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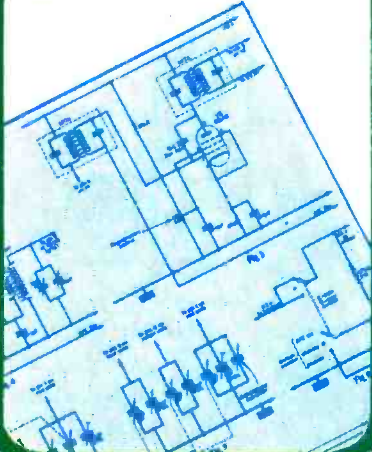

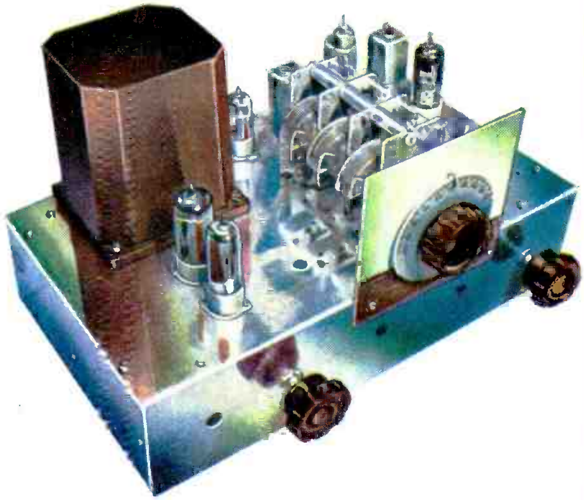

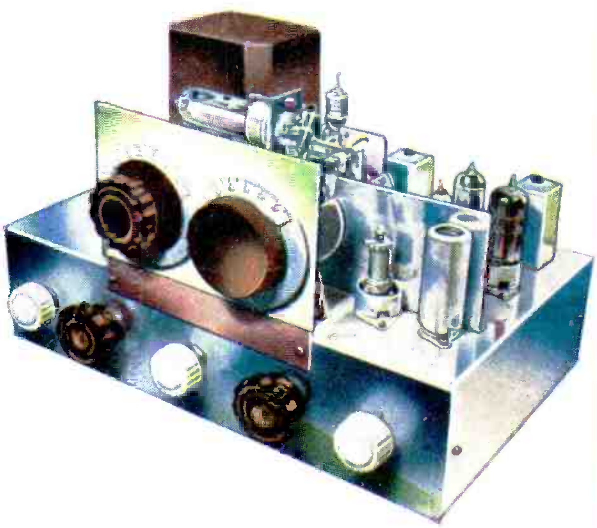

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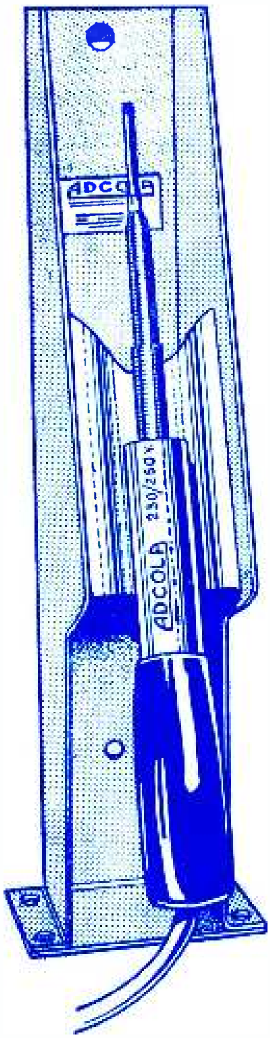

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6P26	9/-
6P28	11/6
6Q7G	4/3
6Q7GT	7/9
6R7G	5/3
6R7GT	11/-
6SA7	7/-
6SC7	4/9
6SG7	7/9
6SG7GT	4/9
6SH7	3/-
6SJ7	4/6
6SK7	4/6
6SL7GT	4/9
6SN7GT	4/6
6SQ7	5/-
6ST7	12/6
6SS7	2/-
6U4GT	8/6
6U5G	5/-
6U7G	7/-
6V6G	3/6
6VGGT	5/6
6X4	3/9
6X5	5/3
6Y7G	12/6
6Z5G	15/-
7A7	12/6
7AN7	5/6
7B6	12/6
7B7	9/6
7C5	8/-
7C6	6/9
7C7	5/-
7D3	15/-
7D5	14/6
7F7	7/-
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
12A8GT	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	9/-
14H7	9/6
14S7	34/11
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/-
28D7	6/9
30C1	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	5/9
161	15/-
185BT	34/11
215SG	6/6
220B	10/6
301	20/-
302	15/-
303	15/-
305	16/6
306	13/-
807	11/9
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
9006	2/6
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
B349	10/3
B719	5/9
BL63	10/6
C1	12/6
CK506	6/6
CL4	19/6
CL33	11/6
CV6	2/6
CV63	10/6
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	4/3
DH76	3/6
DH77	3/6
DH81	23/3
DH101	25/-
DH107	16/11
DH719	5/9
DK32	7/6
DK40	15/6
DK91	4/-
DK92	8/-
DK96	6/6
DL33	6/9
DL35	5/-
DL63	5/3
DL72	15/-
DL75	30/-
DL92	4/9
DL94	5/-
DL96	6/6
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	13/6
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	6/3
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	4/6
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	10/-
ECF804	24/-
ECH3	23/3
ECH21	10/-
ECH33	22/8
ECH35	6/-
ECH42	8/-
ECH81	5/9
ECH83	6/6
ECH84	9/6
ECL80	5/9
ECL82	6/6
ECL83	10/-
ECL86	8/-
EF6	20/6
EF9	20/6
EF22	6/6
EF36	3/6
EF37A	7/-
EF39	5/-
EF40	8/9
EF41	6/6
EF42	3/9
EF50	2/6
EF54	3/-
EF73	5/-
EF80	4/3
EF83	9/9
EF85	4/6
EF86	6/6
EF89	4/3
EF91	3/-
EF92	2/6
EF97	10/-
EF98	9/9
EF183	7/3
EF184	6/6
EH90	9/6
EK32	5/9
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	5/6
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	14/6
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	8/9
HVR2A	8/9
IW3	5/6
IW4/350	5/6
IW4/500	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	3/9
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
M84B	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	3/6
PCF86	8/3
PCF801	9/9
PCF802	10/-
PCF805	9/3
PCF806	12/9
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	5/3
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
QQVO3/10	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	65/-
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	15/6
TH233	6/9
TP22	5/-
TP25	5/-
TP2620	7/6
TY86F	11/8
UABC80	5/6
UAF42	7/-
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/-
UF41	6/9
UF42	4/9
UF80	6/3
UF85	6/9
UF86	9/-
UF89	5/6
UL41	7/-
UL46	8/6
UL84	5/6
UM4	17/6
UM34	17/6
UM80	8/3
UR1C	6/6
UU5	7/-
UU6	11/-
UU7	11/-
UU8	14/-
UU9	5/6
UU12	4/3
UY1N	10/3
UY21	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
VM84B	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	3/6
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	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
AF186	27/6
AFZ12	26/6
BYZ13	11/6
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/-
OA211	13/6
OAZ200	12/6
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/-. 14A163 35/6. 14B130 31/-. 14B261 11/6. FC101 16/9. 16RC.1.16.1 8/-. 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/-. FC31 21/-. FC116 6/-. FC124 12/6. 8B3 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 only. Post/Packing 6d. per item. Orders over £5 post free. No C.O.D. 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.

R.S.C (MANCHESTER) LTD

MAIL ORDERS TO: 54 WELLINGTON STREET, LEEDS 1

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

PERSONAL SHOPPERS WELCOME AT ANY BRANCHES BELOW. OPEN ALL DAY SATURDAY.

BRADFORD 10 North Parade Tel. 25349 (Half-day Wed).

BRISTOL 14 Lower Castle Street (Half-day Wednesday) Tel: 22904.

BIRMINGHAM 30/31 Gt. Western Arcade, opp. Snow Hill Station. CENtral 1279. No half-day

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 Road. Tel: 47096

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

VACANCIES FOR STAFF
AT VARIOUS BRANCHES
SHOP EXPERIENCE UNNECESSARY
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R.S.C. MAINS TRANSFORMERS (FULLY GUARANTEED)

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

MIDGET CLAMPED TYPE 2⅜ x 2⅜ x 2¼in.

250v. 60mA, 6.3v. 2a	13/9
250-0-250v. 60mA, 6.3v. 2a	14/9

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, D.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**.

OUTPUT TRANSFORMERS

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

SMOOTHING CHOKES
60mA, 10H 400Ω **4/11**. 100mA, 10H, 220Ω **8/9**
80mA, 10H 350Ω **5/9**. 150mA, 10H, 250Ω **11/9**

CHARGER TRANSFORMERS
All with 200-230-250 v. 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**.

TWEETERS R.A. 3 ohm **25/9** 15 ohm **25/9**

FANE HEAVY DUTY HI FI SPEAKERS
12" 20 watt. Type 122/10. Post 5/6. Only **5 Gns.**

AUDIOTRINE HF100D 10in. 15 WATT HI-FI LOUDSPEAKERS Heavy cast construction. Dual cone Rubber surround. Smooth frequency response 20-15,000 c.p.s. Speech coil 3 or 15 ohm. Exceptional value at **£5.15.0**

R.S.C. POWER PACK 39/9

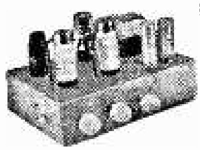
Metal case only 8 x 5½ x 2½in. For 200-250v. A.C. mains. Output at 4 pin plug and socket 250v. 60mA fully smoothed at 6.3v. 2a.

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.

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
11 GNS.
Brand new Garrard 3000 LM. Very latest model. Normal Retail price approx. £12.15.0. Heavy Turntable and lightweight pick-up arm. High fidelity Stereo/Mono cartridge. Fully guaranteed. Carr. 5/6

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



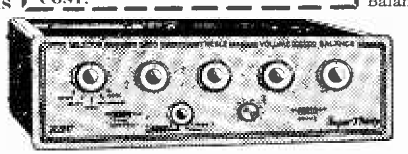
A highly-sensitive 4-valve quality amplifier for the home small club, etc. Only 50 millivolts input required for full output, is suitable for use with latest High-fidelity Pick-up heads and all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls provided giving full long-playing record equalisation. Hum level negligible being 71 dB down 15 dB of Negative Feedback used H.T. of 300v. 25mA and L.T. of 6.3v. 1.5a. available for supply of 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. SUPER 15 HI-FI AMPLIFIER

FULLY TRANSISTORISED 200-250v. A.C. Mains Operation.
OUTPUT 10 WATTS R.M.S. into 15 ohms.
OUTPUT 15 WATTS R.M.S. into 3-4 ohms.
Maximum Instantaneous Peak Power Output 28 watts.
PRINTED CIRCUIT CONSTRUCTION. LATEST MULLARD TRANSISTORS AD149, AD149, OC127Z, OC81Z, OC44, OC44 OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads, **FULL TAPE MONITORING FACILITIES.**
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV, Microphone 4.5mV, Tape Head 2.5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to -14dB at 10 Kc/s.
BASS CONTROL: +12dB to —15dB at 50 c/s.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s. 0.35%. **HUM LEVEL:**-75dB.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. If preferred printed circuit can be supplied with parts soldered in and tested for 21/- extra. **9½ GNS.** Carr. 10/-
Attractive Walnut or Teak finished cover **6 gns.** or Deposit **19/-** and 9 monthly payments **13/2**. Total **£6.17.6.** Or unit factory built and tested, complete with Cover and with our usual 12 months guarantee. **19½ GNS.** Carr. 12/6.
Or Deposit **£3.2.0** and 9 monthly payments **43/3**. Total **£22.11.3.**
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.
Send S.A.E. for leaflet.

