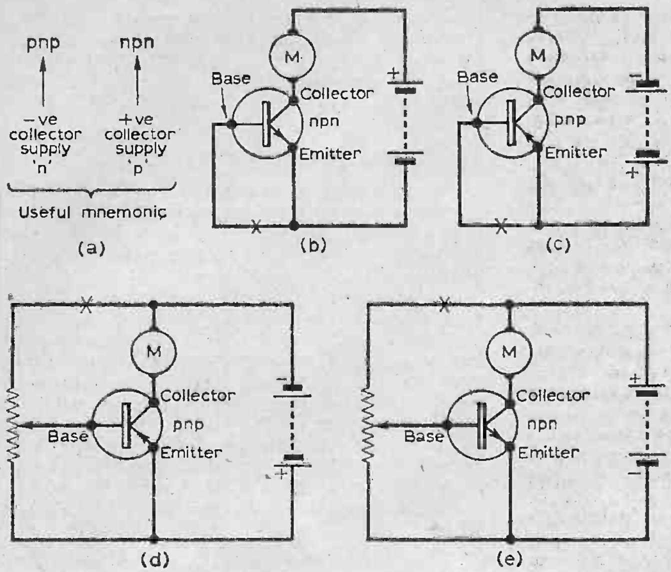
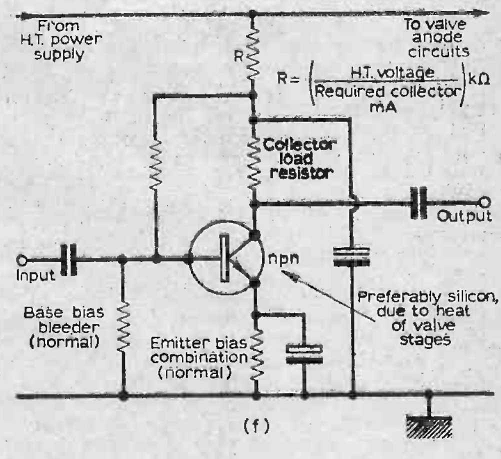


Fig. 1·2: (a) transistor polarity mnemonic, (b) n-p-n leakage currents, (c) p-n-p leakage currents, (d) p-n-p threshold effect, (e) n-p-n threshold effect, (f) operating transistors on h.t. supply. Points on circuit marked "X" are points of disconnection as mentioned in the text.



or emitter bias somewhat, unless the operating point is far removed from cut-off, because of the threshold effect manifested by silicon transistors only.

If germanium transistors satisfying conditions (a) to (d) are substituted for specified silicon types the range of temperatures over which the equipment will work satisfactorily becomes more limited. This reduction of operating temperature range may be small and tolerable if single stages are involved or several stages with RC-coupling.

But if a germanium transistor is substituted for a specified silicon transistor in an early stage of a d.c.-coupled amplifier chain then the increased drift with temperature will generally be intolerable, since the shift of operating point in the substituted stage is amplified through all subsequent d.c.-coupled stages. In d.c.-coupled stages amplification of the leakage current of a germanium transistor may even block the final stage at all temperatures, so that the substitution is completely ruled out.

It is theoretically possible in a piece of equipment to replace all n-p-n transistors with all p-n-p transistors, or vice versa, provided the substitutes satisfy the conditions (a) to (d) and have similar characteristics in other significant respects. It is then only necessary to reverse the power supply polarity and all electrolytics and other polarity dependent components.

It is easier to use n-p-n transistors in hybrid circuitry employing valves, since the positive collector supply may be obtained through large dropper resistors connected to the main h.t. supply. A transistor is not damaged when the collector circuit is taken to the positive h.t. line of several hundred volts through a sufficiently high resistor to limit the collector current to the required operating value and to produce a suitable voltage drop to the collector.

Other protective measures are not in general required. Since only a negligibly small collector voltage is required in relation to the full h.t. voltage the collector dropper resistor must drop virtually the entire h.t. voltage, so that it will have to have a value of E/IkΩ where E is the h.t. voltage and I the desired transistor collector current in mA.

LEAKAGE CURRENT AND THRESHOLD

The conditions for transistor substitutions chiefly refer to operating conditions reasonably remote from the cut-off points. Any stage which operates near collector current cut-off may be more critical and may rule out interchange of silicon and germanium types because of their rather different cut-off behaviour.

Cross-over distortion of push-pull stages operating in Class B is often bad enough for germanium transistors but it can be intolerable with silicon transistors which are unsatisfactory in any other linear power stages but Class A push-pull circuits or in pulse-width modulated audio amplifiers where the output stage transistors merely function as switches irrespective of their transfer characteristics.

If a germanium transistor is connected with the base strapped to the emitter as in Fig. 12c a sensitive meter M in the collector circuit will show a current ranging from 1-2μA with small transistors up to 1mA or so for power transistors. If the base is disconnected (open-circuit) this current will generally be even greater, as much as ten times, even though no base bias is being applied to "open" the emitter and collector circuits.

This leakage current has an enormous positive temperature coefficient and cannot be controlled via the base electrode in the normal manner. It may even already double due to the slight heating obtained by gripping the body of the transistor firmly between the fingertips.

SILICON TRANSISTORS

Silicon transistors also manifest a leakage current having the same qualitative properties. But the magnitudes are generally at least a thousand times smaller than for similar germanium transistors under similar conditions, so that *for many practical purposes silicon transistors have no significant leakage current!* This explains why silicon transistors are more satisfactory for equipment subject to high or fluctuating temperatures. All other transistor characteristics are much less dependent upon temperature.

Silicon transistors (whether n-p-n or p-n-p) also differ in that they manifest a threshold effect not shown by germanium transistors. Due to the significant leakage current of germanium transistors the meter in Fig. 12 (d) and (e) will show a small deflection, even when the base bias potentiometer slider is at the emitter end.

The slightest movement of the slider towards the collector end *immediately* increases the collector current, which may be in part due to a rise of leakage current with the increased base-to-emitter resistance but is in part due to true collector current control through the base.

Controllable collector current commences virtually immediately any base bias is applied to a germanium transistor. If now silicon transistors are used in Fig. 12 (d) and (e) the meter shows no current when the base bias slider is at the emitter end, since leakage current is insignificant for silicon transistors.

If the slider is now gradually moved in the direction of the collector, collector current still does not commence. Only when the applied base bias has reached about 0·5V does collector current commence in the normal manner. At 0·55V, say, collector current can already be very heavy, i.e. this cut-on threshold of about half a volt is usually quite sharp and typical of silicon transistors.

It permits a number of triggered circuits with silicon transistors which would be awkward or impossible with germanium transistors, whilst, on the other hand, several germanium transistor circuits which would be disturbed by this threshold are not directly substitutable with silicon transistors.

ESSENTIAL DIFFERENCES

The essential differences between silicon and germanium transistors are thus seen to lie in the heavy leakage current shown only by germanium transistors and in the base threshold effect shown only by silicon transistors.

An important field of application of silicon transistors is in circuits of very high input impedance, up to some dozens of megohms being easily achieved with commonly available types. Due to the significant leakage current of all germanium transistors, which acts to reduce the input impedance of the circuit, it is not possible to substitute germanium transistors for silicon transistors specified for high-impedance stages, even if all other data is similar and there are no excessive temperature fluctuations to be reckoned with.

SEMICONDUCTOR DIODES

Fig. 13 shows the equivalent circuit of a semiconductor diode. D is the ideal diode with the "wanted" properties for the usual rectifier applications with all the virtual components which make the actual diode differ from an ideal diode depicted externally. Some of these virtual components are made use of in the various subsidiary uses of semiconductor diodes.

The ideal diode D is assumed to be a perfect conductor of zero resistance in the forward direction (anode positive to cathode) and a perfect insulator of zero capacitance in the reverse direction (anode negative to cathode) however large the applied inverse voltage may be.

An actual diode is not a perfect conductor in the forward direction but manifests a small series resistance represented by Rs. In the reverse direction an actual diode will not withstand infinitely large voltages. Above a certain peak inverse voltage the diode commences to conduct again.

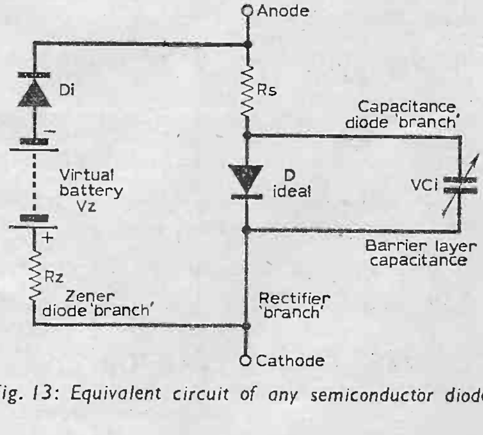


Fig. 13: Equivalent circuit of any semiconductor diode.

This is depicted by the ideal inverse diode Di (which again has perfect diode characteristics) in series with a virtual battery whose e.m.f. is Vz and whose internal impedance is Rz. Vz is the peak inverse voltage of the diode beyond which it commences to draw inverse current. Finally, all actual diodes manifest a barrier layer capacitance VCi when cut off.

This is depicted in Fig. 13 as a variable capacitor because it depends strongly upon the magnitude of the applied inverse voltage. In general the barrier layer capacitance is reduced when the inverse voltage is increased and vice versa.

All semiconductor diodes manifest all the above-mentioned properties. Types which are specially manufactured to enhance the properties of Di and Vz, i.e. which can be run continuously under conditions of significant inverse current without damage and for which Rz is particularly small are called *zener diodes.* Vz is then spoken of as the zener voltage and Rz is the differential zener resistance.

Types which enhance the properties of VCi are called *capacitance diodes* or *varicap diodes;* they permit a smooth control of VCi over a useful range of inverse voltages. Capacitance diodes are frequently employed as tuning correction components across the local oscillator tuned circuits for a.f.c. circuits in modern television and v.h.f. radio receivers.

Other diodes whose principal exploited characteristics are D and Rs constitute the general rectifier group, including r.f. detectors, pulse circuit diodes and true power rectifiers.

DIODE SUBSTITUTIONS

The above generalised description of diode properties should permit many substitutions which one might not otherwise think of. For example, any zener diode can be used as an ordinary rectifier if the zener voltage is treated as being the absolute maximum permissible peak inverse voltage. Some ordinary diodes are usable as zener diodes by applying a voltage higher than Vz through a suitable high-value series resistor to limit the resulting inverse current to very low values.

The reason why many small rectifier class diodes make quite unsatisfactory zener diodes is because their Rz is rather large, so that even very small inverse currents lead to considerable power dissipation in the diode in excess of the ratings. Otherwise there is no fundamental objection to using a rectifier diode in this manner; it is not usually a voltage above the peak inverse rating that damages a diode but rather burn-out due to excessive power dissipation if the resulting inverse current is not limited.

Diodes specially designed as efficient zener diodes have very low values of Rz, so that considerable inverse currents can be drawn (zener currents) without destruction of the diode. In the forward direction, with anode positive to cathode, any zener diode behaves as an ordinary rectifier diode, i.e. it conducts efficiently.

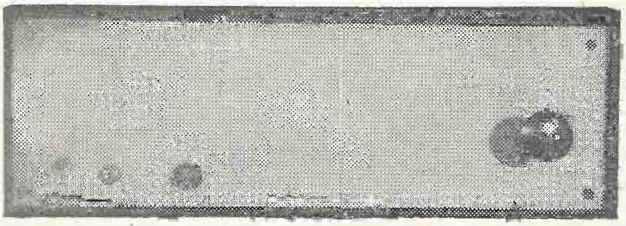
Turning to uses of VCi, possibilities of inter-type substitution are much greater, since the dependence of the barrier layer capacitance upon the applied inverse voltage is a very markked property of nearly all small silicon and germanium detector diodes. If a specified "capacitance diode" is unobtainable look up in the tables any small detector diode listed as having about the same barrier layer capacitance at a simpler inverse (cut-off) operating point and able to withstand the maximum inverse operating voltage arising in the circuit position in question.

When it is desired to substitute diodes of similar application as stated by the makers, compare the salient data given in the tables, i.e. the listed values for the virtual components shown in Fig. 13 and the limiting voltage and current ratings.

Even if one or more characteristics of the envisaged substitute diode differ widely from the original specification this need not necessarily rule out the substitution. For example, it is quite in order to substitute a diode with much greater VCi in a low-impedance audio frequency circuit, but such a substitution would be ruled out in v.h.f. circuitry or in any other stage where stray capacitances are important.

Always observe that the maximum voltage and current ratings in both directions of conduction are at least as great as the intended operating conditions.

CONCLUDED NEXT MONTH

HI FI  ECO

R.J. BR

A UNIT-CONSTRUCTED RECEIVI

THE unit to be described was constructed very cheaply, and no originality is claimed for the design, in fact the i.f. strip is based on the PW Everest Tuner (June 1962, PRACTICAL WIRELESS), and the audio amplifier is taken from an old TV circuit, as were many of the other components for the i.f. section. The power supply was constructed from an old radio transformer, and a TV metal rectifier. The complete unit comprises three main parts: (1) the prebuilt "front end", (2) the i.f. amplifier and discriminator, (3) the audio amplifier and power supply.

The front end can be obtained complete from Henry's Radio Ltd., 303 Edgware Road, W.2., who identify it as a VHF FM tuning heart FMA IU3. The price is 15/- plus 6/6 for the ECC85. Actually, the circuit was designed for a UCC85 (0·1A heater for series operation) but an ECC85 is used instead (6·3V heater). No modifications are, however, required to the tuning "heart", simply plug the ECC85 straight in.

I.F. Amplifier and Detector

It must be pointed out at this stage that this circuit was chosen simply because it was known that its performance was quite good and capable of very good reproduction. Denco ready wound i.f.t.'s and discriminator are however used to ease construction. The layout shown should be adhered to.

The phase discriminator stage, often referred to as a "Foster-Seeley", gives a better hi-fi performance than the more common ratio detector.