R.S.C. SUPER 30 STEREO AMPLIFIER

WE PROUDLY INTRODUCE TWO COMPLETELY NEW UNITS WITH TECHNICAL SPECIFICATIONS COMPARING MORE THAN FAVOURABLY WITH SIMILAR AMPLIFIERS OFFERED AT 2-3 TIMES THE COST.



A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components.
CROSS-TALK:—52dB at 1,000 c.p.s.
CONTROLS: 5 position Input Selector. Bass Control, Treble Control, Volume Control Balance Control, Stereo/Mono Switch. Tape Monitor Switch, Mains Switch.
INPUT SOCKETS (Matched Pairs) (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone.
Operation of the Input Selector Switch assures appropriate equalisation.
Rigid 18 s.w.g. Chassis. Size approx. 12" Wide, 3" High, and 8" Deep.
Attractive Facia Plate and Matching Knobs, Neon Panel Indicator.
Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.

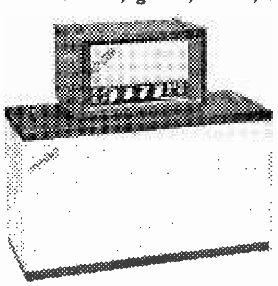
IMPORTANT NOTE. Rated output figures are given in R.M.S. and not speech and music or I.H.F.M., otherwise we could obviously quote much higher outputs.

THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon) CURRENTLY AVAILABLE REGARDLESS OF THE COST. SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. **18 GNS.** Carr. 12/6.
If required printed circuits can be supplied with appropriate components assembled, soldered and tested for 2 gns. extra.
Terms: Deposit **6 gns.** & 9 mthly payments **36/6** Total **£22.14.6.**
Attractive Walnut or Teak finished cover **6 gns.** or Deposit **19/-** & 9 mthly payments **13/2** Total **£6.17.6.** Or unit completely assembled ready for use fitted cover as above or **29 GNS.** Carr. 15/-.
Deposit **£4.12.0** & 12 mthly p'ments **48/-**. Total **£33.8.0**

R.S.C. BASS-REGENT 50 WATT AMPLIFIER

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT

For lead, rhythm, bass guitar and all other musical instruments
For vocalists, gram, radio, tape and general public address



★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.

4 Jack Socket Inputs and two independent Volume Controls for simultaneous use of up to 4 pick-ups or 'mikes'.

★ Separate cabinets fully covered in contrasting tones of Rexine/Vynair with gold trimming for speakers and amplifiers.

★ Separate Bass and Treble Controls giving 'Boost' and 'Cut'.

Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at more than three times the cost.
49 Gns. Or deposit £7.16.0 and 12 monthly payments of 81/6 Total 54 Gns. Carr. 25/-

Full Range of FANE and GOODMANS Speakers in Stock and all types 'Mikes'. Credit terms if required.

TRANSISTORISED SOUND MIXER

Enables mixing of up to 4 standard jack inputs, i.e. mike., tape, gram, tuner, etc., into single output. Compact and completely self-contained, uses standard 9 volt battery **49/9**

R.S.C. B20 MULTI-PURPOSE AMP. especially suitable for Bass Guitar

A highly efficient unit incorporating massive 15in. high flux loudspeaker specially constructed to withstand heaviest load conditions. Rating 25 watts. Individual bass and treble controls give ample 'Boost' and 'Cut'. Two jack socket inputs separately controlled. Cabinet is of substantial construction and attractively finished in two contrasting tones of Rexine and Vynair. Size approx. 24 x 21 x 13ins. Send S.A.E. for leaflet. **29½ Gns.** Carr. 17/6 Or deposit £4.14.6 and 12 monthly payments of 49/- (Total 32½ gns.).

R.S.C. G15 15 WATT AMPLIFIERS for Lead or Rhythm Guitar, Mike, Gram or Radio

High-fidelity push-pull output. Separate bass and treble 'Cut' and 'Boost' controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Loudspeaker is a heavy duty flux 12in. 20 watt model with cast chassis. Cabinet is covered in contrasting shades of Rexine/Vynair. Size approx. 18 x 18 x 8in. Carr. 12/6. Only **19½ Gns.** or DEPOSIT 3 Gns. and 12 monthly payments of 32/6 (Total £22.13.0). S.A.E. for leaflet.

R.S.C. G5 AMPLIFIER

4 watt high quality output. Incorporating high flux 12in. 10 watt loudspeaker. Sensitivity 40 mV. High impedance jack input. Handsome cabinet (size 14 x 14 x 7in. approx.) finished in Rexine/Tygan. 200-250v. A.C. mains. Suitable for Lead or Rhythm Guitar in home or small club, etc. **£9.19.6** or Deposit 30/9 and 9 monthly payments of 22/3 (Total 11 Gns.). Carr. 7/6

R.S.C. BATTERY CHARGING EQUIPMENT

Guaranteed 12 months

All for A.C. Mains 200-250v., 50cs

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 clips. **59/9** Or Deposit 12/- and 5 monthly payments 12/- Total £3.12.0. Carr. 4/6

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

BATTERY CHARGER KITS

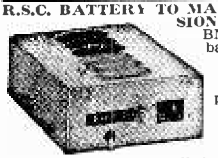
Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders Grommets, panels, Heavy Duty Clips, circuit. Carr. 3/6
6v. or 12v. 1 amp...... 22/9
As above with ammeter 28/9
6v. or 12v. 2 amps...... 25/9
6v. or 12v. 2 amps, inclusive of ammeter.. 35/9
6v.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

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

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 INTERCOMM 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 81/6, carr. 5/-. Ready for use, 6 gns.

R.S.C. BATTERY TO MAINS CONVERSION UNITS. Type BMI. An all-dry battery eliminator. Size 5½ x 4½x2in. approx. Completely replaces batteries supplying 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



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

TANNOY RE-ENTRANT LOUDSPEAKERS. For outdoor or Factory use, 8 ohms, 8 watts. **27/6** Plus 4/6 carriage

HI-FI 12 WATT AMPLIFIERS

BRAND NEW EX-GUITAR AMPLIFIERS Carr. 7/6 **£7.19.9**
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

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. lamp required from amplifier. Size approx. 9 x 6 x 7in. high. Simple alignment procedure. Point-to-point wiring diagrams, instructions and priced parts list with illustrations, 2/6. Total building costs £5.5.0. S.A.E. for leaflet.

TRANSISTOR SALE

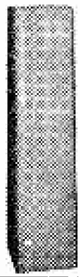
Mullard OC71 2/11 OC45 3/11. OC44 5/11. OC72 2/11. OC81 2/11, OC171 8/9, AF117 6/9. Ediswan XA101 3/9. XA112 3/9, XC101A 3/9. Postage 6d. for up to 3 transistors.

INTEREST CHARGES REFUNDED ON H.P. ACCOUNTS SETTLED IN 6 MONTHS

R.S.C. (MANCHESTER) LTD

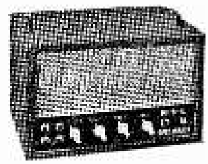
Addresses Page 829

R.S.C. COLUMN SPEAKERS



Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. Normally supplied for 15 ohm matching but can be supplied for 100v. line for 35/- extra.
Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. **12½ Gns.** Carr. 10/-. Or deposit £2 and 9 monthly payments of 27/9 (Total £14.9.9).
Type C412. 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/-. **19½ Gns.** Or deposit of 3 gns. and 9 mthly pymts of 43/2 (Total 21½ gns.).

30 WATT HI-FI AMPLIFIER FOR LEAD, RHYTHM BASS GUITAR and for VOCAL or INSTRUMENTAL GROUPS



A Four Input, two volume control Hi-Fi unit with separate Bass and Treble 'Cut' and 'Boost' controls. Designed for vocal or instrumental groups. For Bass, Lead or Rhythm Guitar. Mullard or Brimar latest type valves. Housed in strong Rexine covered cabinet with twin carrying handles. Attractive black and gold perspex fascia plate. For 200-250v. A.C. mains. Output for 3 or 15 ohm speakers. Send S.A.E. for leaflet. **17 GNS.** Carr. 12/6. or Deposit £3 and 9 monthly payments of 37/-. (Total £19.13.0.)

HEAVY DUTY CHARGER KIT

6/12v. 6 amps., variable output
Consisting of Main Transformer 0-200-230-250v.; F.W. (Bridge) Selenium Rectifier; Ammeter, Variable Charge Rate Selector Panels, Plugs, Fuses, Fuseholder and circuit. Carr. 5/6 **59/9**

SELENIUM RECTIFIERS F.W. (BRIDGED)

6/12v. 1a. 3/11; 6/12v. 3a. 9/9; 6/12v. 6a. 15/3; 6/12v. 2a. 6/11; 6/12v. 4a. 12/3; 6/12v. 10a. 26/9; 6/12v. 15a. 35/9.

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 250 v., 60 mA, 6.3 v., 2a. **19/11**

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 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 5½ x 8½in. Handsome crackle finished metal cabinet. Brand new with full instructions manual. Usual guarantee. Carr. 10/-. **19 Gns.** Or Deposit £5 and 9 monthly payments 37/8 (Total £21.19.0).

15in. 40 WATT EXTRA HEAVY DUTY LOUDSPEAKERS

Famous make. Normal price approx. £19. **11 Gns.** Very limited number to clear with full guarantee. Carr. 15/-

LINEAR TREMOLO PRE-AMP UNIT

Suitable for use with any of our Amplifiers. Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume and Switch. **4 Gns.**

Veritone bring to you a new design in
F.M. Tuners unique in both circuitry and styling
—designed for the modern-minded enthusiast

THE VERITONE SATURN TRANSISTORISED F.M. TUNER

Specifications:

Transistors:—1 x AF125, 1 x AF121, 4 x AF116 . Diodes:—4 x OA79 . 1 Variable Capacity Diode . Solid State Full Wave Bridge Rectifier, 10AZ212 Zener Diode . 4 I.F. Stages . Switchable A.F.C. . Tuning Meter . Tuning Range 87·5-108·5 Mc/s . Stabilised Power Supply Din Outlet Socket . Fully Variable Audio Output Attenuator . Sensitivity 4 mV for 30 dB signal to noise ratio . Attractive Black and Silver Grey front panel with mirror strip top and bottom

Facility for Plug in Multiplex Stereo Adaptor (available at a later date)

PRICE 25 gns. (Inc. P.T.) TEAK CASE OPTIONAL EXTRA

Full technical information and details available on request

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STERN-CLYNE

ELECTRONIC CENTRES THROUGHOUT GREAT BRITAIN

TR2 PORTABLE TAPE RECORDER. A truly first-class portable machine by famous manufacturer incorporating the renown BSR single speed 2-track Tape Deck. 3¾ i.p.s. Tape Counter. Record Level Indicator. Volume and On/Off Tone Control. 3 watts output. Inputs for recording from Microphone and Radio. Tape Monitor Socket. Extension Loudspeaker Socket, Attractive two-tone grey/cream rexine covered Portable Cabinet. Supplied complete with Microphone, Reel of Tape and Spare Spool. Carriage and Insurance 15/- extra. Credit Terms £2.18.0 deposit and 1' monthly payments of £1.9.4 total credit price £20.10.0.