Audio Amplifier and Power Supply

Before describing the audio stage used in this design, it will be as well to describe the reasons for choosing the design chosen. The impetus to build an f.m. receiver came from the desire to record certain BBC transmissions. For the sake of completeness an audio stage was added for normal use, but to get the best results a rather more

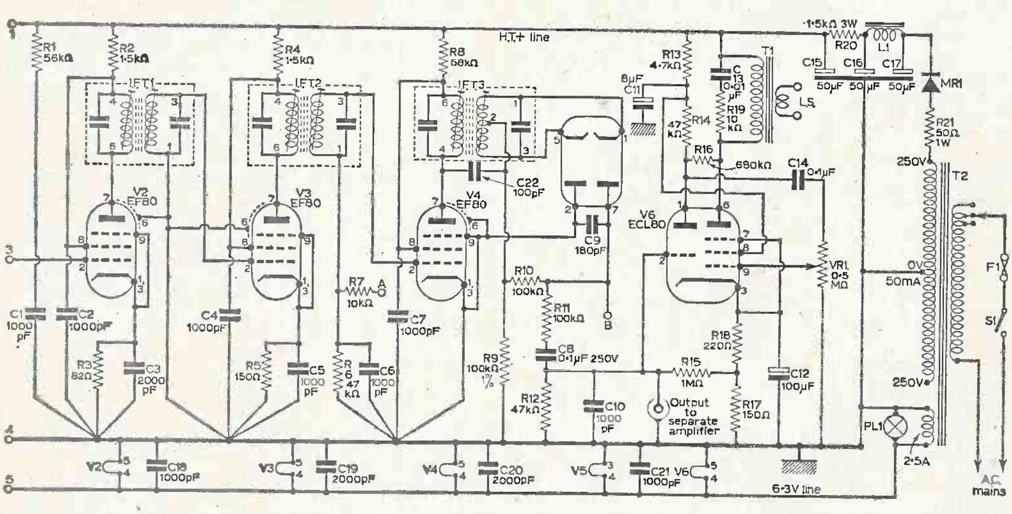


Fig. 1: Circuit diagram of the i.f., detector and audio stages of the f.m. receiver. The numbered connections at the input end are taken to the tuning heart.

AILEY B.Sc.

IOMY FM TUNER

WITH PRE-BUILT FRONT END

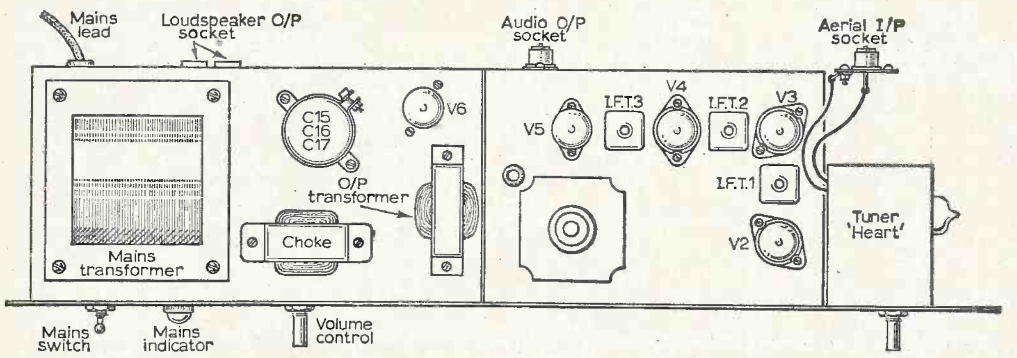


Fig. 2: View of the completely assembled receiver, as seen from the top, showing the location of major components and the connection of the three individual units.

sophisticated power amplifier is required. It will be found, however, that if a good speaker (in a reasonable enclosure) is used, the resulting quality from the ECL80 stage is surprisingly good.

Obviously this very simple design could be omitted or changed to suit the constructors individual requirements. The ECL80 and output transformer were rescued from an old TV. The layout is not critical, although the output transformer should be situated at right angles to the smoothing choke. One half of an 250-0-250V mains transformer is half wave rectified, the smoothing provided is as shown.

Layout and Cabinet

In the prototype the three individual chassis were all bolted to a 16s.w.g. aluminium face plate. The whole thing was mounted in a wooden cabinet with a perspex front plate. No tuning dial was incorporated as the stations can easily be found and drift is negligible after the initial warm-up period. It is worthwhile pointing out that drift is mainly associated with the temperature changes on warm-up, therefore the cabinet should allow a free-flow of air in order to minimize this effect.

It is possible to get results of a kind with tuning by ear, but use of a stable alignment oscillator is necessary if the best performance is required. Better still, the use of a wobbulator and oscilloscope makes alignment a positive joy! However, the majority of constructors do not possess this type of equipment, and therefore a simpler method using a signal generator and a multirange meter will be described. This method gives quite good results, as long as the alignment instructions are carefully followed.

Alignment

The first thing is to check for h.t. line for shorts. If o.k. then switch on and check that h.t. is present and that the heaters are on. The alignment procedure is as follows—

1 With aerial disconnected, the signal generator is set to 10·7Mc/s, r.f. only, and the signal injected between the control grid of V2 and chassis.
2 The voltmeter is connected between point A (Fig. 1) and earth.
3 Increase the signal generator output until a reading is obtained on the meter.
4 Adjust cores of i.f.t.2 to obtain maximum reading on the meter, then i.f.t.1 for maximum reading, reducing the input signal as the reading increases.
5 The cores should then be adjusted so that the meter reading stays sensibly constant as

—continued over

the signal generator is swept from 10·6 to 10·8Mc/s, whilst outside this band the reading should drop sharply.
Now connect the meter between point B and earth with the signal generator set to 10·7Mc/s.

7 If the reading is of the wrong polarity reverse the meter connection.
8 Adjust i.f.t.3 (discriminator) primary core for maximum reading.
9 Adjust the secondary core for zero reading, continue turning the core in the same

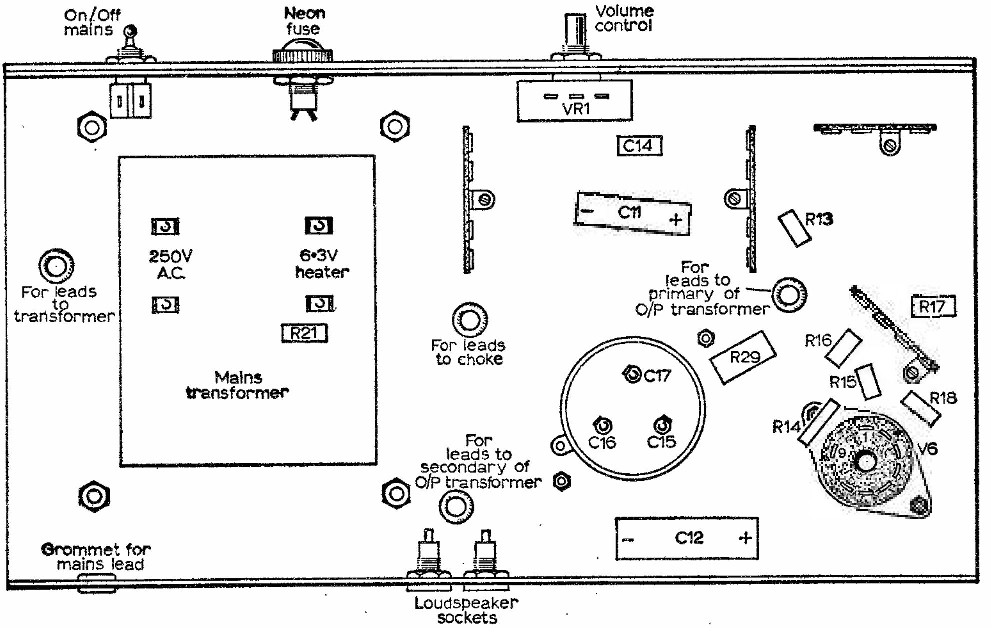


Fig. 3: Underside view of the audio amplifier and power supply unit, showing component layout.

COMPONENTS LIST

Resistors:

R1 56kΩ
R2 1·5kΩ
R3 82Ω
R4 1·5kΩ
R5 150Ω
R6 47kΩ
R7 10kΩ
R8 68kΩ
R9 100kΩ } Matched
R10 100kΩ } to 1%
R11 100kΩ
R12 47kΩ
R13 4·7kΩ
R14 47kΩ
R15 1MΩ
R16 680kΩ
R17 150Ω
R18 220Ω
R19 10kΩ
R20 1·5kΩ 3W
R21 50Ω 1W
VR1 0·5MΩ Pot.

All ½ Watt 10% unless otherwise stated.

Capacitors:

C1 1000pF ceramic
C2 1000pF ceramic
C3 2000pF ceramic
C4 1000pF ceramic
C5 1000pF ceramic
C6 1000pF ceramic
C7 1000pF ceramic
C8 0·1μF paper 350V working
C9 180pF 10% silver mica
C10 1000pF 10% silver mica
C11 8μF 350V Electrolytic
C12 100μF 25V
C13 0·01μF paper 350V
C14 0·1μF paper 350V
C15 50μF }
C16 50μF } 350V Electrolytic
C17 50μF }
C18 1000pF ceramic
C19 2000pF ceramic
C20 2000pF ceramic
C21 1000pF ceramic
C22 100pF silver mica

Valves:

V1 (For 'Tuner Heart') ECC85
V2 EF80
V3 EF80
V4 EF80
V5 EB91
V6 ECL80

Inductors:

I.F.T.1 Ift. 11/10·7 }
I.F.T.2 Ift. 11/10·7 } Denco (Clacton) Ltd.
I.F.T.3 PDT 1/10·7 }

Tuning Unit

FMA1U3 f.m. tuning 'heart'
Henry's Radio Ltd.

Miscellaneous:

MR1: Any 250V type capable of giving at least 50mA. 4 B9A valve bases. B7G valve base with skirt and can. Coax sockets. Wander Plug Sockets. D.P. Toggle Switch. 1 Panel indicator lamp. 1 fuseholder. 18 s.w.g. Aluminium for chassis, etc. T1 Speaker transformer to suit ECL80. T2 Mains Primary Secondary 250V 50mA and 6·3V 2·5A. L1 10 Henry Choke.

direction and the meter reading should go beyond zero. Reverse meter leads to check this. Now readjust secondary core for slight reading (approximately 0·5V) above zero.

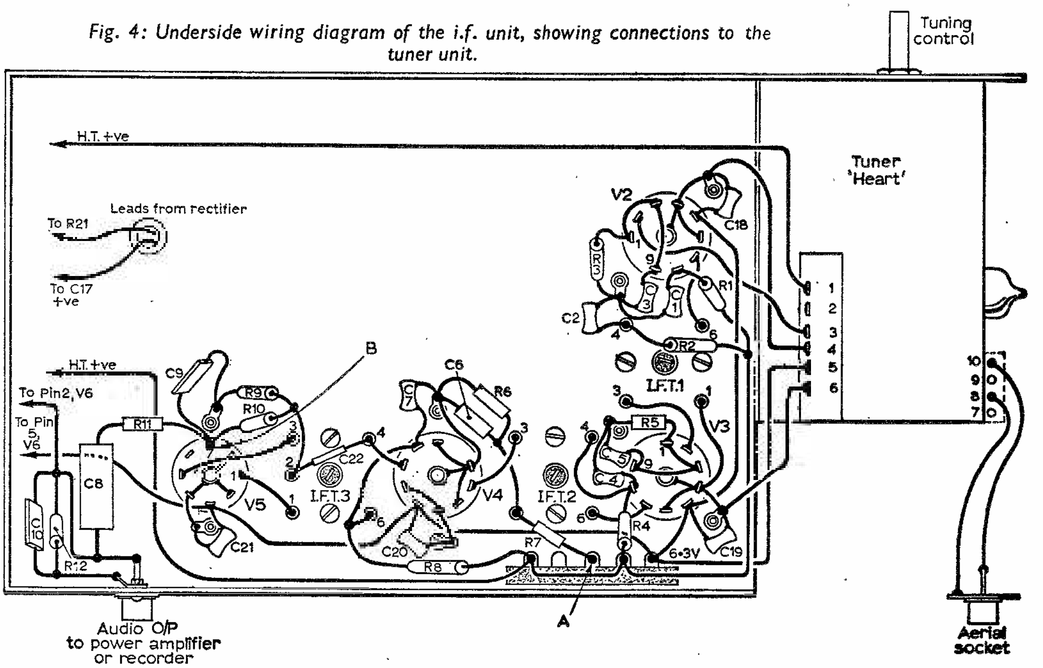
10 Repeat step 8.

11 Readjust the secondary core to *zero.*

This completes the i.f. and discriminator alignment.

12 An aerial should now be connected (a 5ft. loft mounted dipole with a 75Ω coax feeder is ideal), and the tuning control slowly scanned to pick up the three BBC stations. The tuning heart should require no tuning, but a little trimming on the dust cores and trimmers should soon bring in the stations long and clear with little distortion.

Fig. 4: Underside wiring diagram of the i.f. unit, showing connections to the tuner unit.



A CONTROL NOTE ON THE HAWAIIAN GUITAR

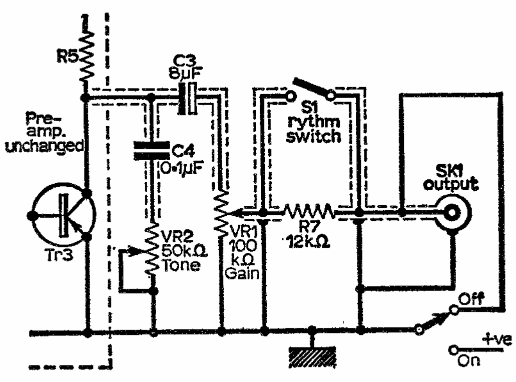
(Described in the June and July issues)

by I. J. Kampel

The control circuit of the Hawaiian Guitar, as shown on the original blueprint, was specifically designed for use with low output amplifiers or low sensitivity amplifiers. As will be seen the output is taken from a potential divider network, only 5K out of a total of 73K being tapped for gain control. The reason for this was that less output than that given by this network would never be required in the above circumstances. If, however, you have a good amplifier, with a reasonably high input sensitivity (minimum is 500mV approx), the output, let us say, in excess of about 1½ watts, then full control will not be experienced, and gain control must cover total resistance from Tr 3 collector line to ground, allowing output to be cut right off, where previously there was a minimum level of cut off.

If, therefore, any readers have built the guitar and found that no control is obtained from the control circuit, then the circuit adaption below should be made. Note there is also a different method of tone control which is more effective and subtle than the previous method.

Note that there are some component value changes, but there is no change to the Veroboard pre-amp itself. Join C4 to board at G7 by a wire, this component flying by pot.



Competent Constructors

I HAVE followed closely the criticisms of my letter in the May issue of PRACTICAL WIRELESS. If those people who wrote them are a cross-section of the constructors today, I am horrified. It just typifies the state of apathy that exists now amongst certain sections of constructors.

Surely the attitude, "if it works, it will do" cannot be tolerated. With the present rate of development in the electronics industry, it seems unbelievable that "home electronics" should stagnate.

I can see that with the present rate of development, the transistor (never mind the valve), in the canned form as we know it now, will be obsolete within ten years. So why do we have to get bogged down with components and equipment designed over 25 years ago. Let's see a little life and vitality amongst the readers with a keen eye on the future, not the past.

Finally, in reply to H. T. Kitchen's letter in the August issue. The answer to your problem is, cost of operation, speed of operation, performance at high speeds and availability of spares.