Originally 23 Gns.

OUR PRICE **18 Gns.**

TR3 PORTABLE TAPE RECORDER. A high quality Portable Tape Recorder for the discerning enthusiast incorporating the latest BSR TD10 3-speed Tape Deck. 1⅞, 3¾ and 7½ i.p.s. 2-Track. Record interlock to prevent accidental erasure. Tape Counter. Record Level Indicator. 3-4 watt output. Volume and On/Off Tone Control. Inputs for recording from Microphone and Radio. Tape Monitor Socket. Extension Loudspeaker Socket. Attactive two-tone blue rexine covered Portable Cabinet with silver trimmings. Supplied complete with Microphone Lead fo recording from Radio or Record Player. Full Reel of Tape and Spare Spool. Carriage and insurance 15/- extra. Credit Terms: £3.3.0 deposit and 12 monthy payments of £1.12.8, Total credit price £22.10.0

Originally 28 gns.

OUR PRICE **20 Gns.**

FULLY AUTOMATIC TAPESPLICER 14/6. P. & P. 1/6.

PLASTIC TAPE SPOOLS
3in., 1/3; 4in., 2/-; 5in., 2/-; 5¾in., 2/3; 7in., 2/6.

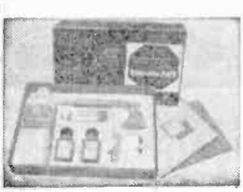
PLASTIC SPOOL CONTAINERS. For spool sizes 5in., 1/6; 5¾in., 2/-; 7in., 2/3. Any single item plus 6d. P. & P. Orders over £1 post free.

We carry fully comprehensive stocks of Tape Recorders, Decks and Accessories at all Branches or order with confidence by mail.

AMERICAN RECORDING TAPE

5in.	600ft.	Std. Acetate	8/6
5in.	900ft.	LP Acetate	10/-
5¾in.	1,200ft.	LP Acetate	12/6
3¼in.	600ft.	DP Polyester	11/6
7in.	1,200ft.	Std Polyester	12/6
5in.	1,200ft.	DP Polyester	15/-
7in.	1,800ft.	LP Polyester	20/-
5¾in.	1,800ft.	DP Polyester	22/6
7in.	2,400ft.	DP Polyester	25/-

P. & P. 1/- per reel. 4 or more reels POST FREE.



ETCH YOUR OWN PRINTED CIRCUITS

A complete kit of parts to make your own printed circuit board to your own specification, high quality materials used to ensure perfect results. Price complete with all necessary chemicals and copper clad laminated boards, 19/6. 2/3 packing and postage.

"the TRAVLER II"

★ MEDIUM AND LONG WAVES. ★ 12 VOLT POSITIVE EARTH. ★ Push Button Wave Change. ★ SIZE 7 x 2 x 7in.

9½ Gns. P & P. 5/-

Ready built complete with 7 x 4in. speaker fitted to baffle fixing brackets, all nuts and bolts and fitting instructions.

Optional Extras: Chromium plated weatherproof telescopic aerials. Type 1, 22in./50in., 19/6. Type 2, 12in./43in., 29/6. Type 3, fully retractable and locking 1in./50in. Depth below wing, 14in., 39/6. All plus P. & P. 2/6, if purchased separately.

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DESPATCH-TODAY?-PHONE-R.C.S.!

DE-LUXE RECORD PLAYER KITS

Autochange 2-tone Cabinets 17 x 15 x 8½in. High flux loudspeaker, 3 watt famous make amplifier ready built. Quality output. Volume and Bass controls. All items fit together perfectly. Special instructions enable assembly in 30 minutes only 5 wires to join. 12 months guarantee.

AUTOCHANGE KITS. Absolutely complete.
B.S.R. Monarch............ £10.10.0 P.P. 7/6
Garrard "1000"............ £11.19.6 P.P. 7/6
Garrard AT50 £12.10.0; AT60 £14.5.0 P.P. 7/6
OR SEPARATELY
Cabinet with board 14 x 13in. £3.9.6 P.P. 5/6
3 watt amplifier with speaker £3.12.6 P.P. 3/6
AUTOCHANGERS with LP/78 xtal pick ups
B.S.R. UA25 or UA14 Mono.. £5.19.6 P.P. 3/6
Garrard "1000" Mono........ £6.10.0 P.P. 3/6
Garrard AT50 £8.10.0; AT60 £10.10.0 P.P. 5/6
SINGLE PLAYERS with LP/78 xtal pick ups.
B.S.R. Junior. £3.7.6; B.S.R. GU7 £4.17.6. P.P. 2/6
GARRARD TRANSCIPTIONS SP25. £11; A70 £21; LAB80. £25; 401. £30. P.P. 5/6 each.

Q MAX CHASSIS CUTTER

Complete die punch Allen screw and key

½in.	14/6	1$\frac{1}{16}$in.	18/-	1¾in.	22/6
⅝in.	14/9	1⅛in.	18/-	2in.	34/3
¾in.	15/6	1¼in.	18/6	2$\frac{3}{32}$in.	37/9
⅞in.	15/9	1⅜in.	20/-	2½in.	44/3
1in.	18/-	1½in.	20/6	1in. sq.	31/6

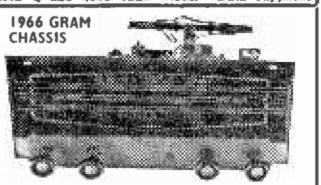
CRYSTAL MIKE INSERTS
1⅛in. dia. x ⅜in., 6/6: BM3 1 x ⅜in., 7/6:
ACOS M.C. insert 1⅛in. dia. x ¼in. 8/6
TANNOY CARBON MIKE complete, 5/6

Coils Wearite "P", 4/-; Osmor "Q" from 4/-. Rep. DRR2 L. & M. with reaction, 4/6. Ferrite Aerials Valve. M. 8/9: M.L., 12/6. Ferrite Aerials. L. & M. for transistor/circuits. OSMOR. 10/-. WEYRAD. 12/6. Ferrite Rod 8 x ⅜in., 6 x ¼in., 6 x $\frac{5}{16}$in., 3/- ea. H.F. Choke. 2/9. Osmor QC1, 6/9. Test Prods. 4/6 pr. Set Trim Tools, 3/-. Neon Mains Tester Screwdriver. 5/-. Multicore Solder. 6d. yd. Dispenser. 2/6. VALVE HOLDERS. Int. Oct 6d. Mazda Oct. 6d. B7G B8A, B8G, B9A 9d.; B7G B9A Cans. 1/-. Ceramic I.O. EF50 BG7 B9A. 1/-. Valve plugs 2/3.

MOVING COIL MULTIMETER TK 20a 0-1000v. A.C/D.C. ohms. 0 to 100K. etc., 47/6.
MOVING COIL MULTIMETER EP10K 0-1000v A.C./D.C. ohms 0 to 3 meg etc. 79/6.
MOVING COIL MULTIMETER EP20K 0-2500v. D.C. 0-1000v. A.C. 20,000 ohms per volt. 0 to 6 meg 50 Microamps 99/6.
MOVING COIL MULTIMETER EP30K 0-1200 D.C. A.C. volts. 30,000 ohms/v. (D.C.) 0-10meg. 23 microamps. Full scale. Decibels —10 to + 23dB. 13?/6

I.F. TRANSFORMERS 7/6 pair
465 K/s Slug Tuning Miniature Can. 3 x 1¼in. dia. High Q and good band width. Data supplied.

1966 GRAM CHASSIS



Three Wavebands. Five Valves ECH81. Long. Med. Short. EF89. EBC81. EL84, EZ80 12-months guarantee. A.C. 200/250v. Ferrite Aerial. 5 watts. 3 ohm. 13½in. x 7in. high x 5in. deep. Dial size 13 x 4in. horizontal working. Aligned. calibrated. Chassis isolated from mains.

BRAND NEW £9.19.6 Carr. 5/6
Matched speakers 10 x 6in.. 22/6; 13 x 8in., 45/-.

VHF-FM RADIOGRAM CHASSIS £16.10.0
With Long and Med. Wavebands. 15in. x 7in. x 9in.

NEW ELECTROLYTICS FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350v	2/-	100/25v	2/-	8/600v	9/-
2/350v	2/3	250/25v	2/6	16/600v	12/-
4/350v	2/3	500/15v	2/6	16+16/500v	7/6
8/450v	2/3	2000/50v	11/6	32+32+32/350v	6/6
16/450v	3/-	8+8/450v	3/6	32+32/450v	6/-
32/450v	3/9	8+16/450v	3/9	50+50/350v	7/-
25/25v	1/9	16+16/450v	4/3	64+120/350v	11/6
50/50v	2/-	32+32/350v	4/6	100+200/275v	12/-

PAPER TUBULARS
350v. 0.1 9d.; 0.5 1/9; 1 mFd, 3/-; 2 mFd, 150v. 3/-
500v. 0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.5 2/6
1,000v. 0.001, 0.0022, 0.0033, 0.0047, 0.01, 0.022, 1/6; 0.047, 0.1, 2/-, 0.22. 0.47 3/-.
2,000v. 0.005, 0.01. 0.02, 2/6; 0.05, 3/6.
Sub-Min. 0.001 0.005. 0.01. 0.02, 0.04. 0.05, 0.1. 1/-
Sub-Min. Electrolytics 1, 2. 4 5, 8, 16, 25, 30. 50 100, 500. 1 000 mFd. 15v.. 2/6. 1,000 mFd 50v. 7/6

SILVER MICA (tolerance 1pF), 2.2 to 47pF. 1/-. ditto 1% 50 to 800 pF. 1/-; 1,000 to 2,000 pF. 1/9
CERAMICS 500v 1pF to 0.01 mFd. 9d. each.
TWIN GANGS. "O-O" 208 pF + 176 pF. 10/6; "O" 365 pF min.. 10/-; 500 pF standard with trimmers 9/6; midget with trimmers. 9/-; 500 pF slow motion standard. 9/-; small 3-gang 500 pF. 19/9. Single "O" 365 pF. 7/6 SHORT WAVE. Single 10 pF 25 pF 50 pF. 75 pF. 100 pF 150 pF. 5/6 each. Can be ganged together. Couplers 9d. each.
TUNING AND REACTION. 100 pF 300 pF 500 pF 3/6 each. solid dielectric. TRIMMERS Compression ceramic. 30. 50. 70 pF 9d.; 100 pF 150 pF 1/3. 250 pF 1/6; 600 pF 750 pF, 1/9.
HEADPHONES. 2,000 ohms 12/6; 4,000 ohms. 15/-.
EL84 Transformer De Luxe. Push-Pull 30w., 90/-.
EL84 (510) Ultra Linear Push-Pull, 10w. 49/6.
10w. Multi-ratio Push-Pull, 18/6. EL84 (3-3) 25/-.
Standard Pentode. 5/6. ELL80 o.p.t. 12w., 45/-.

TRANSISTOR MAINS ELIMINATOR PP1-6v. PP9-9v. 29/6
DOUBLES 42/6. PP1+PP1 PP9+PP9. PP11 (4½+4½) Size as batteries. Also min. 9v. 19/6.

WEYRAD P50 COILS
Ferrite aerial 12/6; Osc. P50/1AC. 5/6; 1st and 2nd I.F. P50/2CC, 5/7 each; 3rd I.F. P50/3CC, 6/-: Driver Trans-LFDT4, 9/6. Printed Circuit 9/6: 35 ohm Speakers, 5in: 17/6: 6x4in. 21/- Book 2/-. 3 ohm OPT 10/6

NEW MULLARD TRANSISTORS
Holders 1/3; OA81 3/-: OC71. 6/-: OC72. 7/6; OC81, 7/6; AF115, 10/6; AF114. 11/-; OC44. 8/-; OC45. 8/-; OC171. 9/-; OC170 8/6. AF117. 9/6. OC26, 12/6; ORP12, 12/6.
SILICON RECTIFIERS. OA210 500 mA. 200v.. 5/6; BY100 550 mA. 400v.. 10/-.

MAINS TRANSFORMERS *Postage 2/- each.*
STANDARD 250-0-250; 80mA. 6.3v. 3.5a. tapped 4v., 4a. Rectifier 6.3v , 1a., 5v. 2a., or 4v. 2a. 25/-; ditto 350-0-350 29/6
MINIATURE 200v., 20mA. 6.3v.. 1a 10/6
MIDGET 220v.. 45mA. 6.3v. 2a 15/6
SMALL 300-0-300 70mA.. 6.3v. 4a 19/6
E.M.I. 280-0-280. 100mA, 6.3v. 3.5a. 6.3v. 1½a 17/-
HEATER TRANS. 6.3v., 1½a.. 7/6; 6.3v. 4a. 10/6
Ditto, tapped 1.4. 2, 3 4. 5 6.3v.. 1½a 8/6
GENERAL PURPOSE LOW VOLTAGE 2 amp. 3. 4. 5, 6. 8 9 10. 12. 15, 18. 24. 30v. 25/-
1 amp. version, taps and C taps up to 60 v. 29/6
AUTO TRANSFORMERS. 230-110v., 60w. 18/- 0-115. 200, 230. 240v.. 150w. 25/-; 500w. 82/6
MULLARD "510" Mains Transformer 33/6
TRANSISTOR 9v. 80mA.. 1¼ x 1¼ x 1in. 7/6

BEST BRITISH P.V.C. RECORDING TAPES (Spare Spools 2/6 ea.)

LP 5in.	900ft.	11/6	DP 5in.	1200ft.	18/6
LP 5¾in.	1200ft.	14/6	DP 5¾in.	1800ft.	24/6
LP 7in.	1800ft.	19/6	DP 7in.	2400ft.	29/6

Volume Controls
Linear or Log Tracks Long spindles. Midget 5 K ohms to 2 Meg L.S. 3/- D.P. 4/6
Stereo L/S 10/6; DP 14/6 1m log+1m A/log. 7/6

80 ohm CABLE COAX
Semi-air spaced ¼in. 40 yds.. 17/6 60 yds. 25/- **6d. yd.**
Ideal 625 lines U.H.F. Low loss 5dB 100ft. 300 Mc/s **1/6yd.**

TELESCOPIC CHROME AERIALS. 12 to 33in.. 6/6.
TRIPLEXERS Bands I.II. III 12/6 COAX PLUGS 1/-
LEAD SOCKETS, 2/-; PANEL SOCKETS. 1/-.
OUTLET BOXES (Surface or flush). 4/- each.
BALANCED TWIN FEEDERS. 6d. yd. 80 or 300 ohm
TWIN SCREENED. 1/6 per yard, 80 ohms only.

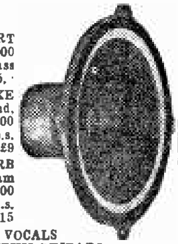
THE "INSTANT" BULK TAPE ERASER AND RECORD HEAD DEMAGNETIZER 200/250v. A.C. 35/-

RETURN OF POST DESPATCH
P.P. Charge 1/6 Full list 1/-. C.O.D. 2/6 extra

BAKER LOUDSPEAKERS

HANDMADE BY CRAFTSMEN

HIGH FIDELITY MODELS



12in., 15w., STALWART 3 or 15 ohm. 45-13,000 c.p.s., 12,000 lines. Bass res. 45 c.p.s. £5.5.
12in., 15w., DELUXE Foam Cone Surround. 25-16,000 c.p.s., 14,000 lines. Bass res. 35 c.p.s. Remarkable value. £9
12in., 20w., SUPERB Aluminium Drive, Foam Cone Surround 20-17,000 c.p.s., Bass res. 22 c.p.s. Unbeatable value. £15

GROUP MODELS FOR VOCALS BASS LEAD and RHYTHM GUITARS
Frequency response 30-10,000 c.p.s.
Voice Coils 15 ohms. Heavy Duty outputs.
"GROUP 25" 12in. dia.. 25w., 12,000 lines 5 gns.
"GROUP 35" 12in. dia.. 35w.. 14,000 lines 8½ gns.
"GROUP 50" 15in. dia.. 50w.: 17,000 lines 18 gns.

LOUDSPEAKERS P.M. 3 OHM FAMOUS MAKES. 2½in.. 3in., 4in.. 5in. 7 x 4in.. 15/6 each: 8in.. 17/6; 6½in. 16/6; 10in., 30/-: 12in. 30/-; (15 ohms. 35/-); 10 x 6in.. 22/6; 8 x 3in., 21/-; 9 x 6in., 21/-.
EMI 13 x 8in. ceramic, double cone. 3 or 15 Ω. 45/-.
WAVE-CHANGE SWITCHES, 2 p. 2-way or 2 p. 6-way; 3 p. 4-way or 1 p. 12-way; 4 p. 2-way or 4 p. 3-way. 3/6 each: 8 p. 4-way 2 wafer. 6/6.
WAVE-CHANGE "MAKITS" available 1 p. 12-way 2 p. 6-way, 3 p. 4-way 4 p. 3-way 6 p. 2-way. Kit Price 1 wafer 8/6; 2-wafer 12/6; 3 wafer 16/-. Extra wafers 3/6 each. extra long shafts 2/- extra.
TOGGLE SWITCHES s.p. 2/-. d.p. 3/6, d.p.d.t. 4/-.

★RADIO BOOKS★ (P.P. 9d.)

Valves, Diodes, Transistor equivs. 10/6
Transistor Audio Amplifier Manual 6/-
Shortwave Transistor Receivers .. 5/-
Beginners' Modern Transistor Sets 7/6
Sub-miniature Transistor Receivers 5/-
Boys' Book of Crystal Sets 2/6
"W.W." Radio Valve Data 7/6
High Fidelity Speaker Enclosure .. 5/-
TV Fault Finding 6/-
Mullard Amplifier Manual 8/6
Valve Guide, Books 1, 2, 3, 4 or 5 5/- ea.
Practical Radio Inside Out 4/6
Transistor Communication Sets .. 6/-
Transistor Controlled Models .. 7/6
International Radio Stations .. 2/6

JACK SOCKETS. Standard 2/6, closed circuit 4/6. Grundig type 3-pin 1/3; Standard Lead Type 6/-. Phono Plugs 1/-. Socket 1/-. Banana Plugs 1/-.
JACK PLUGS. Screened 3/-. Grundig 3-pin 3/6.
BULGIN NON-REV. PLUGS and SOCKETS. P74. 2-pin 4/3; P73 3-pin 4/6; P194 6-pin 6/6; P466 12/6.
RESISTORS. Preferred values, 10 ohms to 10 meg. ¼ w., ½ w., 1 w. 20% 4d.; 1½ w., 3d.. 2 w. 1/-.
HIGH STABILITY ½ w., 1% 2/-. All Values. 10 ohms to 10 meg. Ditto 5% 10 ohms to 22 meg.. 9d.

5 watt / 10 watt / 15 watt WIRE-WOUND RESISTORS 0.5 to 8.2 ohm 3 W, 10 ohms—6,800 ohms 1/6 / 1/9 / 2/-
10 K. 15 K. 25 K. 10 w. 3/-
MAINS DROPPERS Midget. With sliders 0.3a., 1 K., 0.2a.. 1.2 K., 0.15a.. 1.5 K., 0.1a. 2 K.. 6/- each. Line Cord 100 ohms ft., 3-way. 1/- ft.
Wirewound Ext. Speaker Controls 10 Ω 3/-; 25 Ω 6/6.
WIRE-WOUND POTS 3 WATT. Miniature TV Types. All values 10 ohms to 25 K., 3/- each. 30 K.. 4/-. (Carbon 30K to 2 meg.. 3/-). All with knob.
WIRE-WOUND POTS 4 WATTS. Long ¼in. Spindle. Value 50 ohms to 50K. 6/6; 100 K., 7/6.
SPEAKER FRET Tygan various colours 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples S.A.E.
EXPANDED METAL Gold or Silver 12 x 12in., 6/-.

ARDENTE TRANSISTOR TRANSFORMERS
D3035 7.3 CT.1 Push-Pull to 3 ohms output 11/-
D3034 1.5:1 C.T. Push-Pull Driver 11/-
D3058 11.5:1 Output 3 ohms, 11/-; D1001, 12/-;
D239 4.5:1 Driver. 11/6; D240 8.5:1 Driver. 11/6
TRANSISTOR POTS 5 K Switched VC1545 5/3
SUB MIN EARPIECE Xtal or Magnetic 7/6
SUB-MIN JACK AND PLUG 2.5 or 3.5mm. 3/6 pr.

TV REMOTE CONTROL for Philips 19TG111A, 121A. 125A, 142A 23TG111A 113A. 121A. 131A. Cossor CT1910A. 21A. CT2310A 21A 31A. Stella ST1033A. 39A 43A. 53A. Plug-in with 11ft. 7-way cable. 3 DP switches, dual pot. volume and brightness. OA81 diode etc. etc. List 3 gns. New, boxed. OUR PRICE 12/6 post free.