R. A. Packer.

Sevenoaks,
Kent.

C.W. Standards

I AM writing with reference to F. Taylor's letter on C.W. Standards (PRACTICAL WIRELESS, August, 1965).

In my opinion, any person (ex-W.T. Operator or not) who is incapable of memorising a few simple formulae, does not deserve his ticket.—I say this of course, with all due respect.

Mr. Taylor mentions several lads of 16 years who have passed the necessary tests but still do not meet the present-day standards. Obviously, this cannot be true; if *they* had the ability to pass the R.A.E. *and* the Morse test, then they must know how to operate both the key and their equipment.

One last point: "speed is not important, quality is!"

C. Walker.

Woodhouse Park,
Manchester, 22.

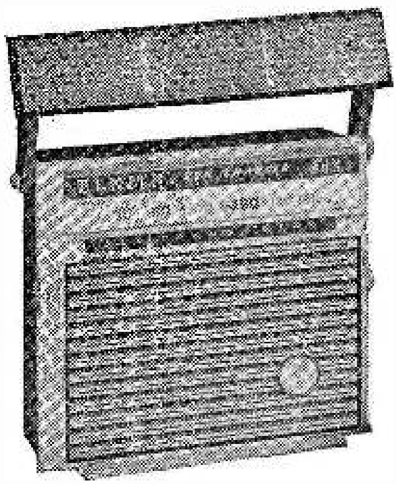
NEWS AND..

DIRECTION FINDERS FOR KOREAN FISHERMEN

Ten new Korean deep-sea fishing vessels now under construction in France will be fitted with Raytheon automatic direction finders.

The electronic navigational aids cover the marine and aviation beacon bands, the consolan band and the standard broadcast band, together with marine communications frequencies. The Raytheon model 358 direction finders can be used to take a rapid round of bearings to pinpoint a vessel's position or they can be used to continuously "home" on the radio signal of another vessel or radio beacon at a distant port.

ZENITH INTRODUCE SUN-POWERED RECEIVER



From the United Mercantile Company Ltd., comes the Zenith Royal 555 sun-powered 8 transistor receiver. This set plays directly from battery power, plugs into a mains socket so that the internal nickel-cadmium batteries are charged automatically whether the radio is playing or not, or plays on power provided by direct sunlight that hits the solar cells mounted in the radio's handle. It covers long and medium waves and incorporates Vernier tuning.

Measuring $4\frac{5}{8}$ in. high x $5\frac{5}{32}$ in. wide x $1\frac{7}{8}$ in. deep, the Royal 555 comes complete with carrying case, earphone attachment, batteries and a.c. battery charger line cord. Price: £41 15s. 6d.

NEW HOME RADIO CATALOGUE

Home Radio (Mitcham) Ltd., have recently published a new 1965 edition of their comprehensive catalogue. It comprises 200 pages and is fully illustrated, covering a very wide range of electronic components and equipment.

Coil formers, crystals, slow-motion drives, plugs, communications receivers, panel lights, insulators, microphones and hi-fi amplifiers are but a few of the items listed.

A wide range of valves and transistors with their prices is given in the No. 1 Catalogue Supplement which is free with the catalogue.

Copies may be obtained for 7s. 6d. plus 1s. post and packing, and every copy contains 5 coupons each worth 1s. when used as directed.—Home Radio Ltd., 187 London Road, Mitcham, Surrey.

CUTTER AND WIRE STRIPPER

Multicore Solders Ltd., of Hemel Hempstead, Herts., announce a new addition to their range of accessories. It is the Bib Model 8 Wire Stripper and Cutter.

Model 8 if fitted with a selector gauge which can be preset for any s.w.g. between 12 and 26. Retail price is 7s. 6d.

.. COMMENT

TV PICTURES FROM MARS

Pictures of the surface of the planet Mars, taken by the Mariner IV spacecraft in July were transmitted 134 million miles back to Earth by a 10W transmitter using binary digital coding. Owing to the sinal/noise ratio limitations, the TV pictures, generated at a high information rate of 10,700 bits/sec. were recorded firstly on magnetic tape then played back for transmission to earth at a slow rate of 8.33 bits/sec. Consequently, a picture generated in less than a minute required nearly 8 hours to transmit to earth.

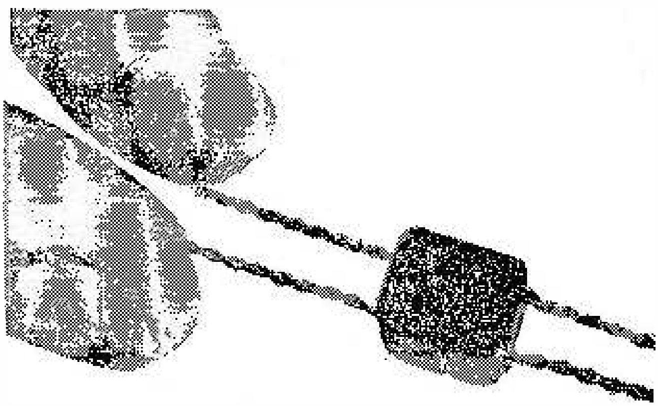
Each transmitted picture was composed of 40,000 elements arranged in 200 lines. The tonal scale of the picture from black to white was quantized into 63 levels and the level for each element was transmitted to Earth by a 6 bit code.

POWER FROM LASER BEAMS

Devices which have to operate in situations which do not allow the use of electric cables, i.e. in nuclear reactors can now be powered by the use of laser beams. This is a new technique developed by the National Aeronautics and Space Administration of the USA.

A laser beam, produced by stimulated emission in a gallium arsenide p-n junction, is directed at the remote apparatus, where the light energy is converted back into electrical energy by a gallium arsenide photodiode. The electric current resulting from this is then used to power the apparatus.

MULLARD SILICON BRIDGE RECTIFIER



Complementary to the recently introduced Mullard harmonious range of audio transistors this new silicon bridge rectifier, type BY122, is intended for use in the power supply sections of mains-operated equipment.

It is rated for an r.m.s. input voltage of 42V and gives a rectified output of up to 50V at a current of 0·5A.

The BY122 measured only 12 x 10 x 7mm and has an insulated plastic encapsulation.

It's Not Too Hard If You Try

FROM time to time I read in your correspondence columns the groans of those would-be amateur operators who want things the easy way—i.e. no examination.

Last September and, in complete ignorance of everything relating to the transmitting side of radio, I decided to read for the R.A.E. This I sat on May 7th last, and I am the very pleased (and very surprised) possessor of a pass-ship.

You will probably ask, "What's so unusual about that?" To which I must reply "Nothing except that next birthday I shall be 63 and due for the scrap-heap two years afterwards!"

I feel that if types like myself can succeed, the modern youngster should float through the exam with ease. Let them take heart and "have a go". They will find it not too difficult if they are prepared to work.

For myself—now for the Morse test and an Amateur (sound) licence A.

R. S. Welford.

Sunbury-on-Thames,
Middlesex.

Correspondents

I WOULD like to hear from readers, in any country, who have an interest in radio and television. I will answer all letters received.

S. A. Ariyasena.

Sirisewana,
Nawagamuwa, W.P.,
Ranala, Ceylon.

I WOULD like to hear from readers in Great Britain or any other country who have an interest in short wave listening and who are of my own age (14). I will promptly reply to all letters received.

G. Newstead.

40 Kenilworth Court,
Warwick Road,
Coventry,
Warwickshire.

I WOULD like to correspond with other radio enthusiasts of my own age (13).

Edward Tweedly.

27 Orchard View Drive,
Kirkfieldbank,
Lanark, Scotland.

TAPE
TAPE
TAPE TERMINOLOGY
TAPE
PART THREE

by H. W. Hellyer

MODULATION

The variation of magnetism on the tape produced by the application of signals.

MODULATION INDICATOR

There are three principal types, (a) neon, (b) magic-eye and (c) meter. Type (a) uses the striking voltage of a neon to indicate peaks and/or the preset "normal" modulation level. Type (b) has a number of variations of display but fundamentally is as described above (see Magic Eye). As the electron beam is virtually inertialess and the signals are applied via a rectifier to a control electrode, this device responds to modulation peaks, and is quick responding.

Meters take three main forms, (a) average-level indicators, (b) VU meters and (c) PPM meters. (a) is simply an ordinary meter fed by a bridge rectifier, and is sluggish in action. Having no advantage over the magic eye, which is also cheaper, it is now seldom used.

The VU or Volume-Unit meter is widely used in the U.S.A. and has been incorporated in a number of semi-professional tape recorders in this country. It has a long-term response to signals of varying waveform, and the associated circuitry is designed to give a slow indication, which is simple to measure but which does not respond readily to peaks.

PPM or Peak-Programme meters are most widely used professionally, having a fast rise-time to signal peaks and a slow falling-off. The expense of the movement and associated circuitry makes them little used by manufacturers of medium-priced machines.

Meters used for the above three applications are almost invariably moving-coil.

MODULATION NOISE

The granular nature of the tape coating can give rise to very small variations of flux which cause signal variations. This is also accentuated by poorly demagnetised tape, and should be checked by playing through an unmodulated tape and measuring the output level compared with that from a measured signal.

Modulation noise should be below 40—50dB that of the signal with general purpose tape. In bad cases this noise is heard as a "hiss". It is most annoying in the mid-aural range (1 to 5Kc/s).

MONITORING

Sampling the signal being recorded (and in certain cases, while being replayed). Method employed in cheaper domestic machines is a simple socket, usually marked "Hi-Z Output" or "Monitor", connected via a limiting resistor to a signal point just prior to the feed to the recording head.

A more effective method is the sampling of the recorded signal by means of a second replay head, (or by switching of the existing separate playback head), this signal being amplified and equalised by a separate amplifier. Better class tape recorders use both methods, employing a Comparator Switch which allows direct comparison of input to the head and output from it.

The term "Monitoring" is sometimes applied to tape position or modulation level indication to demonstrate continuity of the checking process.

MONAURAL

A term used to indicate single-track recording. Often challenged by hi-fi enthusiasts who object on the grounds it implies "listening with one ear". The term, however, is sufficiently self-explanatory. Monophonic is the preferred description of single-channel recording.

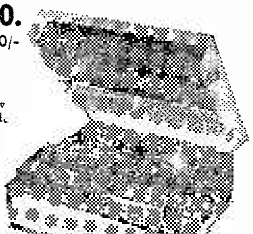
MOTORS

Four types of motor are generally employed in tape recording machines, for different purposes.

(1) Shaded-pole. Type of induction motor which is reliable and inexpensive but relatively inefficient. Principal drawback is the effect of a change of loading upon its speed. "Shading" consists of notching the pole face of the stator (four poles being the usual construction) and inserting a copper ring in the notch. This provides a movement of magnetic flux across the pole faces and affects starting. The number of poles determines motor speed. Thus, a four-pole motor (single-phase), used on 50 cycles/sec mains supply tends to rotate at 1500 revs/min, while a two-pole shaded motor runs at twice this speed. This type of motor is widely used as a spooling motor, and as a capstan motor on cheaper decks, where light

26½gn TAPE RECORDER for ONLY £19.10.

carr. 10/-

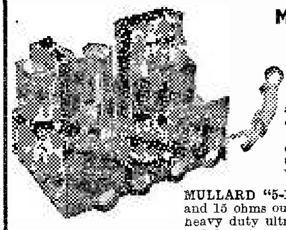


Bargain of the Year Offer -Cancel Export Contract

Famous manufacturers brand new unused and factory tested 2 speed. 3¾ and 7½ i.p.s. twin track tape recorder 3 Watt output. Tape position Rev-counter, fast forward and rewind, takes 7" reels, mike and gram input. Straight through amplifier facilities. Output sockets for e.x.t. speaker, monitor or external amplifier. Super-imposed switching magic eye recording level and mains neon indicator. Volume and tone controls 7"x4" speaker. Attractively styled cabinet, with detachable lid mike and reel storage facilities. AC 200/250 volts operation. Complete with crystal mike, tape spare reel and screen lead, etc.

MULLARD "3-3" & "5-10" HI-FI AMPLIFIERS

3 ohm & 15 ohm output



"3-3" Amp. 3 valve, 3 watt hi-fi quality at reasonable cost. Bass Boost and treble controls quality sectional output transformer, 40 c/s-25 kc/s + 1 dB, 100mV for 3W, less than 1% distortion. Bronze escutcheon panel **Complete Kit only £6.19.6.** Carr. 5/- Wired and tested **£8.10.0.**

MULLARD "5-10" AMPLIFIER. 5 valves 10W 3 and 15 ohms output. Mullard's famous circuit with heavy duty ultra-linear quality output transformer

Basic amplifier kit price **£9.19.6** Carr. and Ins. 7/6.
Ready built 11½ gns.

CONTROL PANEL KIT. Bass, Treble and Volume controls **with 4-position** selector switch for radio tape and 11in. x 4in. escutcheon panel.

AMPLIFIER KIT AND CONTROL PANEL KIT, £11.19.6. Ditto, ready wired. £14.19.6.

2-VALVE PRE-AMP. UNIT. Based on Mullard's famous 2-valve (2xEF86) circuit with full equalisation, with volume, bass, treble and 5-position selector switch. Size 9x6x2¼in. Complete Kit **£5.19.6, carr.** 3/6. Ready Built **£7.19.6.**

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By leading British Manufacturers

Professional Grade DOUBLE SIDED

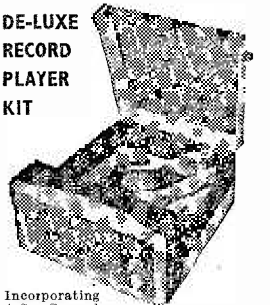
(each side coated) 5¾-in. reels only.

Special Price Offer

1,450 feet (2 reels) **20/-** post free.

Ideal for the experimenter who wants to record both sides, and a good L.P. Tape for the enthusiast who wishes to record single side only.

DE-LUXE RECORD PLAYER KIT



Incorporating 4 Sp. Garrard Auto-Slim unit and Mullard latest 3 watt printed circuit amplifier (ECL 86 and EZ 80), vol., bass and treble controls, with 8" x 5" 10,000 line speaker. Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue-relief. Size 17½" x 16" x 8". A stylish unit capable of quality reproduction. Circuit and const. details 2/6 (free with kit)

COMPLETE KIT **£13.19.6**
Carr. and ins. 10s.

Illuminated perspex control panel escutcheon, 7/6 extra. Ready wired 30/- extra. Four contemporary mounting legs (6 or 13in.) 12/6 per set.

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Midget I.F.'s—465 Kc/s 9/16in. diam. 5/6
Osc. Coil M. & L.W. 5/3
Midget Driver Trans. 3.5:1....6/9
Midget Output Trans. Push-Pull—3 ohms..............6/9

Elect. Condensers—Midget Type 1 mFd.-50 mFd. **ea. 1/9,** 100 mFd. **2/-,** 12V.