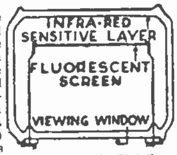
Blank Aluminium Chassis. 18 s.w.g. 4 sides. riveted corners. lattice fixing holes. 2½in. sides 7 x 4in., 5/6; 9 x 7in., 6/6; 11 x 7in.. 7/6; 13 x 9in.. 9/6; 14 x 11in.. 12/6; 15 x 14in.. 15/-; 11 x 3in.. 6/6.
Panels 18 s.w.g. 12 x 12in.. 5/6; 14 x 3in. 4/6; 12 x 8in.. 3/6; 10 x 7in., 2/9; 6 x 6in., 2/-;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

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD WEST CROYDON Telephone THO 1665

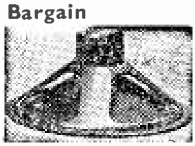
Written guarantee with every purchase *(Export: Send remittance and extra post, no C.O.D.)* Buses 133, 68 pass door, S.R. Stn. Selhurst

SNIPERSCOPE



Famous wartime "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. It follows that as light from an ordinary lamp is rich in infra-red these cells will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price **5/-** each. Post 2/-. Data will be supplied with cells if requested.

Speaker Bargain



12in. High-fidelity loudspeaker. Highflux magnet type with either 3 ohm or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price **29/6** + 3/6 post and insurance.

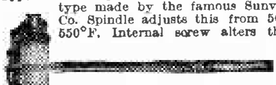
SPOT OR FOG LAMP

Made by Lucas, Flat or pencil beam, 36 watt. Suitable for car, boat, caravan, etc. Complete with 6 or 12v bulb, flex, cables and fixing bolt. Remarkable bargain. Price **12/6** + p. & p. 3/6

THERMOSTATS

Type 'A' 15 amp for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob quickly adjustable from 30°—80°F. **9/6** plus 1/- post. Suitable box for wall mounting, **5/-**. P. & P. 1/-.

Type 'B' 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550°F. Internal screw alters the



setting so this could be adjustable over 30° to 1,000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flamestat or fire alarm. **8/6** plus 2/9 post and insurance

Type 'C' is a small porcelain thermostat as fitted to electric blankets, etc. 1½ amp. setting adjustable by screw through side. **3/6.** P. & P. 6d.

Type 'D' We call this the Ice-stat as it cuts in and out at around freezing point 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. **7/6.** P. & P. 1/1.

Type 'E' This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, **7/6**, plus 1/- post.

9-Way push-button switch

Each way having two single pole change over and one shorting switch, good length push rods **30/-** per doz. **3/6** each, post 2/9 per doz.

Waterproof Heater Wire

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

Three Unusual Items

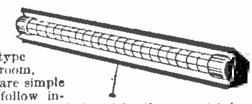
OZONE OUTFIT—for removing smells and generally improving any oppressive atmosphere. Kit consists of Philips Ozone Lamp and mains unit only needs box. **19/6** plus 3/6 postage and insurance.

BLACK LIGHT UNIT. 40 watt intensity, comprises lamp, lamp holder and 40 watt choke. Only **19/6** plus 6/6 carr. & ins.

TIMER KIT. Special offer of all components except metal box to make mains operated interval timer for photography etc. **12/6** plus post 2/6.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9.

INFRA RED HEATER



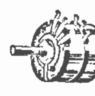
Make up one of these latest type heaters, ideal for bathroom, kitchen, bedroom, etc. They are simple to make from our easy to follow instructions—use silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated, **21/6** plus 3/6 post and insurance. Pull switch 3/- extra.

SNIP FOR RECORD LOVERS

Acos GP83 Turnover Cartridge

for Stereo—LP—and 78 records fitted with two Styli—diamond for Stereo and LP—Sapphire for 78. This is mounted and is a standard replacement for most record players using Garrard—B.S.R.—Collaro etc., etc. The regular price of this cartridge is 55/-. We offer these new and perfect for **15/-** (less than the price of one stylus) plus 2/- post and insurance.

GANGED POTS



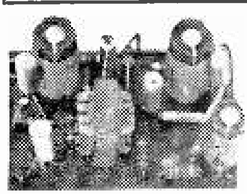
Standard type and size with good length of spindle—made by Morganite. List-price is **10/-** each but if you act quickly you can have them at **12/-** doz. (or **1/6** each if less than doz). Following values in stock all "lin"—5K + 5K—10K + 10K—100K + 100K—500K + 500K—1 meg + 1 meg all new and unused. Post 2/9 on 1st doz then 1/- per doz 6 doz or more post free.

YOUR LAST CHANCE FOR THIS

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

"CORONET" Mk. IV

It fully covers the medium waveband and that part of the long waveband to bring in B.B.C. Light. The circuit includes a highly efficient slab aerial and 2½in. P.M. speaker. Overall sizes approximately 4½ x 2½ x 1½in. Supplied complete with carrying case and instructions.



750 mW TRANSISTOR AMPLIFIER

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 5 m/v.

Price 19/6

Post and insurance 2/6. 35 ohm Speaker **12/6** extra.

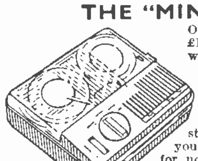
THIS MONTH'S SNIP

B.S.R. UA 16 RECORD PLAYER

WHICH IS THE BEST RECORD CHANGER TO BUY?

If you want a "pretty" unit which will give next to perfect results and years of trouble-free service even though it may not always get the most careful treatment then the unit for you is the B.S.R. UA16. It operates at usual four speeds off standard A.C. mains, takes one to ten records (mixed sizes if you like), is super slim and fitted with famous "Full-Fi" head for 33 or 78 records. You can have one of these brand new in perfect order, guaranteed and sent by insured transport for only **£4.19.6** plus 7/6 carriage and insurance.

THE "MINY" TAPE RECORDER



Of the many tape recorders to offer at £12 or less we have at last found one we can recommend. This instrument uses two motors, is completely portable and is beautifully styled and looks like a good tape recorder. Among its many good features is a switch on the microphone to stop and start the tapes, a very useful feature for you when recording, and for your typist for note taking, stock taking, etc. Other points are twin track recording—40 mins. with normal tapes, standard batteries. Although originally sold at **£16.16.0** we are able this month to offer for only **£6.19.6** plus 5/- post and insurance. Brand new and complete with microphone, batteries, tape and spools, nothing else to buy. DON'T MISS THIS AMAZING OFFER.

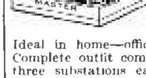
BATTERY ELIMINATOR

With this you can operate your pocket radio from the mains. You can also re-charge PP3 batteries five or six times. Only **18/6** plus 3/- post and insurance. Will save its cost in no time.

TWO WAY RADIOS

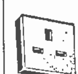
Give communication over ½ mile. FULLY transistorised —crystal controlled built-in telescopic aerial—press button operation—PP3 batteries —pair instruments complete and ready to use. **£7.9.6.** plus 5/- post and insurance. G.P.O. Licence required if used in this country.

FOUR-STATION INTER-COM



Will save time and improve efficiency. Ideal in home—office—shop—surgery etc. Complete outfit comprises Master unit and three substations each of which can call the master and have full two-way working. No wiring problems as subs fitted with 60ft. twin flex and they plug into sockets. Also included is packet of staples—and battery. **Nothing else to buy—£7.15.0** plus 4/6 post and insurance.

13 AMP SOCKET



Change all those old-fashioned ones to these modern fused types or install a new ring main. White sockets for surface mounting or for letting into wall or skirting —best make (G.E.C.). **5/6 with switch** or **3/9 less switch.** Six or more post free otherwise add 2/-.

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Gives 300 watts of heat with approx. 150 watts of light and simply fits in place of lamp. **29/6.** Plus 3/6 carriage and insurance.

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Soil heating wire and transformer. Suitable for standard size garden frame. **12/6** plus 2/6 post & ins.

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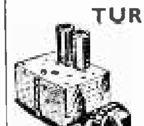

By the famous Cyldon or Brayhead firms complete with coils, but less coil cover valves and knobs—all 35 mc/s—wonderful bargain at **6/6** each plus 2/9 post.

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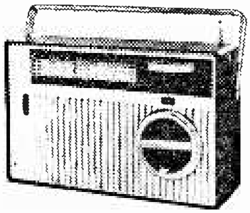
GENERAL SPECIFICATION

7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. The SKYROVER and SKYROVER DE LUXE cover the full Medium Waveband and Short Waveband 31-94 M and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection The coil pack and tuning heart is completely factory assembled wired and tested. The remaining assembly can be completed in under three hours from our easy to follow stage by stage instructions.



A simple additional circuit provides coverage of the 1100/1950M. band (including 1500 M. Light programme). All components and detailed construction data.
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This conversion is suitable for both models that have already been constructed.

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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Now supplied with redesigned cabinet, edgewise controls, black and chrome plastic cabinet.
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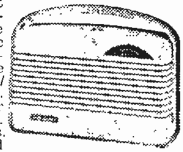
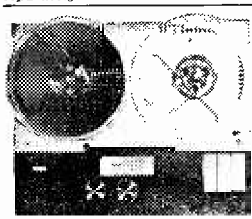


Can be built for **£5.19.6**
Post 4/6.
PP9 Batt. 3/9. Data and Instructions separately 2/6. Refunded if you purchase the parcel. All parts sold separately.

REALISTIC Seven DE LUXE

With the same specifications as standard model—PLUS a superior wood cabinet in contemporary styling with full vision circular dial. ONLY **£1** EXTRA



The Very Latest MAGNAVOX-COLLARO 363 TAPE DECKS

3 speed model—1⅞, 3¾, 7½ i.p.s., available with either ½ track or ¼ track heads. Features include: pause control: digital counter; fast forward and rewind; new 4 pole fully screened induction motor; interlocking keys. Size of top plate 13½ x 11 x 5¼in. deep below unit plate. For 200/250v. A.C. mains, 50 c.p.s. operation. New, unused and fully guaranteed.

LASKY'S PRICE with ½ track heads **£10.10.0**
LASKY'S PRICE with ¼ track heads **£13.9.6**
Carriage and packing 7/6 extra

SPECIAL for OVERSEAS CUSTOMERS—the new Magnavox-Collaro 363 Deck for 110/125 v., 50 or 60 c.p.s. mains now available, prices as above. Post to any part of the World 35/-.

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XO/750 HALF SECTION CROSSOVER. For use with bass and treble speakers. 15Ω imp. to crossover at 750 c.p.s. Rated at 25 watts (British). In wood case 6¼ x 4½ x 4in. New and unused.

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STEREOPHONIC FILTER. This is a frequency divider/mixer for use with a Stereo amplifier. Its function is to combine the bass frequencies up to 300 c.p.s. into a single bass speaker for both channels and to divide the frequencies above 300 c.p.s. into two separate mid/top range speakers. It can also be used as a 300 c.p.s. crossover for a mono system. 15 Ω imp. Rated at 25 watts (British). In wood case 10 x 4½ x 3 in. New and unused.