Condensers 150 v. working: .01 mFd., .02 mFd., .03 mFd., .04 mFd. **9d.**; .05 mFd., .1 mFd., **1/-** .25 mFd., **1/3**; .5 mFd., **1/6,** etc.

Midget Tuning Condensers. J.B. "OO" 208 pF and 176 pF, **8/6,** ditto with trimmers, **9/6.** J.B. 220 pF and 105 pF conc. slow motion **10/6.** 365pF single **7/6.** Sub. min. ¾in. Dilemin 100 pF, 300pF 500pF, **7/-** each.

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Speakers: P.M.; 2in. Plessey 75 ohms **15/6.** 2½in. Continental 8 ohms, **13/6.** 7 x 4in. Plessey **35** ohms, **23/6.**

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6 VALVE AM-FM TUNER UNIT

Med. and VHF 190m-550m, 86 Mc/s-103 Mc/s, 6 valves and metal rectifier. Self-contained power unit, A.C. 200/250V operation. Magic-eye indicator, 3 push-button controls, on/off, Med., VHF. Diodes and high output Sockets with gain control. Illuminated 2-colour perspex dial 11½"x4", chassis size 11⅝"x4"x5¾".

A recommended Fidelity Unit for use with Mullard "3-3" or "5-10" Amplifiers. Available only at present as built-up units, aligned and tested ready for use.

This popular unit will be available in kit form within the next few weeks. Circuit and constructor's details, 2/6.

BARGAIN PRICE £12.10.0

Condensers—Silver Mica. All values 2pF to 1,000pF, **6d.** each. Ditto Ceramics **9d.** Tub. 450V T.C.C. etc. 0.001 mFd to 0.01 and 0.1/350V., **9d.** 0.02-0.1/500V., **1/-.** 0.25 Hunts 1/6, 0.5 T.C.C. **1/9,** etc., etc. Close **Tol. S/Micas**—10% 5pF-500 pF **8d.** 600-5,000pF, **1/-.** 1% 2pF-100pF, **9d.** 100pF-500pF, **11d.** 575pF, 5,000pF, **1/6.** **Resistors**—Full Range 10 ohms-10 meg. ohms 20% ¼ and ½W, **3d.,** ¾W, **5d.** (Midget type modern rating) 1W, **6d.,** 2W, **9d. Hi-Stab.** 5% ¼W, ½W, **6d.** (100 ohms-1 meg). Other values **9d.** 1% ½W, **1/6,** etc., etc.

Volume Controls—5K-2 Meg. ohms, 3in. Spindles. Morganite Midget Type 1⅛in. diam. Guar. 1 year. LOG or LIN. ratios less Sw. **3/-.** DP. Sw. **4/6.** Twin Stereo less Sw **6/6.** DP. Sw. 8/-. **Specials to order**

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ENAMELLED COPPER WIRE—¼lb. reels 14g-20g, **2/6;** 22g-28g, **3/-;** 30g-34g. **3/9;** 36g-38g, **4/3;** 39g-40g, **4/6,** etc.

JASON FM TUNER UNITS Designer-approved kits of parts. **FMT1, 5 gns.** 4 valves, **20/-. FMT2, £7.10.0.** 5 valves, **35/-. JTV MERCURY 10 gns.** 3 valves **22/6. JTV2 £13.19.6.** 4 valves, **28/6. NEW JASON FM HANDBOOK, 2/6.** 48 hr. Alignment Service **7/6.** P. & P. 2/6.

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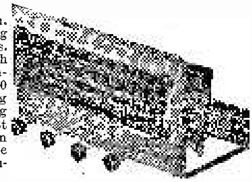
25/25v. 50/12v. 1/9; 8+8/450v. 4/6; 50/50v.100/125v. 2/-;32+32/275v.4/6. 8/450v. 4/350v. 2/3; 50/50/350v. 6/6 16+16/450v. 5/6; 60/250/275v. 12/6 32+32/450v. 6/6; 100+200/275v. 12/6

Est. 1949

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80. New 1965 Model **now available**



Three Waveband and Switched Gram. positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Phillips Continental Tuning Insert with permeability tuning on FM and combined AM/FM IF transformers. 400 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ x 6½in. Height 7½in. Edge illuminated glass dial 11½x3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250v. operation. Magic-eye tuning. Circuit diagram now available. Aligned and tested ready for use £13.19.6. Carr. & Ins. 7/6

Comp. with Tape. O/P socket, ext. spk'r and P/U sockets and indoor F.M. aerial and 4 knobs—walnut or ivory to choice. 3 Ω P.M. Speaker only required. Recommended Quality Speakers 10" Rola, 27/6. 13½" x 8" E.M.I. Fidelity, 37/6. 12" R.A. with conc. Tweeter, 42/6. Carr. 2/6.

BONDACOUST Speaker Cabinet Acoustic Wadding (1in. thick approx.) 18in. wide, any length cut, 2/3 per ft., 6/- per yard. **TINNED COPPER WIRE,** 16-22g. 2/6 ½lb. **ERSIN MULTICORE SOLDER.** 60/40 4d. per yard. Cartons 2/6 etc.

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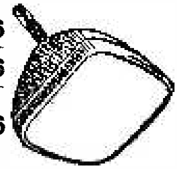

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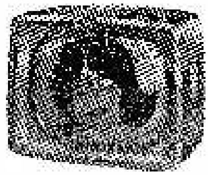

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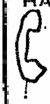

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(3) A synchronous or non-synchronous induction motor. Also a hysteresis type with capacitor start, whose speed depends on loading, making it particularly suitable for spooling purposes but not for capstan drive, where constant speed is required.

Both hysteresis types lend themselves to speed switching and can be reversed. An example of switching for speed variation is shown in Fig. 11.

(4) D.C. Motor. This type is used in battery portables. It is usually series-wound to obtain the necessary high starting torque and needs governing to maintain constancy of speed. Several methods of governing are used including the relatively simple centrifugal switch, directly controlling current, and transistorised control circuits, using the switch as a sensor to control bias to a transistor circuit through which the motor current flows. See Fig. 12.

Principal drawback with d.c. motors is the stringent need for suppression to eliminate noise. Complicated circuits are employed in better-class machines, and the mechanical layout is carefully designed for minimum interference radiation.

A recent German design has been announced, but is not yet in production, eliminating the commutator by using a four-transistor circuit, and thus developing a brushless motor. A high frequency centrifugal transistorised governor is suggested for speed control.

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This is a low-output, low or medium impedance transducer with an omni-directional or cardioid response, according to construction. Its rugged construction makes it particularly suitable for field work, and careful construction can make full use of its fairly wide frequency range. Also known as "Dynamic Microphone". See Microphones.

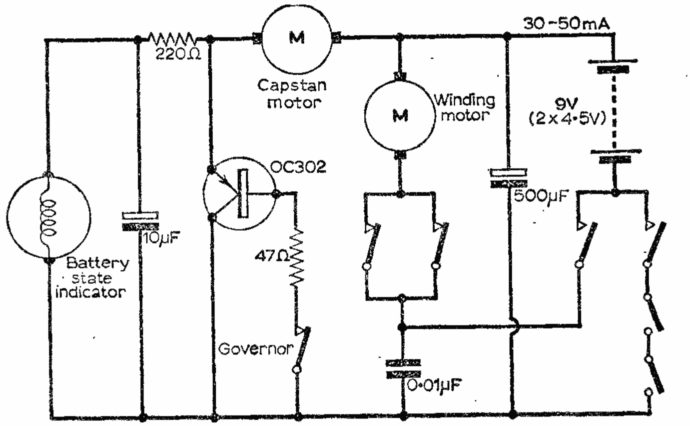


Fig. 12: D.C. motor control circuit as used in Stuzzi Magnette. Collector current of transistor limits motor current when governor closes, applying base bias. (Battery state indicator is moving coil device with mechanical indication).

MOVING COIL METER

Type of meter used as a modulation indicator or output meter. See Modulation Indicators.

MOVING COIL LOUDSPEAKER

The general construction of loudspeakers employs the moving coil technique, whereby a speech coil wound on a former to which the cone is attached is suspended in the field of a magnet (usually a permanent magnet). The interaction of the fields of the magnet and the coil, energised by the audio signal, causes movement of the cone, displacement of air, and sound.

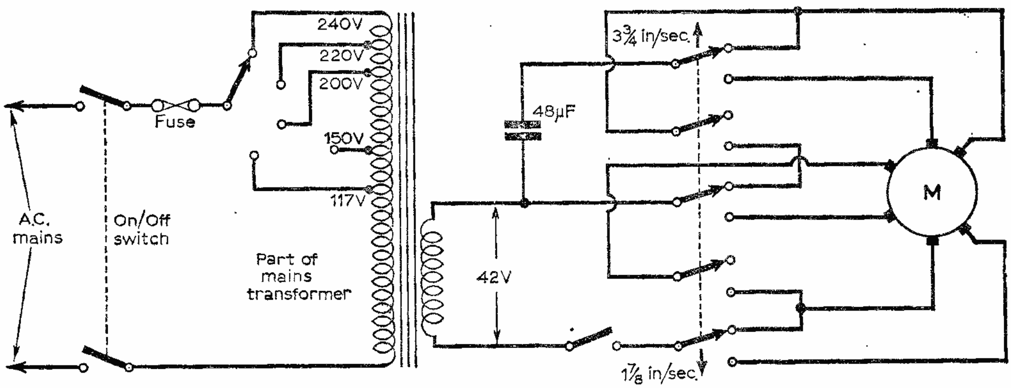


Fig. 11: Speed selection by switching of coils of motor field winding in combinations of series and series-parallel, as used in Grundig TK25 and similar machines.

MYLAR

Trade name for polyester film based tape. Special features are its strength (compared with previously used paper and acetate materials) and its stability with respect to temperature and humidity. See also Tape.

MIL

One-thousandth of an inch. Term often used in reference to head gaps, etc.

MULTIPLAY

Term used to denote crosstrack recording. Signals recorded on one track are re-recorded on another and can be mixed with a previous signal and an incoming signal. The system lends itself to many variations, the mixing process overcoming the inherent re-biasing effect of super-imposition. See Crosstrack and Sound-on-Sound.

N.A.R.T.B.

The standard used in the U.S.A. Characteristics for tape recording and replay and tape manufacture have been drawn up by the National Association of Radio and Television Broadcasters (also abbreviated to NAB).

The Magnetic Recording Industry Association (MRIA) has an active committee working on these standards and their correlation with international standards. See Equalisation and Standards.

NEON INDICATOR

Form of modulation level indicator used in some domestic models. Modulation level can be preset for the indicator to light at overload or extinguish beneath desirable recording level. A combination of these techniques can give an effective visual indication of recording level. See also Modulation Indicator.

NOISE

Unwanted signals. Background noise can be caused by mechanical or electrical defects or faulty tape. It is most troublesome in the mid-frequency region (1 to 5kc/s) and is thus difficult to filter out. See also Modulation Noise.

A prevalent cause of noise is a magnetised head and de-gaussing should form a part of regular maintenance of tape recorders.

OUTPUTS

The output from a tape recorder can take several forms. Domestic machines usually employ loudspeaker output, with extension loudspeaker facilities, for 3-7Ω and/or 15Ω impedance matching, and a high impedance output for application to an external amplifier or headphone monitoring. See also Monitoring.

Additional forms of output used with better machines are line output and PA output. Line output usually provides a signal level of 0·1 to 1V and matches from 100,000Ω to 1MΩ. Used where matching to a number of loudspeakers is required.

Cathode follower output allows matching at a lower impedance and with longer cable runs.

PA (public address) line output is a distribution system, usually at medium impedance and with 50-100V output, occasionally greater. Higher voltage outputs usually employ separate amplifiers and tapped transformers are used for standard PA output to give distribution over an extensive installation.

PINCH WHEEL OR ROLLER

Free-running pulley, which may be of rubber, composition or, in rare cases, metal. Used to hold the tape in contact with the revolving capstan spindle to obtain constant speed of tape transport. Adjustment of pinch wheel pressure is sometimes provided and can be important.

Too little pressure causes tape slip and irregular recording or playback. Excessive pressure can cause the tape to "ride" up the capstan, impairing the effective azimuth adjustment, may cause flutter due to back torque of the feed spool in certain machines or wow when the flywheel is belt driven and a certain amount of slip is possible. See also Capstan.

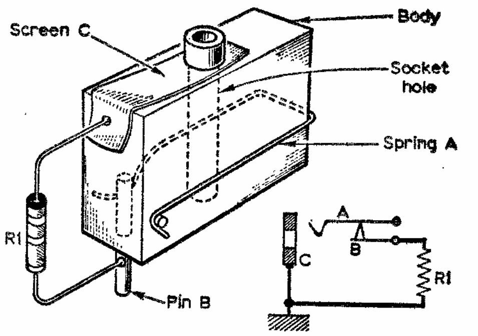
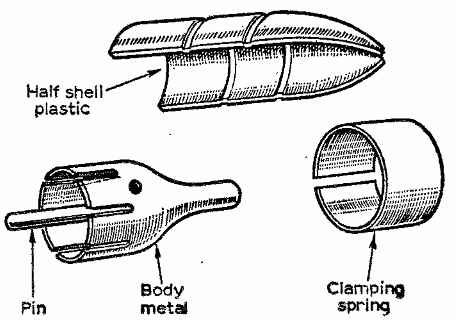


Fig. 13a: Phono socket of simple type, with spring wire contacting plug pin when this is inserted in socket hole. This action pushes the spring A from the contact B, removing the short circuit. Electrical circuit is shown inset.

Fig. 13b: Exploded view of typical phono plug. Spring clamp holds two halves of plastic shell to plug body. Pin is insulated from body.



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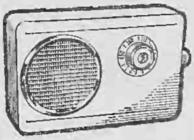
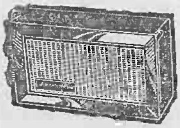


"Transona Five" size 6½ x 4¼ x 1½in. approx.



"Pocket Five" Size 5½ x 1½ x 3¼in.

Covers M. and L. Waves and Trawler Bands, a feature usually found in only the most expensive radios. On test Home, Light, 208, and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and new type fine tone super dynamic 2¾in. speaker. attractive plastic cases with red grille.

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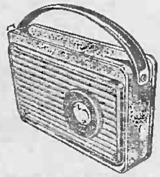
TRANSONA 6

● 8 stages—6 transistors and 2 diodes



This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. speaker makes listening a pleasure. Ferrite rod aerial. Many stations listed in one evening, including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6½ x 4½ x 1½in. (Uses PP4 battery, available anywhere.) Carrying strap 1/- extra.

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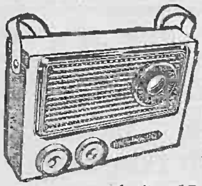

● 9 stages—7 transistors and 2 diodes

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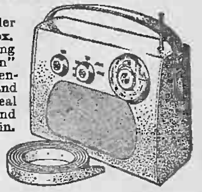

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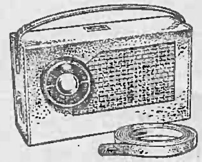

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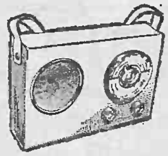

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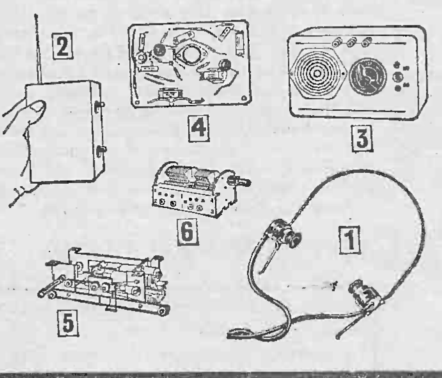

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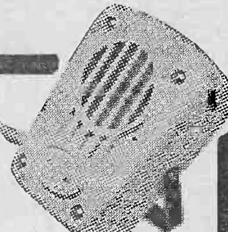

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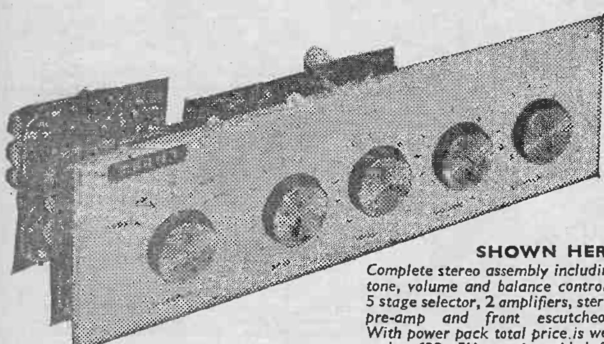

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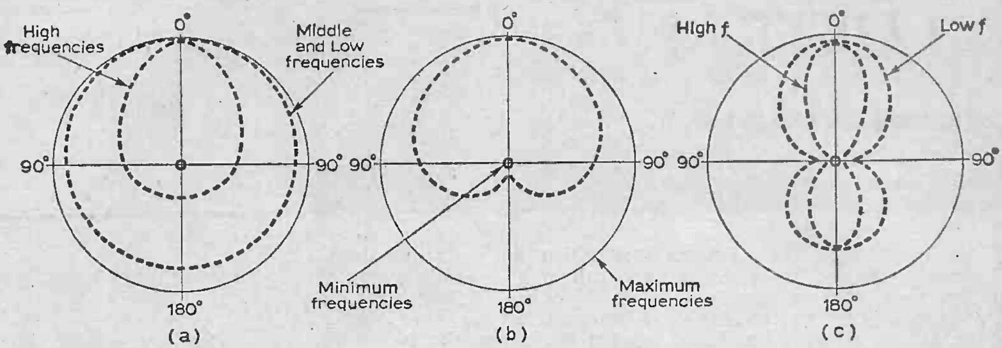


Fig. 14: Typical polar diagrams. (a) Moving coil microphone, showing virtually omni-directional response at low and mid-frequencies, more directional response at higher frequencies. (b) cardioid response. and (c) figure-of-eight response of ribbon microphone.

PARALLEL TRACK

Method of recording or replaying two tracks simultaneously, mixing the outputs during replay or using separate amplifiers for special effects.

PAUSE CONTROL

Device used to move the pressure roller from the capstan temporarily to stop tape drive while leaving the machine in the record or play function. Often associated with auxiliary braking mechanisms. Widely used for editing and in dictation work.

Better-class machines also provide for the temporary inhibition of erase and bias supplies during recording when the Pause Control is operated.

PERSONAL LISTENING

Method of allowing headphone connection, usually with muting of internal loudspeaker. See also Monitoring.

PHONO PLUG

Small type of coaxial connector widely used in cheaper machines and found in many of the American models, even of the professional variety.

PHONO SOCKET

Socket to receive the phono plug. Special feature is often the short-circuiting device used to prevent noise pick-up and imbalance of input stages. See Fig. 13.

PLINTH

Shallow box-like stand used as a support for a tape deck when this is combined with other equipment.

POLAR DIAGRAM

With reference to microphones: a curve traced around a microphone when a source of constant sound output moves around so as to produce a constant output from the microphone to its amplifying equipment. In the case of an omni-directional microphone this curve would be a circle.

A typical moving-coil microphone polar diagram might be heart shaped, i.e. cardioid, and that of a ribbon microphone figure of eight. Polar diagrams can also be traced for loudspeakers, plotting sound output for constant power.

In all cases the frequency at which the tests were made should be stated. See Fig. 14.

POLYESTER

A plastic backing widely used in tape production. See also Tape.

PREAMPLIFIER

Input stage of a tape recorder carefully designed for the best signal-to-noise ratio to handle the very small signals (down to $2\mu V$ in a typical machine). Also used to denote the first stage of amplification during playback.

A separate preamplifier, with sometimes an equalisation network and bias supply, is referred to as a tape preamplifier and may be a self-contained unit, often with its own power supplies. Mixing facilities can also be added.

PRE-EMPHASIS

Method of boosting the high-frequency content of the signal to be recorded to compensate for head and tape losses. The amount of pre-emphasis is important to preserve correct signal-to-noise ratio. Too much boost will cause overloading, requiring reduction of the modulation level and hence a poor S/N ratio.

See also Equalisation. Known also (principally in the U.S.A.) as pre-equalisation.

In practice some measure of low-frequency boost may also be employed in the recording process to reduce the effect of hum pick-up, which would be increased if full low-frequency boost was applied during playback.

A tape recorded with no low-frequency boost (as on many professional machines) and replayed on a domestic machine would sound shrill and lacking in bass. Hence the need for common equalisation standards—still, we regret, being negotiated.

TO BE CONTINUED

A COMMENTARY BY HENRY

PRACTICALLY WIRELESS

No. 14 On turning Pro.

EACH month, the Editor receives letters from eager readers who want to turn pro. This looks an easy way to earn a living, as well as being fun. Let's throw up the nine-till-five clerkery and join the telly-boys' rat-race.

Before telling the boss what you think of him and rushing home to pack your toolbox, take a few words of well-meant advice from one who has spent his working life in the dubious field of radio service. Dubious, for it attracts to its ranks numbers of get-rich-quick amateurs (or worse, tax-evading, part-time professionals.

First, the pros. It is true that there is a great deal of pleasure in doing a job that awakes your interest. And in certain sectors of the trade there are fairly good rewards. The "perks" vary from an unlimited use of the firm's van to useful discounts on radio, electrical and audio goods. Except with firms that are hardly worth working for, there is no rigid timekeeping for the field engineer: no clocking on and off. And the nature of the work usually ensures that there'll be plenty of overtime.

But the cons can outweigh the pros. That last point, overtime for example. In most trades it is possible to reckon on a few hours regularly. Service work means that we are at the beck and call of a demanding public. Sets have a habit of breaking down just as we are locking up the workshop. The telephone becomes a hated incubus. The clock is a hard taskmaster.

Telling the boss what you think of him.

It is all very fine whiling away a wet Saturday on Uncle George's pre-war special, but hardly economic if you reckon the true worth of your labour. And in business it is labour charges that make the radio service bills so provocative to those types that dash off protests to the Editors of local papers.

Further: Uncle George, as he tips you a packet of fags, congratulates you on getting the old set going. In the cold world of business, it is more likely that the customer will sniff disparagingly because the quality of the programme does not satisfy his taste. This is part of a well-known "customer-ploy"; preparing the ground for a delaying action when the invoice is submitted.

There are various return volleys that come under the general heading of "Servicemanship" and need not occupy us here. What will occupy us, painfully, is the difficulty in dealing with sets we've never even heard of and for which neither service information nor spares may be available.

While it is possible, privately, to turn down work of this nature, it becomes harder when the bloke with the dubious Oriental receiver is also your best customer for light fittings, or has just had his Neo-Regency Super Stereo-Gram repaired.

The problem of obtaining spares is made worse when the set we are doing is a well-known make, but the manufacturer, for reasons of his own, fails to fulfil your urgent order. He'll ignore your letters and make vague promises over the telephone. But just you try doing the same to your customer.

Doing a job that awakes your interest.

"What! A fourpenny knob for a Popular Ten", he will protest. *"You should keep such things in stock."* Useless to argue that if you kept spare knobs for all the sets you handle your capital would be tied up and you'd have difficulty opening the storeroom.

And this business of stock supplies brings me to one of my pet aversions. This is the practice of service engineers doing a few jobs in their spare time. From any point of view, it is sheer dishonesty. They pay no tax on the income thus derived, often they make use of their employer's vehicle and test gear, and there are often doubts about the source of the spares they use.

I've nothing against what a colleague in the trade calls "the kitchen-table amateur". Although he sneers, it is obvious that many of us who spend our time servicing also enjoy pottering in our spare time—usually with some special aspect, such as hi-fi work, ham radio or closed-circuit TV. It is one of the reasons that so many professionals read PRACTICAL WIRELESS; for the type of helpful article they would never find in their trade magazines.

Even if they do pretend that they only came across the copy by accident, and had nothing better to do than read it!

FOR THE BEGINNER

A BEAT FREQUENCY OSCILLATOR

Add-on B.F.O.

FOR TRANSISTOR S.W. SETS

by A. J. McEvoy, B.Sc.

THE transistor has by now secured its position in the short-wave field and increasing numbers of kits and commercial sets feature some coverage below 1·6Mc/s.

However, some owners, especially those with an interest in amateur transmissions, will be frustrated to find that their new portables, while very satisfactory for a.m. transmissions, are incapable of reproducing s.s.b. or c.w. signals.

This is because when tuned to a c.w. signal the i.f. stages of the receiver are passing an unmodulated waveform, i.e. a sine wave of constant amplitude. It follows that the diode detector, which responds to variations in amplitude, will not produce an audio signal.

SSB and CW

On s.s.b. an asymmetrical i.f. signal is passed to the detector, so that the output from it is unintelligible. The device to be described enables both these modes of transmission to be resolved.

On c.w. it injects into an i.f. stage a sine wave at a frequency a little removed from the i.f. frequency: the two waves beat and, since the frequency difference is small, this beat frequency will lie in the audio range. The detector functions as usual and an audio tone is heard reproducing the Morse signal transmitted.

On s.s.b. a sine wave is injected at such a frequency as to replace the missing sideband; the resulting waveform appears symmetrical to the detector, so the audio signal is faithfully reproduced.

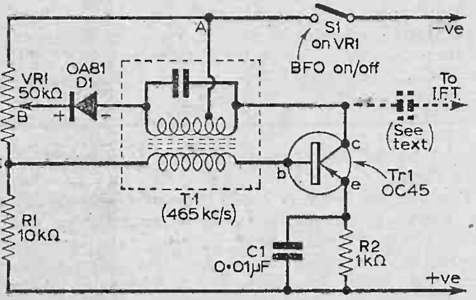
Obviously what is required is an oscillator whose frequency can be varied within close limits about the i.f. frequency of the set. Further, it must fit in the little space available in a portable receiver and for obvious reasons the current drain must be low. The unit finally produced fulfils these conditions, measuring only $\frac{7}{8}$in. x $\frac{7}{8}$in. x $\frac{5}{8}$in. and drawing 1 ma. at 6V.

Construction

The unit is built around an i.f. transformer (in the prototype one supplied by Eagle Products in their type H402 coil kit, but any miniature type for transistor use will do) which provides a circuit tuned to the desired frequency and a coupling winding for feedback.

Most b.f.o.s use a variable capacitor to control their frequency but in this case, aside from considerations of hand capacitance and "strays", this was ruled out by lack of space. Instead, using the fact that the capacitance of a semiconductor diode varies with the potential across it, a potentiometer is used as frequency control.

The unit is constructed on a piece of paxolin $\frac{7}{8}$in.



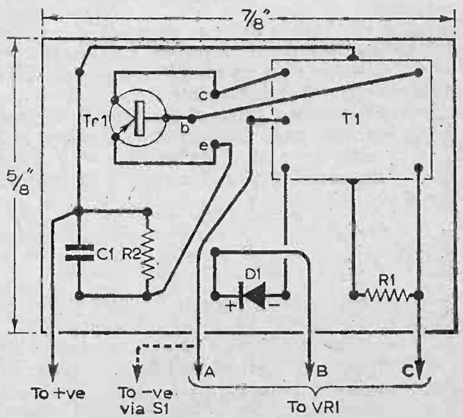


Fig. 1 (above): Circuit diagram of the b.f.o. unit.
Fig. 2 (right): Wiring of the unit on the paxolin board.

x $\frac{3}{8}$in. Holes for the components are drilled as in Fig. 2 and the components mounted. Connections are made on the reverse side of the board, using the leads of the components, and the wires for the power supply and the frequency control soldered in. Note the polarity of the diode—it is reverse biased—otherwise both it and the transistor may be damaged.

Fitting

The unit is now ready to be mounted in the receiver. The positive line is earthed, as is usual in transistor circuitry, and the negative line taken to a convenient point on the decoupled negative line on the set, i.e. the section supplying the current for the i.f. stages; this avoids cross-modulation by the audio stage.

The frequency control is mounted at a convenient point on the front panel of the set; the length of the wires required does not matter, since none of them is at signal frequency. The switch on the control is connected between the b.f.o. and the power supply and so switches the unit off when not required.

Adjustments

The set is now switched on and a station tuned in. If the b.f.o. is switched on and the frequency control rotated a whistle should be heard, dropping in pitch to a minimum, then rising again. The core of the oscillator coil is set so that the minimum occurs at the centre of the travel of the frequency control.

The injection of the b.f.o. signal into the i.f. stages of the set is as yet only by stray capacitances —if necessary a 5pF capacitor may be added—from the collector of T1 to the collector of the first i.f. transistor.

COMPONENTS LIST

R1	10kΩ	Tr1	OC45 or similar
R2	1kΩ	D1	OA81 or other semiconductor diode
VR1	50kΩ with switch		
T1	Miniature 465 kc/s. I.F.T.		
C1	0·01μF min. ceramic		

Operation

If the set is now tuned to the amateur bands the constructor may try to resolve a c.w. signal with the b.f.o. It will be found to make these audible at a frequency (pitch) which can be set by the b.f.o. control.

Similarly on s.s.b. one setting of the control will render intelligible the distorted signal otherwise received. It will be understood that a little practice is required to obtain maximum benefit from this addition, but the owner will quickly come to appreciate the increased scope of his set. ■

TWO-STAGE VFO

—continued from page 478

control, would be an added convenience.