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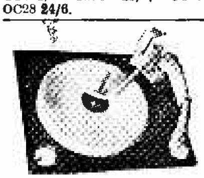

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4in.	Triple play 900ft. Mylar base	17	6
5in.	Double play, 1,200ft., Mylar base	15	0
5in.	Long play, 900ft., Acetate base	10	0
5in.	Standard play, 600ft., PVC base	8	6
5in.	Triple play, 1,800ft., Mylar base	35	0
5¾in.	Double play 1,800ft. Mylar base	22	6
5¾in.	Long play, 1,200ft. Acetate base	12	6
5¾in.	Standard play, 850ft., PVC base	11	6
5¾in.	Long play, 1 200ft., Mylar base	15	0
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
7in.	Long play 1,800ft. Acetate base	15	0
7in.	Triple play, 3,600ft., Mylar base	58	6

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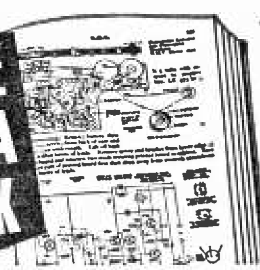

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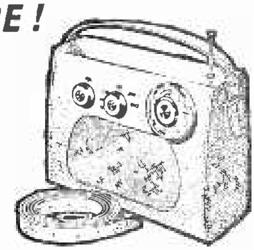

7 WAVEBAND PORTABLE OR CAR RADIO

Amazing performance and specification ★ *Now with PHILCO MICRO-ALLOY R.F. TRANSISTORS*

FULLY TUNABLE ON ALL WAVEBANDS ● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room filling volume from rich toned 7" x 4" speaker. Air spaced, ganged tuning condenser. Ferrite rod aerial for M & L waves and telescopic aerial for S waves. Real leather look case with gilt trim and shoulder and hand straps. Size 9 x 7 x 4in. approx. The perfect portable and the ideal car radio. (Uses PP7 batteries available anywhere.)

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". . . amazed at volume and performance . . . has really come up to my expectations." S.G. Stockton-on-Tees.

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

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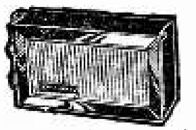
POCKET FIVE

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



Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5¼ x 1¼ x 3¼in. (Uses 1289 battery available anywhere).

Parts Price List and easy build plans 1/6 (FREE with kit)

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NEW ROAMER SIX

NOW WITH PHILCO MICRO-ALLOY R F TRANSISTORS

● **6 WAVEBAND ! !**

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

Listen to stations half a world away with this 6 waveband portable. Tuneable on Medium and Long waves, Trawler band and two Short Waves. Sensitive ferrite rod aerial and telescopic aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings. Size 7½ x 5¼ x 1½in. Carrying strap 1/6 extra.

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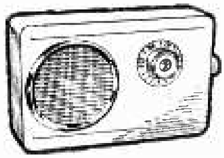
Parts Price List and easy build plans 2/- (FREE with kit) Total cost of all parts now only **£3.19.6** P. & P. 3/6

New TRANSONA FIVE



"Home, Light, A.F.N., Lux. all at good volume." G.P. Durham.

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

Fully tunable over Medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic 2½in. speaker etc. Attractive case. Size 6¼ x 4½ x 1½in. with red speaker grille. (Uses 1289 battery available anywhere.)

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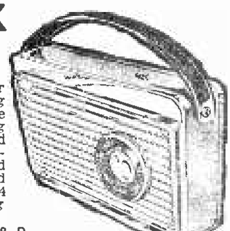
TRANSONA SIX

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



This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6¼ x 4½ x 1½in. (Uses PP4 battery available anywhere.) Carrying strap 1/- extra.

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Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 R.F. Stages, push-pull output. 3in. speaker (will drive larger speaker). Size 7¼ x 5¼ x 1½in. (Uses 9v. battery, available anywhere.)

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PRACTICAL WIRELESS

FEBRUARY 1966
VOL 41 NO 708

INCONSISTENCY

THE radiation of unlicensed radio signals is illegal. Yet how does the responsible body—the GPO—deal with offenders? It depends, it would seem, not so much on points of law but of expediency.

Unlicensed "hams" are quickly pounced upon, fined and their equipment confiscated, as can be seen from the names and addresses of those now sadder and wiser which appear in the RSGB Bulletin. And recently, the Postmaster General quickly clamped down on the use of radio microphones following a clamorous press campaign.

But what of the pop pirates? Despite an EBU agreement and despite assurances from the PMG shortly after taking office that "steps will be taken", all we have had so far is prevarication. Admittedly, a Government not wishing to jeopardise its popularity would have to think twice before taking steps against these stations. And in the meantime, they are allowed to go their merry way, untouched and—we cannot help thinking—with tacit approval.

On the other hand there are no political undercurrents associated with the sphere of piracy manifest in the 27 Mc/s walkie-talkie situation. The Board of Trade continues to license the import of these transceivers, radio dealers continue to sell them to all and sundry and the GPO (except for the recent spectacular swoop on the fisherman's radio net) appears to sit back and wait for individuals to start using them.

This is a ludicrous situation from any standpoint, yet it could be solved simply and quickly given a little energy. In the matter of unlicensed radio transmitting the GPO moves in wondrous and mysterious ways. Some consistency of purpose is very long overdue. *One practical idea is to make the production of a licence legally essential before anyone can purchase any transmitting equipment.*

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 MARCH ISSUE WILL BE PUBLISHED ON FEBRUARY 3rd.

Ham or Sham?

THE editorial in the December issue of P.W. brought back many happy memories of the early 20's when I first became a "ham" and the proud possessor of the call-sign 2OY. Later, in 1924 when I was transferred to India, I was able to re-open my station there with the call-sign 2JL.

When 2OY first transmitted it was with largely home-built equipment; so also was 2JL. Government surplus became available and the station was improved with components from surplus sets.

In order to obtain my licence it was necessary to have five sponsors who stated in writing that they would be willing to exchange signals with me and to give full details of the equipment to be used. The P.O. official who called at my home to give the 12 w.p.m. morse test did so at about 20 w.p.m. and when I said, "Wasn't that a bit fast for 12 w.p.m.?", he said he thought he would see what I could do.

I was first licensed to transmit on 1000 metres and wavelengths up to 180 metres. Sometime later 1000 metres was cancelled and 440 metres substituted.

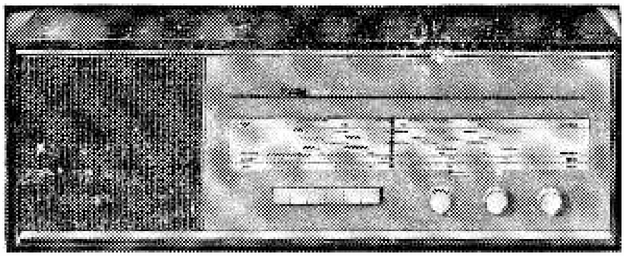
My transfer to India was made at fairly short notice so I wrote to the Posts and Telegraphs Dept., Delhi, and explained the position and said I proposed to bring my equipment with me in the hope that it would be admitted by Customs on arrival at Bombay and that I might be allowed a licence later. Imagine my pleasure and surprise to find a letter awaiting me on arrival saying the customs officials had been authorised to admit my equipment and my licence approved. Would I be so good as to remit the licence fee at my convenience.

But to come back to your point. I wonder if I would have made a bee-line for a store selling commercially made transmitters and receivers? I doubt it! The pleasures of surmounting the many obstacles would have been missed, including the numerous congratulations I received on the quality of the speech and music transmissions using an early model Ford ignition coil as the power supply.

E. J. Hobbs. Sidcup, Kent.

NEWS AND...

NEW PAM RADIO



From Pam (Radio & Television) Ltd., comes the solid state mains radio, model 5230. Features include: ten transistors with complimentary push-pull output of over 2½W; four wavebands (v.h.f., long, medium and short); piano key controls (gram, tape, LW, MW, SW and f.m.) and an 8in. x 5in. 15Ω speaker. The slim-line cabinet is of selected Sapele veneer with scratch-resistant finish. Weight is 15lbs. and the price, 32 guineas.

SELLOTAPE INSULATING TAPE

Sellotape polythene insulating tape, which is invaluable for the serviceman, is available from most good hardware and electrical stores. The tape is available in six colours—red, blue, black, white, green and yellow. It is fully insulating and completely waterproof, and has a certain amount of elasticity which makes for neat and tidy repairs. A ¾in. x 15ft. roll retails at 1s. 9d.

HEATHKIT GUITAR/PUBLIC ADDRESS AMPLIFIER

From Daystrom Limited, Gloucester, comes the Heathkit PA-2 power amplifier.

It employs a fully transistorised circuit, capable of delivering 20W r.m.s. power (33W IHFM) when fully loaded, into the two 12in. heavy-duty loudspeakers.

Two channels are provided—one with a tremolo facility—and each channel has two inputs.

Sensitivity is sufficient for the vast majority of electric guitars and for most microphones. An input suitable for the more sensitive type of microphone is available on one channel.

The equipment, comprising a preamplifier with controls, a power amplifier and two 12in. loudspeakers, is housed in a sturdy, attractive cabinet. Legs or castors are available as optional extras.

SPECIFICATION. Power output: 20W r.m.s., 33W IHFM; output impedance, 8 ohms. Channel 1: sensitivity, input A, 20mV; input B, 5mV. Controls: continuously variable; volume, bass and treble. Channel 2: sensitivity, inputs A and B, 20mV; controls: continuously variable; volume, bass, treble, tremolo speed and tremolo depth (with tremolo On/Off switch). Transistor complement: 5—OC44, 2—2N2712, 1—2N408, 4—BC107, 2—2N2147, 2—2N2148. Diode complement: 8—silicon diodes, 2—1N2326. Speakers: two 12in. heavy duty, 15 ohms each, approx. 8 ohms in parallel. Hum and noise: channel 1:—50dB channel 2, —44dB; cabinet: wood, finish black/gold Vynair, gold trim. Power requirements: 100-250V a.c., 50/60c/s 32W. Dimensions: 19in. high x 30in. wide x 10in. deep. Net weight, 49lb; shipping weight, 60lb. Kit price, £44 19s 0d.

Optional extras: set of four legs, 17s 6d; set of four 1⅝in. diameter castors, 13s 0d.

..COMMENT

"PRACTICAL WIRELESS" AND "PRACTICAL TELEVISION" FILM SHOW

The Film Show, which is held annually, is to be held, as before, at Caxton Hall, Caxton Street, Westminster, London, S.W.I. The date of the Show, which is arranged in collaboration with Mullard Limited, is Friday, February 4th, 1966, at 7.30 p.m. sharp. The films to be shown are "Electromagnetic Waves, Part II" and "Thin Film Microcircuits". The illustrated talk will be on "Transistor Topics". The talk will be given by Mr. Ian Nicholson of Mullard Limited, and in the chair will be Mr. W. N. Stevens, Editor of "Practical Wireless" and "Practical Television".

Refreshments will be provided during the interval.

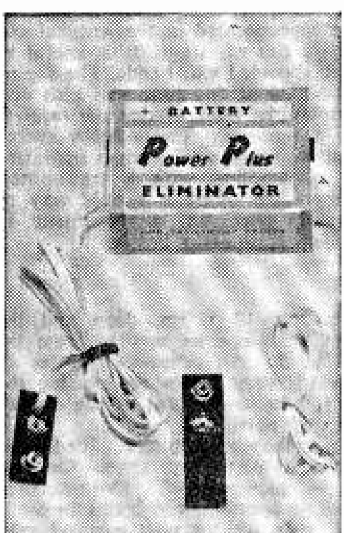
Applications for free tickets should be made to FILM SHOW, "Practical Wireless", Tower House, Southampton Street, London, W.C.2 and NOT to Caxton Hall. A stamped addressed envelope must be enclosed.