To avoid instability it is usual to employ doubling between the v.f.o. and transmitter first stage. Therefore the r.f. choke is switched into the anode circuit of V2 for 7Mc/s and the 7Mc/s coil here is used when the transmitter first stage is giving drive to the p.a. on 14Mc/s or a higher frequency.

For 3·5Mc/s the r.f. choke is also used as an untuned load for V2. If the transmitter is of simple type and more drive is required on 7Mc/s it may be in order to switch to L2. If this is done find if any grid current appears at the p.a. with V1 withdrawn.

If so and the 7Mc/s drive is essential it may be helpful to enclose the bottom of the chassis of the v.f.o. by bolting on an aluminium plate. This should have several fixing points.

Normally the crystal stage of the transmitter can be driven at one half its output frequency and when it is used as a doubler in this way there should be no instability and ample grid current for the p.a.

Top Band

For 1·8-2Mc/s coverage omit L2 and the two-way switch. C1 should be changed to 250pF, 1%, and VC1 remains at 100pF. L1 can be wound on a cored former as described and has 55 turns of 33s.w.g. enamelled wire side by side. The core should be adjusted to obtain 1·8Mc/s with VC1 fully closed.

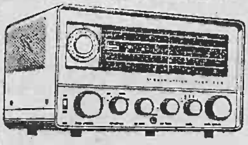
The output from V2 can be sufficient to drive the usual top-band low-power transmitter p.a., which generally has a 5763, 6BW6 or similar valve. Should more output be required on 160m than is available from V2 with the r.f. choke a coil broadly resonant at about 1·9Mc/s can be fitted here instead. ■

COMPONENTS LIST

B7G holder. Two skirted B7G holders with 2in. screens.
OA2; 6C4; 6AM6.

Silver mica capacitors:
C1 270pF 1%
C2 1000pF 1%
C3 1000pF 1%
C5 100pF
C7 100pF

Ceramic disc capacitors:
C4 2000pF
C6 2000pF
C8 0·01μF
C9 0·01μF
VC1 100pF short wave type. Dial or drive.
R1 100kΩ high stability
R2 2·2kΩ, 1W R3 5·6kΩ, 2W
R4 100kΩ, $\frac{1}{2}$W R5 47kΩ, 1W
R6 to suit h.t. available
Chassis 7x4x2in. or similar. Two $\frac{1}{2}$in. dia. cored formers. Wire, etc. RFC1, Osmor Radio QC1. RFC2, Eddystone 50mA, 2·5mH. 2-way rotary switch. Knob.



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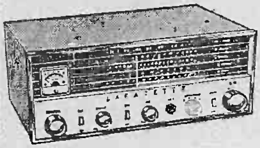

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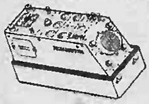

High quality Portable American Oscilloscope. 3in. c.r.t. T/B 3c/s-50 kc/s X Amp: 0-500 kc/s Y Amp: 0-2 Mc/s. Power requirements 105-125v. A.C. Supplied in "as new" condition, fully tested. £25. Carr. 10/-. Suitable 230/115v. Transformer, 15/6.

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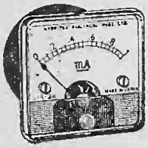

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		5mA	22/6	10V. DC	22/6
		10mA	22/6	20V. DC	22/6
		20mA	22/6	50V. DC	22/6
		50mA	22/6	100V. DC	22/6
		100mA	22/6	150V. DC	22/6
		150mA	22/6	300V. DC	22/6
50µA	32/6	200mA	22/6	500V. DC	22/6
100µA	29/6	300mA	22/6	750V. DC	22/6
200µA	27/6	500mA	22/6	15V. AC	22/6
500µA	25/-	750mA	22/6	50V. AC	22/6
50-0-05µA	29/6	1-0-1mA	22/6	150V. AC	22/6
100-0-100µA	27/6	1A. DC	22/6	300V. AC	22/6
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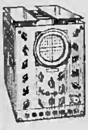

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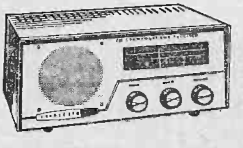

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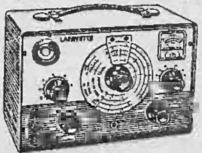

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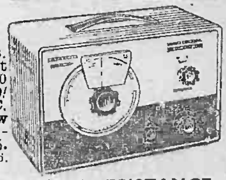

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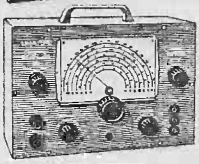

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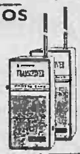

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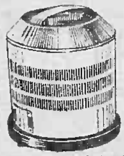

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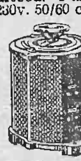

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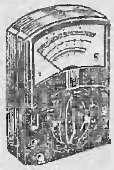

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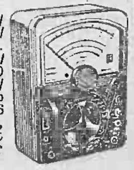

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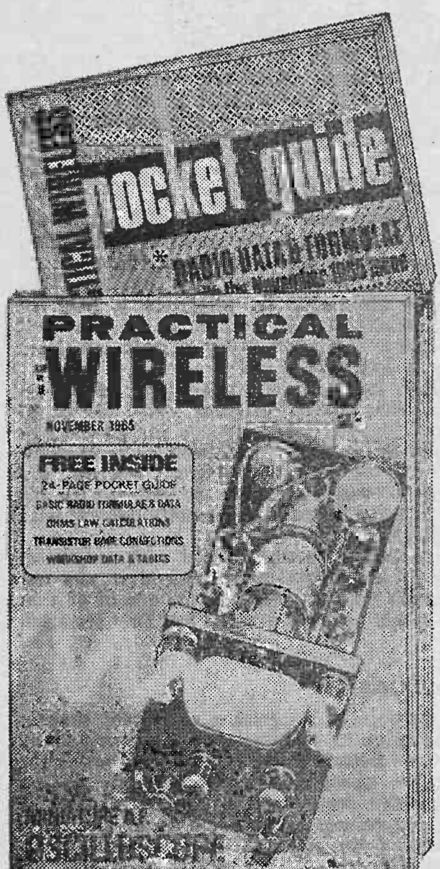

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by R. F. Farley, G3SSJ

A Thumbnail History of Radio

PART I: WIRE TO WIRELESS

SOMEHOW the word "radio" has never really replaced the word "wireless" with the British public as a whole. There are many who do not like to describe a thing by the use of a negation; however, to the telegraph concerns at the turn of the century it was an apt term for a new science. For wireless communication had been the dream of many of the telegraph pioneers who depended on costly cables across land and sea.

It is hard to realise in today's world, tintinnabulating with transistor radios and television, that scarcely a century has elapsed since James Clark Maxwell published what was to mark a turning point in scientific history.

Faraday Experiments

In 1860 Maxwell was sent to Cambridge, where Faraday was still working in his laboratory at the Royal Institution. The tireless energy with which Faraday had transcended his poor early environment was still with him. It was here that Faraday performed the experiments with coils and magnets which led him to the development of the induction coil, the transformer, generator and other electrical machines.

Maxwell became interested in Faraday's theories about the lines of magnetic force, and for a period of eight years worked on his own electromagnetic theory. During this time he was also working on the theory of gasses.

After a long series of experiments Maxwell reasoned that electromagnetic effects were due to waves, or "undulations" as he called them, in a medium which surrounded electric or magnetic bodies. Hitherto it was generally believed that the bodies acted on each other directly.

Now Faraday had observed that the plane of polarised light could be influenced by a strong magnetic field. From this Maxwell concluded that light consisted of electromagnetic disturbances in his hypothetical medium.

Maxwell's Paper

In December, 1864, Maxwell presented a paper to the Royal Society entitled "A dynamic theory of the electromagnetic field" in which he expounded his hypothesis for the existence of the medium to which he attributed two main properties. Firstly, "that the motion of one part communicates motion to the part in its neighbourhood". Secondly, "that this communication is not instantaneous but is progressive and depends on the elasticity of the medium as compared with its density.".

He concluded further that wherever magnetic force is exerted the medium is in a state of constraint; any change in the force would bring about a change in the medium, setting up wave motion. Maxwell devised a very accurate method of measuring both the electromagnetic field between two charged plates and of the magnetic field produced when the plates were discharged through a conductor. Since the magnetic field for any given charge is proportional to the velocity of the electricity flowing it was possible to determine the former by knowing the latter.

Electromagnetic Theory

From this experiment Maxwell deduced that the electricity was flowing at the speed of light. This would also be the speed of propagation of the electromagnetic waves postulated by him. In addition to the paper he produced a page of equations which, in one form or another, appear in most of our textbooks today but often without reference to Maxwell at all!

According to the electromagnetic theory all electromagnetic waves, including light, consist of alternating electrical and magnetic disturbances at right-angles to each other and both being at right-angles to the plane of propagation. Maxwell did not actually devise a generator or detector for his waves and seems to have been wholly content with his hypothesis.

Needless to say he was treated with scepticism by many of his fellow scientists and it was not until after his untimely death at the age of 48 that physical proof was provided by Dr. Heinrich Hertz.

Scientific Instinct

But meanwhile in America a significant chapter in the evolution of wireless was being written by Dr. Marlon Loomis, whose work today seems for some reason obscure. Being by profession a dentist, Loomis would seem to have missed his vocation, for he was a keen student of electricity and worked from scientific instinct rather than systematic research.

He became obsessed with the idea that telegraphy was possible without the use of wires and seems to have come very near to developing the first practical system before Marconi was born.

His notes are written in an almost mystical and ambiguous style. It must, however, be realised that electrical science was then still very young and many pioneers stumbled upon truth as the result of an inspired guess.

In 1866 he demonstrated his system from two mountain peaks in Virginia. He ran up two kites on wires 600ft long. To each kite was attached

a 15in. square of copper wire gauze connected to the wires. An earth connection was made by placing a coil of wire on the damp ground. A galvanometer was connected between this aerial and earth system at the receiving and at the transmitting end.

The actual circuits, however, were not completed until a precise moment at which the connection was made at the transmitting station, the two stations having identical apparatus. Three separate half-minute connections were made and observers said that the galvo needle at the receiving end moved just as though it were connected to a battery.

By a careful arrangement with the other station the performance was repeated after five minutes, using the former receiving station as a transmitter, with identical results.

Ridicule

Loomis believed that his system worked by interrupting the flow of static electricity in the upper atmosphere, but in the writer's opinion it is possible that the back e.m.f. from the galvo coils (which had become energised by the static) produced high-frequency oscillations which were radiated by the aerials. Possibly poor earth connections produced some form of rectifying action at the receiving end. It is hoped that one day the experiments will be repeated, using modern measuring techniques to clear up the mystery.

After several unsuccessful attempts to launch his system commercially, Loomis applied to Congress for financial aid. A Bill was passed in 1873 incorporating the Loomis Aerial Telegraph Company, but unfortunately he did not get the 500,000 dollars he requested to perfect his system. He died brokenhearted and almost forgotten in 1866 after suffering much ridicule from the popular Press and seekers after political capital.

Hertz's Resonator

Hertz's wave generator consisted of an induction coil the secondary of which was connected to a spark gap. Across the spark gap were connected two metal rods which were in turn connected to two metal plates. His receiver was simply a loop of wire having a small gap at the end. Thus the energy was fed directly into what was certainly the first dipole resonator. In the primary of the induction coil was a make and break interrupter in series with a battery of cells.

When the current was switched on a high voltage appeared across the secondary of the coil, producing sparks across the gap, each spark producing a train of oscillations in the dipole resonator circuit which, of course, contained capacitance and inductance.

Since these circuit elements were opened out the charges appearing across the dipole were radiated into surrounding space as the electrons rushed to and fro. Hertz adjusted the gap of his detector with a micrometer, usually looking for the spark in darkness. But although it was a very insensitive device it enabled him to study the phenomena of e.m.f. waves.

He called his detector a resonator and experimented endlessly to give it the right size and shape to resonate or tune to the transmitter frequency. By moving his resonator Hertz was able to measure the plane of polarisation.

He also discovered that there were two peaks at which the spark was at maximum strength: from this he was able to measure the actual wavelength and from this he calculated the frequency. The formula is familiar to all radio enthusiasts.

Later Hertz used a parabolic reflector and found that the beamed waves were reflected when directed at a sheet of metal, a technique which doubtlessly had much in common with radar.

The Coherer

During the 1890's a French physicist, Dr. E. Branley, produced a device he called the coherer. It consisted of a tube of iron filings having metal inserts at the ends fitted with terminals. In its ordinary state it offered quite a high resistance to electric current flow but when excited by high-frequency alternating current the resistance decreased substantially until the filings were made to "decohere" by tapping the tube.

In England Sir Oliver Lodge added a mechanical tapper to the device and during 1894 demonstrated his apparatus before the British Association. He is said to have received signals over a distance of 150yd on this occasion. Neither Lodge nor Branley appear to have been interested in developing a practical system from their experimental data.

Maritime Signalling

About this time Admiral Sir Henry Jackson became interested in the possibility of signalling by wireless between battleships. He believed this would afford more secrecy than the other methods of signalling used by the Fleet. In August, 1896, he succeeded in signalling between ships using a coherer and an electric bell movement as a decoherer.

In 1895, under orders from the Admiralty, he met Marconi and the two pioneers discovered that they had both been working along the same lines. They corresponded together for the next 18 months and in 1898 Jackson succeeded in signalling over a distance of 60 miles during manoeuvres at sea.

Atmospheric Electricity

During the years 1895-6 the Russians, Popov and Minchin, were using some of the methods of Hertz to study atmospheric electricity. Popov devised a receiver which is said to have worked well over short distances, but little seems to be known of these experiments.

Marconi, whilst still a youth, carried out many experiments in the grounds of his father's estate. At first he used beam reflectors behind Hertzian-type transmitters but soon discovered that he could cover far greater distances by using aerials suspended from high buildings or church steeples, sometimes using kites in the manner of Loomis.

After many successes, at the age of 22 Marconi came to England and was introduced to Sir William Preece, then chief engineer to the

G.P.O. Preece had successfully telegraphed over a distance of three miles using a purely inductive method.

Marconi Experiments

Marconi demonstrated through the walls of several rooms 100yd apart and later over two miles on Salisbury Plain. In 1897, using a 20in. spark coil, he spanned the Bristol Channel. Later, in 1899, he spanned the English Channel, the signals also being received at the new Marconi Company's factory at Chelmsford. This was a distance of 85 miles from the transmitter. At this time he was also carrying out trials for the Italian Government.

Now since Hertz's transmitter was tuned by the dipole resonator the waves he used were very short, the resonator having low values of inductance and capacity. It is now well known that these very short waves, or v.h.f. waves as we now call them, travel in straight lines. By using a large aerial with an earth system Marconi, probably by accident, tuned his transmitter to a lower wavelength.