NEW STC PUBLICATION

STC have just published Application Notes covering the use of their BCY42 transistors in: (1) A 10Mc/s wideband amplifier. (2) An audio amplifier delivering 1mW into a 600Ω load.

Circuit diagrams and components lists are given and both Application Notes are in publication MK/185X available from STC Components Marketing Division, Footscray, Sidcup, Kent.

"BIJOU" MAINS POWER PACK



The drawback of the pocket-type transistor radio is the strictly limited life of the small battery when the set is extensively used. The voltage quickly drops and the reception becomes distorted. With the "Bijou" 9V power unit the voltage remains constant all the time; the consumption being less than that of an electric clock.

This power unit is easy to use: the battery should be removed and the battery clip of the set connected to a similar clip which is on one of the leads coming from the power pack. The other lead from the unit goes to 250V a.c. mains.

A "Booster" strap is also supplied with the unit. This enables old batteries to be reactivated. The Booster strap is connected to the clip of the power pack, and the old battery plugged into the other side of the Booster strap. The makers state that to get best results from the Booster strap, it should be plugged in soon after the set has been switched off.

The photograph shows the power unit complete with Booster strap. The price of the complete unit as shown, is 17s. 6d. plus p. and p., and it is obtainable from R.C.S. Products Ltd., 11 Oliver Road, London, E.17.

Plastic Sheet Tagboards

In your November issue you published a letter from Mr. W. E. Thompson, in which he advised readers not to use any form of decorative plastic sheet, on the grounds that "As it is heat-resistant it has a thin metal foil sandwiched in it, and this foil can cause short-circuits."

I would like to make it clear to your readers that "Arborite" decorative laminate, although heat-resistant, has no metal foil sandwiched in it.

L. Allen,
Publicity Manager,
Arborite Ltd.,
Ealing,
London, W.2.

Guitar Preamp

I recently constructed the guitar preamp described by Mr. Kampel in the June issue of Practical Wireless and although I found this little unit excelled itself in normal domestic use, the large amount of subsequent amplification needed for high-power work exposed a very troublesome hiss, which did not appear to be caused by faulty components. After some research, I found it was necessary to make two modifications to the circuit to overcome the hiss. One was to fit a resistor directly across the input: the value of resistor being about the same as the impedance of the pickup. (This can be found approximately by doubling the d.c. resistance of the pickup.) The second adjustment was to connect a capacitor across the output to effect a form of treble cut. The value of this capacitor can be found by trial and error, however, a good starting point is about 0·01μF if the next stage is transistorised, and 0·001μF if it employs valves.

One feels, however, that these measures are rather unsatisfactory as some attenuation of the signal is bound to occur. It would perhaps be interesting to know whether other constructors who have built this preamp have managed to find any other more satisfactory ways of suppression.

Ian Gregorig.
Borehamwood,
Hertfordshire.

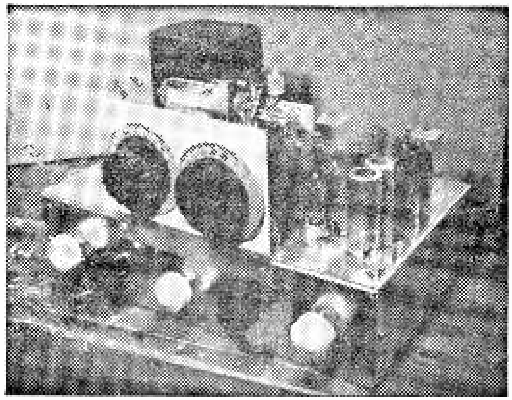
more News and Comment on page 876

The blueprint given away with this issue provides all the circuits and wiring diagrams.

designed by

R. F. GRAHAM

- ★ 5V SUPERHET
- ★ R.F. STAGE
- ★ I.F. REGENERATION
- ★ BANDSPREAD
- ★ TUNING INDICATOR



PROGRESSIVE SHORT WAVE RECEIVER

THIS receiver can be constructed in a number of stages, beginning with the basic 4-valve (plus rectifier) superhet. It should thus be useful for anyone who is looking for a sensitive and selective receiver covering medium and short wave bands, but who hesitates to build a rather complicated set immediately.

Coverage is from 580 to 9·5 metres, or 515kc/s to 31·5 Mc/s, in four bands. Ready made miniature plug-in coils are employed, to avoid the complication of switching. Actual band coverage is approximately as follows: 515—1545kc/s (580—194m). 1·69—5·3Mc/s (180—57m). 5—15Mc/s (60—20m). 10·5—31·5Mc/s (28—9·5m).

Some of the additions which can be made to the original receiver, to increase its scope, include bandspreading, r.f. stage with r.f. gain control, regenerative i.f. amplifier, tuning indicator, and stand-by/a.v.c. switching. These extras are added after the original receiver is in working order, and a high standard of performance is obtained.

Basic Circuit

This is shown in Fig. 1 and the receiver is first made in this form. Very good results are obtained on all bands. The aerial plug in coils are blue, and the oscillator coils are red. Each oscillator coil has a different pin•P for the padder capacitor, so that the correct capacity is automatically in use when a coil is inserted. VC1 and VC2 are sections of the ganged tuning capacitor. VC3 is a fully variable aerial circuit trimmer, so there is no need for a separate pre-set trimmer for each band. TC1, in the oscillator circuit is the only pre-set capacitor, and there are no trimming difficulties, despite the full waveband coverage of the receiver.

The second valve is the usual intermediate frequency amplifier, followed by a double-diode-triode for detection, a.v.c. bias, and audio amplification. The a.v.c. bias also controls the tuning indicator, when fitted. The 6BW6 output stage delivers ample volume for all ordinary purposes. The 6X4 is a full-wave rectifier.

For general all-wave reception, the receiver can be kept in the form shown in the circuit. For greater range and more freedom from 2nd channel interference, the r.f. stage can be added. Bandspreading can be incorporated in the original circuit, or added with the r.f. stage. It is useful to simplify tuning on crowded s.w. bands. The tuning indicator can be added at any time and also acts as an aid to alignment or when netting the receiver on a transmitter frequency. The standby switch (which leaves heaters on) is useful when operating the receiver in conjunction with a transmitter. Adding i.f. regeneration offers a simple way of receiving c.w. and gives an improvement in selectivity for crowded amateur bands.

Chassis Drilling

The chassis is 7 x 12 x 3in. deep and the positions of most holes can be marked from the dimensions in Fig. 2. An adjustable cutter or valveholder punch is very handy for making the larger holes. It is best to do most of the drilling before mounting any parts.

The mains transformer actually fitted was surplus but there is plenty of space for any transformer of the rating listed. Drop-through transformers need an opening, which can be made by drilling holes, then cutting with a metal saw. Other transformers mount above the chassis with leads descending through small holes.

Each i.f. transformer needs four clearance holes for pins two holes for 6BA bolts and a central hole to permit adjustment of the lower core. The valveholders are placed as in Fig. 3 and a 6BA tag added under each nut.

The ganged capacitor has three sections to allow tuning of the r.f. stage later. An insulated lead is soldered to each tag and passes down through a ¼in. hole. The dial plate is bolted to the front of the chassis and the ball drive is fixed to it. Trimmer TC1 is a 30pF air-spaced beehive soldered directly from VC2 to a tag bolted to the tuning capacitor frame.

The rotor tags of the ganged tuning capacitor are wired together and to 6BA tags under the heads of the fixing bolts. Other tags on the same bolts below the chassis provide earthing points for the oscillator coil padders and aerial coil holder.

Below Chassis

Components and wiring appear in Fig. 3. Leads to the coil holders, variable capacitors, padders and 12AH8 should be short and direct. Wires to VC1 and VC2 are clear of the chassis.

The 6·3V heater connections are against the chassis and away from other circuits. The mains transformer shown had a separate 6·3V winding for the rectifier heater but the 6X4 heater may be connected in parallel with other heaters if this winding is not available. To do this connect positive on C17 to *pin 7 only* and take pin 3 to chassis and pin 4 to the 6·3V line.

If the mains transformer has a 5V heater winding for a rectifier such as the 5V4, 5Y3 or 5Z4 it is quite in order to fit an octal holder for one of these and use it instead of the 6X4.

The two i.f. transformers have numbered pins which must be located as in Fig. 3. All points MC are tags bolted tightly to the chassis. A tag strip is used to anchor some of the components near the 6AT6. Leads to the volume control VR1 run against the chassis. Speaker connections can be made by fitting terminals (insulated from the chassis) or by employing a two-way socket strip. The aerial connector may be a coaxial socket, socket strip or terminal.

The mains lead should pass through a grommet and be well anchored. All the power-pack components are near the right runner (Fig. 3). Connections should be checked throughout before inserting the valves for a first test. A 2/3Ω speaker in a cabinet or fixed to a baffle is necessary.

I.F. Circuits

These are aligned at about 465kc/s. This can be done by tuning in a weak station and rotating the cores with an insulated trimming tool for best volume. If the tuning indicator is fitted later this will prove to be an aid to exact alignment.

When adjusting the cores by ear it is necessary to remove the aerial or choose a weak signal so that the automatic volume control does not mask the effects of adjustments. No loss of efficiency arises if the transformers are aligned at some frequency which is not exactly 465kc/s.

If a signal generator is available its output can be used to check adjustment of the cores in the usual manner.

Aerial and Oscillator

Provided the aerial trimmer VC3 is not at the limit of its travel in either direction, aerial and oscillator circuits are sufficiently well aligned and good efficiency is obtained. But to avoid unnecessary adjustment of VC3 each band may be checked and the aerial or oscillator coil cores may be moved if needed.

First set the trimmer TC1 at about half capacity. The medium wave band is best checked first by inserting the appropriate blue and red coils. All coils have a pip which should lie between sockets 1 and 9 of the holders.

If a station around 1,400-1,500kc/s is tuned in, VC3 should peak reception quite sharply. Stations of lower frequency are then tuned in and the aerial coil core is rotated for best volume. This is continued up to about 600kc/s. If it proves necessary to close VC3 as frequency is reduced this shows that the aerial coil core is too far out. It should thus be screwed in. On the other hand, if VC3 has to be opened as frequency is reduced the core is too far in. When the cores are correctly positioned only occasional slight adjustment of VC3 is required throughout the waveband. *Exact* alignment throughout the band would mean that VC3 does not need adjusting at all and this is generally unobtainable. It is thus clear that having VC3 as a panel control allows maximum possible efficiency at all points of the scale and with any aerial.

Short wave ranges are treated in the same way as the medium wave band. If it is found that with the ganged tuning capacitor fully open VC3 has to be set to almost minimum capacity for best reception then TC1 should be screwed down slightly.

With the high frequency bands "images" will begin to become apparent. Such interference (also called "second channel") arises at twice the intermediate frequency from the required transmission, that is about 930kc/s from the wanted station. This is always so with a simple superhet on the high-frequency bands and it will be very much reduced when the tuned r.f. stage is added. Such interference will not be experienced on the lower frequencies.