His spark gap was connected straight across the ends of his aerial and earth conductors and this radiating system possessed much greater inductance and capacitance. Hence its resonant frequency was lower and the wavelength longer.

Now, using these waves, Marconi was able to cover much greater distances because they had ground wave. Later it was discovered that there were reflecting layers above the earth which affected the propagation of waves having a frequency up to approximately 30Mc/s.

At Chelmsford Dr. Eccles was on Marconi's staff designing a method for testing coherers without using an aerial. It consisted of graphing the characteristics. He also worked on the design of coupled circuits. Commercial wireless telegraphy had arrived.

The Atlantic Spanned

In 1901 the first message was transmitted across the Atlantic from Poldhu, in Cornwall, to Newfoundland. At the receiving end was a long aerial attached to a kite. As the faint letter S was heard by Marconi and his assistant, Kemp, perhaps a few trumpets sounded on the other side for Dr. Loomis!

It is the writer's opinion that the long-sighted vision of Maxwell set the ball rolling, although probably, like many physicists, he would have considered wireless an unimportant by-product, being wholly concerned with the quest for physical truth.

TO BE CONTINUED

ON THE SHORT WAVES

—continued from page 483

MP4BEU, OD5EE, PY2BFO, TF5TP, W7WVE, ZB2AO, ZS6VL, 5X5IU, 7Q7PBD. **I. Black** (Kent) HE30 Window frame via 100μA meter (most novel S-meter I ever heard of) CX8BM, EL2AG, LU—1DAB, 2BG, 8DAF, OA4AR (Peru), PY1MA, VK—3BW, 3TF, 5GQ, VP2SK, (St. Vincent) W5HWR/VP9, YV5BKW, ZB2AO, ZP5CF, 4X4JU, 5T5AD.

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Finally—logs in alphabetical order PLEASE!

MEDIUM WAVE DX

We regret that the article on this subject, scheduled for this issue, has been held over due to pressure on space. It will definitely appear next month.

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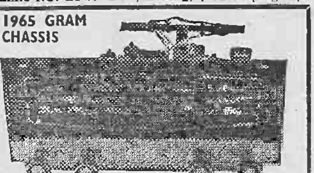

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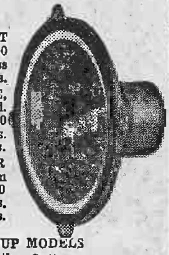

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±2 dB, 30 c.p.s.–20,000 c.p.s.

BASS CONTROL
+15 dB to —15 dB at 50 c.p.s.

TREBLE CONTROL
+12 dB to —12 dB at 10 Kc/s.

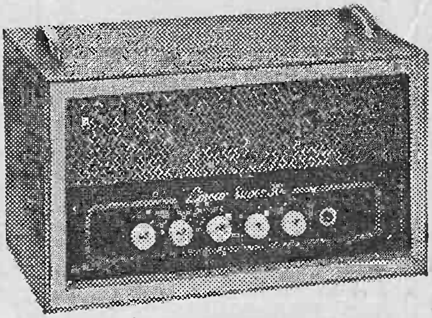
HUM AND NOISE
—60 dB.

HARMONIC DISTORTION
0.5% for 30 watts.

VALVES
Mullard ECC83, ECC83, ECC83, EL34, EL34, GZ34.

NEGATIVE FEEDBACK
20 dB.

DAMPING FACTOR
12.



RETAIL PRICE **33 Gns.**

Send S.A.E. for leaflet.

For operation on standard 200-250v., 50 c.p.s., A.C. mains. 110/120v. models available for export.

Trade and export enquiries invited.

LINEAR PRODUCTS LTD.
ELECTRON WORKS, ARMLEY, LEEDS

A HIGHLY EFFICIENT 30 WATT GENERAL PURPOSE PUBLIC ADDRESS UNIT

With input mixing facilities and outputs for 3-7.5-15 and 330 ohms (100v line)

A special feature of the **'SUPER 30'** is its high degree of stability, ensuring that the longest output leads can be used without fear of the usual troubles associated with instability.

Three high sensitivity standard jack inputs with provision for high and low impedance microphones.

Mullard MAINTENANCE MANUAL

Service Engineers will find the latest edition of the MULLARD MAINTENANCE MANUAL an essential source of information on all current replacement valves, semiconductors and cathode ray tubes.

It includes comprehensive data on over 200 types. The equivalents list provides cross references to over 500 types.

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Model 63 £17.1.9

★ Laboratory Specification 10 C/s to 100 Kc/s.
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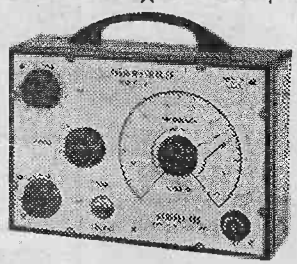

Also available:

★ INDUCTANCE BRIDGE 66	...	£18. 6.9
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BOOKS REVIEWED

AMATEUR RADIO, by F. G. Rayer.
Published by Arco Publications, 9, Grape Street, W.C.2.
191 pages 8¾ x 5¾, Price 30s.

THERE must be many people who are interested in radio, amplifiers and electronic gadgets. To say "I do radio" really tells very little as the word "radio" is so ambiguous these days. "I do electronics" suffers from the same problem.

However, say "I'm a Ham" and you can be pin-pointed immediately, as one who chats to other "Hams" all over the world via the medium of wireless. You are also pinpointed as one who will sooner or later be asked by someone—"What book should I read to understand more about ham radio"?

Aren't you lucky? All you have to do now is say "'Amateur Radio' by F. Rayer" and the job is done painlessly. You can go away happy and sleep nights too because you know that the book contains a gentle introduction to Amateur Radio and also gives a number of sound practical projects like a complete c.w./a.m. transmitter, grid dip meter, absorption wavemeter, frequency meter etc.

You will also know that there is some sound theory too, and that included at the end of the book is a very useful table of coils to wind and their coverage when used with a specific value of capacitance. The morse code and a Radio Amateur Examination Paper are included too so that the book literally contains just about everything from oscillators, t.r.f. and superhet receivers, aerials, valves, modulators and test equipment.

The price is a little high at 30s., but then that won't bother you. After all it's for your enquirer to decide if he can afford it.—*D.L.G.*

ELECTRONIC ORGAN HANDBOOK, by H. Emerson Anderson.
Published by W. Foulsham & Co. Ltd.
270 pages 8¾ x 5¾. Price 35s.

THIS book will be invaluable to any reader and its full value appreciated IF the reader intends servicing any of the commercial electronic organs mentioned later.

Nine of its eleven chapters are parts of circuits and schematics of organs like to the Conn, Hammond and Baldwin etc., each chapter being devoted to a particular organ. For the home constructor there is very little of practical use, although it may be interesting to read of the methods used in professional models.

The commercial units complete with servicing details described are Baldwin, Conn, Gulbransen, Hammond, Kinsman, Lowrey, Thomas and Wurlitzer. Any enthusiast purchasing one of these would doubtless find the relevant chapter of interest but 35s. for one chapter does work out a bit expensive. I found the book theoretically interesting and it was enlightening to observe the schematic circuitry of the various organs. However this did strike me as the kind of book which would be sought after on the shelves of the local library rather than over the counter of a bookshop. A handy book to browse through if the subject interests you and you come into some money unexpectedly.—*D.L.G.*

FUN WITH TRANSISTORS, by Gilbert Davey.
Published by Edmund Ward (Publishers) Ltd., 194/200 Bishopsgate. E.C.2.
64 pages 10in x 8in. Price 12s. 6d.

THE title implies a practical aspect—to have fun with. Unfortunately that is where it ends—at the title. The Foreword tells that it will bring pleasure and satisfaction to the modern boy.

Here's one modern boy to which it certainly didn't bring pleasure and satisfaction A lot of it is filled with uninteresting photographs and/or descriptions of commercial apparatus which can be obtained free from any manufacturer's brochure.

The chapter "Transistor Shortwave Receivers" consists of barely three pages and of this, half the second page is taken with a photograph of the IBM 1620 Data processing system. Half the last column consists of another photograph of a new automatic system for assembling computer transistors.

There are numerous large photos of commercial sets, some taking up a whole page. There is over a page devoted to the names and addresses of firms like Sobell, McMichael, Ever-Ready. If my son spent 12/6 on a book which disappointed so much I would vote to bring back the "cat".—*L.S.A.*

FUN WITH RADIO, by Gilbert Davey.
Published by Edmund Ward (Publishers) Ltd., 194/200 Bishopsgate, E.C.2.
64 pages 10in x 8in. Price 13s. 6d.

THIS might at first be thought to be eminently suitable for a youngster perhaps as a Christmas gift. Again the inside cover assures that this edition is a book of modern designs and is completely revised. Your reviewer disagrees with both suggestions.

As regards "modernisation", some valves are old octal type of the wartime junk era and details of pin connections for the W21 and PM22a valves are given. One circuit even uses a grid bias battery!

A "high fidelity" amplifier uses a 6J7 into a single ended 6V6 output stage. The chapter on transistors and transistor receivers covers *three* pages and describes but one 2-transistor **t.r.f. I rest** my case!—*L.S.A.*

CLUB NEWS

ACTON, BRENTFORD AND CHISWICK RADIO CLUB
Hon. Sec.: W. G. Dyer, G3GEH, 188 Gunnersbury Avenue, Acton, London, W.3.

The next meeting will be on Tuesday, 21st September at 7.30 p.m. at 66 High Road, Chiswick. At this meeting G5ZA will be talking about 'Earths'. Visitors welcome.

BROMSGROVE AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: J. K. Harvey, 22 Elm Grove, Bromsgrove, Worcestershire.

The monthly meeting will be held on 10th September in the Co-op Rooms, High Street, Bromsgrove, when G3GVA will lecture on Home-Brew Rx's.

R.A.E. classes have been arranged for the Autumn at Bromsgrove College of Further Education, Wednesday nights.

BURSLEM AMATEUR RADIO CLUB
Hon. Sec.: J. R. Sherratt, G3SAJ, 23 Ash Way, Ash Bank, Bucknall, Stoke-on-Trent, Staffordshire.

The next meeting will be on 21st September and new officers of the Committee for the following year will be elected. This will be followed by a filmshow.

A hearty welcome is extended to any prospective members who wish to join at the Moorland Junior High School, Burslem, S.O.T.

BURY AND ROSSENDALE RADIO SOCIETY
Hon. Sec.: K. Drinkwater, G3RHR, 16 Lindadale Avenue, Accrington, Lancashire.

The September meeting is to be held at the Old Boar's Head Hotel (private room), The Rock, Bury, at 8 p.m. when a lecture on Tuned Circuit Calculations by G2FMU is scheduled.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: P. J. Holland, G3TZO, Field House, 19 Kingsley Road, Great Boughton, Chester.

At the meeting on 24th August there was a Radio Quiz and on 31st August, A. Bennett, G3SQP, gave a lecture on Building a 2m Converter.

COPPULL AND DISTRICT RADIO CLUB, G3KXO
Hon. Sec.: R. Calderbank, 165 Preston Road, Coppull, Lancashire.

We have made R. E. Dewhurst, G3KXO, an Hon. Member of the Club and he will be operating mostly on Top Band/A from the Club QTH almost every Saturday.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.

At the meeting on 8th September, M. Shardlow and J. Anthony gave a Technical Film Show. There will be a D.F. Practice Night on 15th September and there will be a Social Evening for non-participants.

On 24th September is the proposed R.S.G.B. Region 4 Lecture I —Lecture Theatre, Derby and District College of Technology, Kedleston Road, Admission by ticket only.

EAST WORCESTERSHIRE AMATEUR RADIO GROUP
Hon. Sec.: M. Nicholas, G3TOI, 12 Crabtree Close, Redditch, Worcestershire.

At the meeting on 9th September, there will be a lecture on Cryogenics and a demonstration on very low temperature phenomena.

HAVERING AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: P. J. Moore, G3TUW, I Bonns Farm Cottages, Stapleford Tawney, Nr. Romford, Essex.

At the meeting on 1st September there was a lecture on Safety Regulations. Meetings are held at Goodchild House, 54 Western Road, Romford, on alternate Wednesdays at 8 p.m.

HARLOW AND DISTRICT RADIO SOCIETY
Hon. Sec.: G. O'Donald, G3TLJ, "Great East", Harlow Road, Roydon, Harlow, Essex.

Our Annual Mobile Rally and Field Day is to be held on 26th September at Magdalen Laver Village Hall, near Harlow.

IPSWICH RADIO CLUB
Hon. Sec.: J. Rhind, 67 Rosecroft Road, Ipswich, Suffolk.

The Club meets on the last Wednesday in the month at the Civic College, Ipswich at 7.30 p.m.

Past activities have included a visit to the local ITV station, talks on Mobile Gear, The R.A.E., Chassis Construction, TV, and running an exhibition station at a local fete.

MAGNUS RADIO SOCIETY
Hon. Sec.: R. Wallwork, B.Sc., G3JNK, Magnus Grammar School, Newark, Notts.

GB3RH 11th and 12th September. At the symposium on Amateur Radio to be held at the Residential Youth Centre, Ollerton, there will be a special station operated by the Magnus Radio Society assisted by the Mount School Radio Society. "Robin Hood" will operate on 160m, 80m and 20m. A special QSL card will be issued to confirm all contacts. Reports which will be greatly appreciated should be sent to G3PAW, Magnus Grammar School, Newark, Notts, or the R.S.G.B. QSL bureau.

MORAY FIRTH AMATEUR RADIO SOCIETY
Hon. Sec.: Paul A. Harris, 20 Hamilton Drive, Elgin, Morayshire.

With the Society now well into its second year, plans are forging ahead for having the Club station, GM3TKV, on the air regularly.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY, G2SU
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.

On 7th August the Society visited the Calder Hall Atomic Power Station, and on the 14th, manned a demonstration station at the Halifax Agricultural Show.

On 1st September, the Society held a Pea and Pie Supper.

SALOP AMATEUR RADIO SOCIETY
Hon. Sec.: Dr. K. Jones, G3RRN, Greystones, Shrewsbury Road, Church Stretton.

There will be a Junk Sale at the meeting held on 9th September and the Society will be manning a station at the Shrewsbury Carnival to be held on 11th September.

SALTASH AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. Bowers, B.R.S. 26760, 95 Grenfell Avenue, Saltash, Cornwall.

On 15th August, the Club joined Plymouth Radio Club for the Inter-Club Picnic.

The Club magazine, *Tamar Pegasus* continues to flourish. Copies are available, at 9d. post paid from the Hon. Sec. at above address.

SLADE RADIO SOCIETY
Hon. Sec.: D. Wilson, 177 Dower Road, Sutton Coldfield.

On 3rd September, Geof Sykes gave a lecture on Radio Teleprinting. This was followed by a demonstration arranged by Jack Hartwell.

At the meeting on 17th September, member Dr. Williams will discuss and demonstrate his sound reproducing equipment.

SOUTH BIRMINGHAM RADIO SOCIETY, G30HM
Hon. Sec.: J. Rowley, G3TQO, 195 Castle Lane, Solihull.

At the meeting to be held on 16th September, there will be a demonstration and lecture on the well-known "Eddystone" receivers.

VERULAM AMATEUR RADIO CLUB
Hon. Sec.: G. Slaughter, G3FAO, 6 Leggatts Wood Avenue, Watford, Hertfordshire.

Wally Dennis, G3NCK, was asked by the committee to arrange a Film Show for 15th September. He has been most successful and has managed to book the film, "Friendship Seven". This film, about the American manned spacecraft, is something not to be missed.

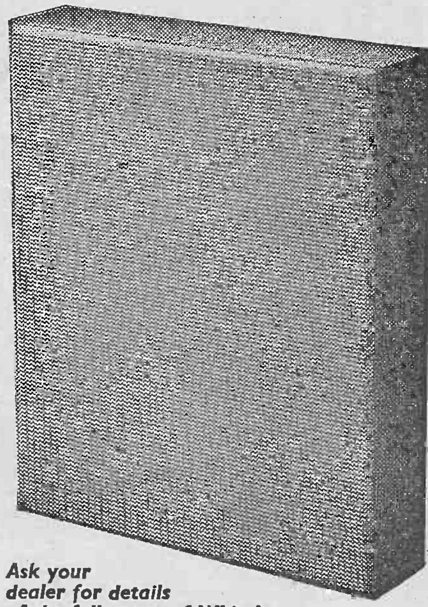
WAKEFIELD AND DISTRICT RADIO SOCIETY
Hon. Sec.: Edwin Price, G3TQV, 23 Elmwood Grove, Horbury, Nr. Wakefield, Yorkshire.

On 30th September, the Society will be paying a visit to the Spen Valley Radio Society.

The Sudbury World Communications Club has changed its name to the World Communications Club of Great Britain. Subscription for European members is now 10s. a year. For an extra 5s. members may use the Club's new QSL bureau. There is also a special tape recordings bureau membership of which costs a further 5s. Address of the club is c/o Mr. C. L. Everitt, 4 Suffolk Road, Sudbury, Suffolk.

WHITELEY

SLIMLINE
LC.92
SPEAKER SYSTEM



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only 6" deep. Height 29". Width 24"

• A 9", 15 OHMS DRIVE UNIT
with graded cone and extended treble response.

• ACOUSTIC LABYRINTH CABINET
gives balanced response throughout the audio spectrum.

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Walnut cabinet with satin melemine finish. Weight 25½ lbs.

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TRANSISTOR POCKET RADIOS

Ideal Gifts—all supplied complete with personal earpiece, battery and carrying case. Fully guaranteed. **Post free.**

BOY'S 2 TRANSISTOR
In attractive plastic case. Size only 4 x 2¼ x 1in. 2½in. speaker. Uses PP3 battery. Tunable over full medium waveband. 39/6

BOY'S 4 TRANSISTOR MODEL 45/-

6 TRANSISTOR MODEL
In plastic case, 4 x 2¼ x 1in. with 2½in. speaker. Uses PP3 type battery Tunable over full medium waveband. 59/6

2 Waveband (Long and Medium) Model size 5 x 3¼ x 1½in., cream/black plastic case. 89/6

NEW SUPER MINIATURE POCKET RADIOS

THE SINCLAIR MICRO-6. Self-contained pocket radio. Size only 1 4/5 x 1 3/10 x ½in. Complete with earphone and detailed construction data. **Can be built for only** **59/6**
Mercury cell **1/11** extra (2 required).

THE SINCLAIR SLIMLINE. The new 2-transistor pocket radio size only 2¼ x 1⅝ x 1⅜in. Micro alloy transistorised and printed circuit. All components available separately. Easy to assemble. **Can be built for** **49/6**

INTERNATIONAL BRAND TAPE—Fully Guaranteed

MYLAR BASE		ACETATE BASE	
3¾in. Triple play, 600ft.	15/-	3in.—150ft.	3/6
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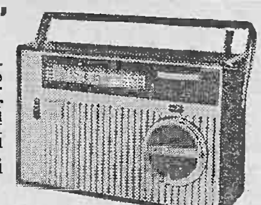
7in. Long play, 1,800ft.	19/6	**P.V.C. BASE**	
7in. Double play, 2,400ft.	25/-	5in. Stand play, 600ft.	8/6
7in. Triple play, 3,600ft.	58/6	5¾in. Stand play, 840ft.	11/6

P. & P. 1/- extra per reel. 4 reels and over Post Free.

THE "SKYROVER" RANGE



7 transistor plus 2 diode superhet. 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. Cover the full Medium Waveband and Short Waveband 31-94 M and also 4 separate switched band-spread rangers. 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station selection.

NEW—THE "SKYROVER" Mk III
Now supplied with redesigned cabinet, edgewise controls, black and chrome plastic cabinet. Size 10 x 6¼ x 3½in.
Can now be built for £8.19.6 Post 5/- **H.P. Terms: 27/- dep. and 11 months at 15/9. Total H.P. Price £10.0.3.**

THE "SKYROVER" DE LUXE
Tone Control Circuit is incorporated with separate Control. **In a** wood cabinet, size 11¼ x 6½ x 3in., covered in **a washable material,** fitted carrying handle.
Can now be built for £10.19.6 Post 5/-. **H.P. Terms: 38/- dep and 11 mths. at 19/2. Total H.P.P. £12.3.10.**

A simple additional circuit provides coverage of the 1100/1950M. band. This conversion is suitable for both models that have already been constructed. **ONLY 10/- EXTRA** **Post Free**

Data for Receiver 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries 3/4 extra. *All components available separately*

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TYPE 3001 Integrated Stereo Amp. List price £38.10.0.
WIRECOMP'S PRICE 23 Gns. Post 10/6.
TYPE 1002A Control Unit. WIRECOMP'S PRICE £4.19.6. Post 2/6.
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All fully described in our advertisement in "P.W." April 1965.

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MICRO-RECEIVERS
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- **THE WORLD'S SMALLEST RADIO**
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- **IDEAL FOR PERSONAL LISTENING**

SINCLAIR MICRO-6

■ $1\frac{4}{5}$" x $1\frac{3}{10}$" x $\frac{1}{2}$" ■ weighs under 1 oz.

No transistor set has ever yet compared with the Micro-6 for size, power, performance and design. No set has ever given such pleasure and satisfaction both in building and using it. Thousands upon thousands are now in use throughout the world. Everything except the lightweight earpiece is contained within the smart minute white, gold and black case. Unique features include bandspread over the higher frequency end of the medium waveband for easy reception of Luxembourg, powerful A.G.C. to counteract fading of distant stations, and vernier type tuning. Quality of reproduction is outstandingly good. Order your Micro-6 now and prove for yourself why it cannot be too highly recommended as an intriguing design to build and a most practical radio to use. When you have built it, you will want to have it with you always—and it plays everywhere! Build it in an evening.

It's easy to build your Micro-6 and have it working in an evening. All parts including the special Metal Alloy Transistors, case, dial, lightweight earpiece and easy to follow instructions come to **59/6**

MALLORY MERCURY CELL **ZM312** (2 required) each 1/11 (Pack of 6—10/6)
"Transrista" black nylon wrist strap for Micro-6—7/6.

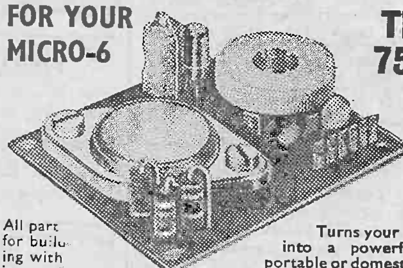
FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

ALL IN A SET SMALLER THAN A MATCH BOX

The technical specification of the Micro-6 is fantastic for its size: The 6-stage circuit using 3 M.A.T's provides 2 stages of R.F. amplification, double diode detector and high gain 3-stage A.F. amplifier plus A.G.C. Tunes over medium waveband.

A POWERFUL AMPLIFIER FOR YOUR MICRO-6

TR 750



All parts for building with instructions **39/6**

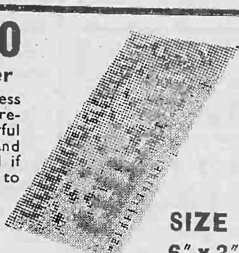
Ready Built **45/-**

Turns your Micro-6 into a powerful car, portable or domestic loud-speaker set. 10mV input gives 750 milliwatt output into a standard 25-30Ω speaker. Frequency response 30-20,000 c/s± 1dB. Also makes a good record player, intercom, baby alarm, etc. Complete with built-in volume control and switch. 9v. operation.

SINCLAIR X-10

Integrated P.W.M. Amplifier

Recommended for use where a less powerful amplifier than the X-20 is required. The X-10 also offers wonderful advantage of quality, compactness and price, and it can be battery operated if desired. Tone control system added to choice. For 12-15 volt operation.



Complete kit and instructions	**£5·19·6**
Ready built and tested	**£6·19·6**
X-10 power supply unit	**£2·14·0**

SIZE 6" x 3"

Manual free with all X-10's

OTHER SINCLAIR CONSTRUCTOR DESIGNS

MICRO AMPLIFIER—smaller than a 3d. piece. Suitable for A.F., R.F., F.M., etc., etc. **28/6**

MICRO-INJECTOR—easy to build and use fault tracer. *Ready-built 32/-* **27/6**

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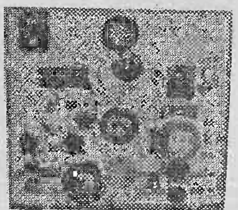
Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full and at once without question. Please quote PW.10 should you prefer to write your order instead of cutting out this coupon.

RECEIVERS & COMPONENTS
(continued)

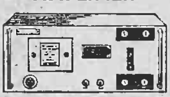
MARCONI CANADIAN RECEIVER NO.52



Shipping Amateur. & Broadcast. Magnificent 10-valve receiver in three switched wavebands covering 1.75-16 Mc/s. (19 - 170 metres), plus 3 valve crystal calibrator employing dual crystal to provide marker check at 10-100-1000 kc/s. One RF and two IF stages. Other refinements: valve, HT, and Signal check meter. Internal 3in. speaker and two H/Phone outputs with switched control. RF-AF Gain Noise Limiter, Filter, BFO Heterodyne pitch control, Wide and Narrow Bandwidth Man or AVC on CW & RT. Fast and Slow tuning with lock. Additional OSC Tuning (plus & minus). Power requirements HT 160v. 60mA: LT 12v. 1½ amps. size 15 x 14 x 12in. Fully tested and working. ONLY £9.19.6. Carr. 15/6 or complete with Power supply unit suitable for 115/230v. AC mains £12.19.6. Carr. 20/-.

No. 52 GROUND-STATION comprising Receiver. Transmitter and 12v. D.C. Power Unit. £27.10.0, Carr. £2.10.0. (Mainland only.)

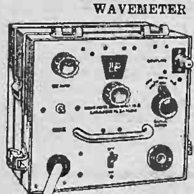
4 VALVE 4 WATT AMPLIFIER



"C" Core transformers A.C. Mains 110/230 volts 600 ohms of high impedance input. Output 3 or 600 ohms (state choice) Controls: On/Off switch. Gain control. Indicator light. Valve inspection panel. 19 x 7 x 7in. Brand New in maker's carton 79/6, Carr. 10/-.

TELESCOPIC AERIAL MASTS. Tubular steel copperised, spray finish, ring cam locking on each section provides for full or any height required. Suitable all fixings and base locations. Bottom section 1¾in. diameter. 20ft. (4 section) Closed 5ft. 9in. Weight 16lb. 55/-, Carr. 5/- 34ft. (6 section) Closed 6ft. 6in. Weight 20lb. 75/-. Carr. 5/-. Further height by adding 3-4ft. Whip sections 13/6. Carr. 4/-. Special price for quantities.

WAVEMETER CLASS D



Freq. band 1 900 Kc/s. to 8,000 Kc/s. (158-37.5 metres) in two ranges. 1,900 Kc/s. 4,000 Kc/s. also 4,000 Kc/s. 8,000 Kc/s. Supply 6 v. D.C. input. Complete with twin crystal. As new. PRICE 62/6. P. & P. 5/-.

TELEPRINTERS

CREEL 7B used condition Price from £15; Teletype Corp., Type 14B £17.10.0. Carr. 30/- each.

MOVING COIL HEADPHONES (BRAND NEW). Chamois padded complete with jack plug, 15/6. Post 2/-. also available with matching moving coil Microphone, 19/6, post 2/-.

All No. 19 Set parts available.

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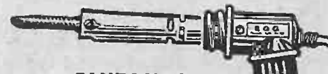

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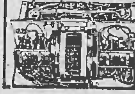

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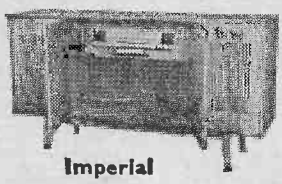

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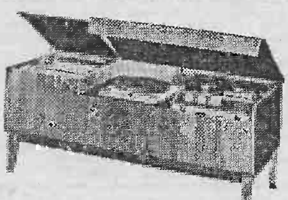

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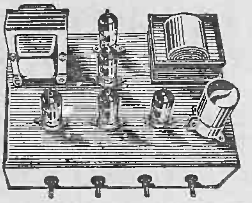

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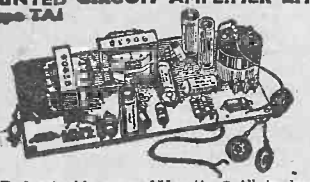

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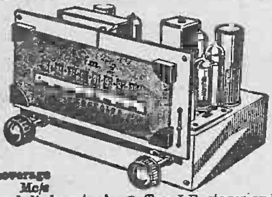

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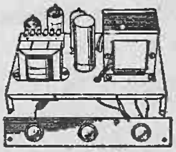

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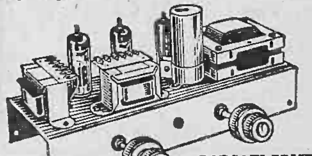

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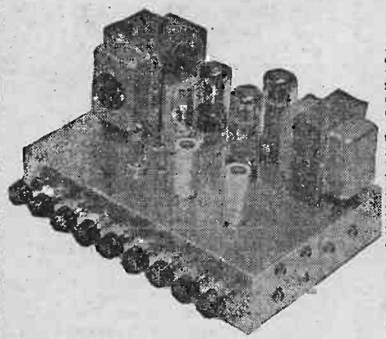

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