Band coverage depends on the position of the coil cores, so can be modified if wanted until it approximately agrees with the ranges quoted. Some change in coverage will not influence actual results. When alignment with all coils is satisfactory, fix TC1 with sealing wax and place a 6BA locknut on each coil core stud. Dial readings can then be logged.

Tuning Indicator

The holder for the EM84 is bolted to a piece of scrap aluminium which can be attached to the front of the tuning capacitor. With the holder viewed from below connections are as in Fig. 9. It is most convenient to mount the 470kΩ resistor R1 directly on the holder. The 470kΩ resistor R2 is soldered to pin 4 of the first i.f. transformer. Four colour-coded flexible leads can then be taken from the EM84 holder. They are twisted together and run through a hole in the chassis near the front of the tuning capacitor. The leads can then be taken to their appropriate points.

The indicator has a central shaded area which reduces its length when signal strength increases. So VC3 can be peaked at any frequency by rotating it to secure maximum length for the luminous areas or minimum shaded area.

The i.f.t. cores may be touched up by observing the indicator with a station tuned in. This allows much more accurate adjustment than possible by ear. Both cores of i.f.t.1 are tuned for minimum shadow. The top core of i.f.t.2 is similarly adjusted. However, the a.v.c. is not obtained from the secondary of i.f.t.2, so the lower core (diode winding) is adjusted for a small *fall* in the length of the luminous areas in the usual manner for this type of circuit.

The indicator allows netting of a transmitter with the receiver by tuning the transmitter v.f.o. and buffer stages for minimum shadow length.

I.F. Regeneration

This is easily provided by adding a 50kΩ potentiometer in the h.t. circuit to pin 6 of the 6BA6 as in Fig. 5. The potentiometer is mounted on the front runner with a control knob.

A piece of stiff wire about ¾in. long is soldered to tag 1 of the holder, standing vertically when the receiver is upside down. A similar wire is soldered to tag 5. These two wires form the small capacitor C (Fig. 5) and they are bent so that they are about ¼in. apart.

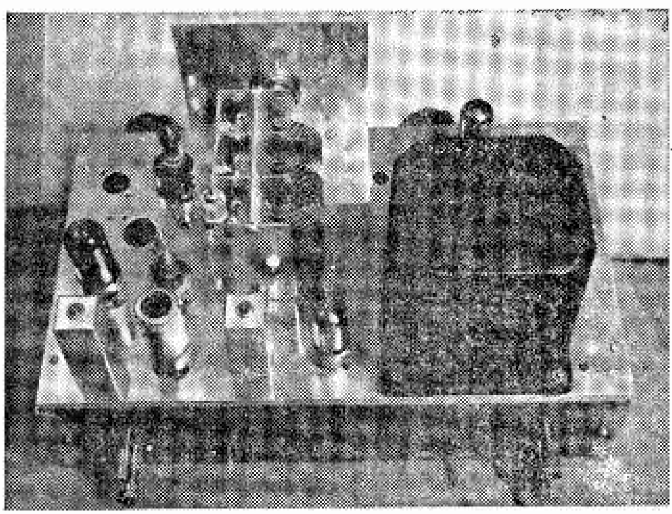
A check should then be made by tuning in a weak transmission and advancing the regeneration control slowly from zero. When oscillation begins a heterodyne note will be heard on tuning through the transmission or c.w. morse will produce an audible beat. If this happens with the regeneration control only slightly above its zero position bend the wires forming capacitor C away from each other. Repeat if necessary until the heterodyne only appears when the 50kΩ potentiometer is well turned towards maximum (say half or three-quarters of its rotation).

If a weak station is tuned in, suffering from adjacent channel interference in a crowded band, it will be found that interference is reduced if regeneration in the i.f. amplifier is brought *nearly* to the oscillation point. For best results touch up i.f. alignment with the circuit in this state. Regeneration also increases the sensitivity to weak signals.

Standby and A.V.C.

An a.v.c. in/out switch is useful to render the i.f. stage independent of a.v.c. bias when operated in the regenerative state for c.w. or weak signals. Such a switch can merely short the a.v.c. line to chassis.

A standby switch which leaves the heaters running is also often convenient and especially when using the receiver with a transmitter. Both these functions can be arranged in a single two-pole, three-way switch wired as in Fig. 8. This switch is mounted on the front runner. It disconnects the h.t. circuit for "Standby", the 47kΩ resistors serving as a bleeder to discharge the smoothing capacitors.



Rear view of receiver built up to the basic 5-valve stage.

R.F. Amplifier

The addition of the tuned r.f. stage increases range and selectivity and greatly reduces second channel interference on the h.f. bands. The lead from tag 2 of the 12AH8 is removed from tag 6 of the aerial coil. The extra coilholder and valveholder can then be added in the positions in Fig. 2.

Fig. 4 shows the circuit of the r.f. stage. The existing blue coils with VC1 are now used for the grid of the 6BA6. A.V.C. is taken from pin 4 of i.f.t.1 to the 1MΩ resistor. VC3 remains as the aerial trimmer connected as originally.

Tags of the yellow coilholder are wired as in Fig. 4 and the centre section of the ganged capacitor is used for tuning. To avoid any loss of efficiency or difficulty with ganging the yellow coils have their own 50pF trimmer mounted on the front runner and fitted with a knob.

The 6BA6 should have a screening can and a vertical aluminium screen runs between aerial and yellow coils from the ganged capacitor to the edge of the chassis. A 50kΩ potentiometer with knob acts as r.f. gain control.

The yellow coils are adjusted to gang with the blue aerial coils in the way already described.

Only occasional adjustment of the panel trimmers will be required to obtain maximum possible efficiency with weak transmissions.

With the r.f. stage added sensitivity is much higher and really long distance reception is possible. For many transmissions the r.f. gain can be set a little below maximum and left provided the a.v.c. is on. When the a.v.c. is off the 50kΩ potentiometer is rotated as necessary to adjust signal strength and avoid overloading.

It is convenient to place the new 50pF trimmer a little to the left of the ganged tuning capacitor when viewing the receiver from above and the front. The r.f. gain control can then be situated between the two 50pF trimmers.

Bandspreading

Bandspreading allows a narrow range of frequencies such as an amateur band to be tuned with a wide movement of the capacitor. Two methods have been tried. Both are successful, though they are rather different in character.

The simplest method is shown in Fig. 7 and has the bandspreading capacitor in parallel with the oscillator circuit only. The capacitor is 10pF or 15pF maximum value and has its own dial. If the two 50pF trimmers are peaked for best results, as shown by the tuning indicator with the bandspreading capacitor at half capacity, a narrow range of frequencies can be tuned effectively. If necessary the 50pF trimmers may be slightly readjusted so there is no loss of efficiency.

The method of bandspreading in Fig. 6 is easier to use as no readjustment of the trimmers is required. In terms of results or efficiency Fig. 7 is the same as Fig. 6. In Fig. 6 a three-gang bandspreading capacitor is used. It is possible to obtain miniature low-value capacitors or to gang individual capacitors with couplings but this is relatively expensive. After trying various arrangements it was decided to use an ordinary three-gang capacitor from which most plates had been stripped.

The capacity required is about 25pF to 35pF per section. An equal number of plates must be removed from each section. The ganged capacitor used had fairly wide spacing and two rotor plates were left on each section the resultant capacity being nearly 25pF. An idea of the capacity to expect may be fairly easily obtained. To do this count the number of times the surface of a fixed plate is near the surface of a moving plate and divide the total capacity by this figure to get the capacity of a single fixed plate near a single moving plate; e.g., if the capacitor has 12 fixed plates and 11 moving plates there are 22 individual "capacitors", so the value of one with a 500pF gang is 500/22=about 23pF. If preferred alternative plates can be removed to obtain double spacing. This is more difficult and the capacity will have to be measured or found by trial.

The three-gang bandspreading capacitor is fixed near the main tuning capacitor and connected to it with short leads. It is most convenient to use a 0-100 or 0-180 dial on the main tuning control with a 6:1 or similar ball drive for bandspreading. With a 0-100 dial the amateur bands were located as follows:

Range 2. 1·9Mc/s, 70. 3·65Mc/s, 0.
Range 3. 7Mc/s, 71. 14Mc/s, 0.
Range 4. 14Mc/s, 60. 21Mc/s, 20. 28Mc/s, 0.

Range 1 is medium waves, and the 14Mc/s band may be tuned in on both Range 3 and Range 4. Exact readings will naturally depend on core and trimmer settings.

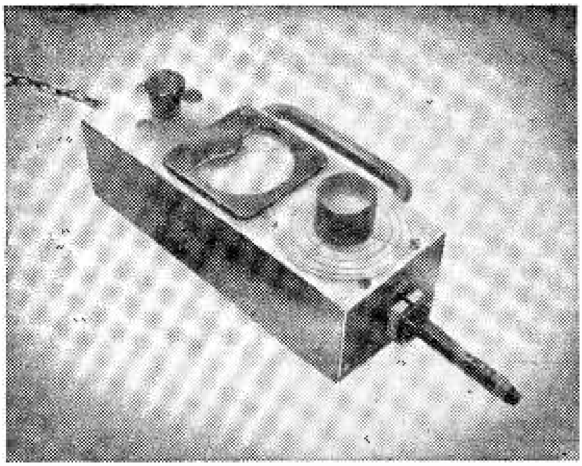
With the r.f. stage added, measurements were made of sensitivity and susceptibility to second channel interference on 21Mc/s. Sensitivity was slightly better than 2μV. The image ratio rejection was just over 18dB. Harmonic markers allowing exact calibration have been described in past issues. ■

MEASUREMENTS WITH THE

G.D.O.

a modified version of a previously described design and some notes for newcomers on the applications of the G.D.O.

K. L. SMITH, G3JIX



BEFORE discussing the main item of this article, modifications to the original GDO ("Grid Dip Oscillator", PRACTICAL WIRELESS, August, 1960, page 319) will be described showing how various difficulties of construction have been overcome. In this modified instrument the performance is slightly better. Many readers wrote saying that the coil pins were difficult to obtain and also that the split stator capacitor seemed to be a rare item. The following design is put forward to overcome these difficulties.

The oscillator circuit has been changed from the original Colpitts to a Hartley arrangement. This circuit requires a tap on the coils but only a single gang capacitor. The tap does not appear to add any difficulty because the new plug-in coil system makes available more pin connections. The circuit is shown in Fig. 1. The circuit action is similar to the earlier description except, of course, the feedback tap is into the inductance of the tuned circuit instead of into the capacitive arm.

A point which does require a little discussion is the new method of controlling the amplitude of the signal" to the amplifier driving the meter. Instead of keeping the oscillator h.t. supply at the same value and tapping off the voltage from the grid leak by means of a variable control (VR1 in the original) the whole oscillator level is varied by altering the h.t. to it by the use of VR3. This enables the amplitude of the oscillations to be set to an optimum value on each range.

One reason why it was desirable to reduce the amplitude of the oscillations in this way, was that it was possible to light a loop lamp on some ranges—and this was considered to be more than adequate power in an instrument of this type (especially when checking aerials!).

CONSTRUCTION OF THE COILS

The coils are wound on the long (0·3in.) diameter formers usually found in the small square section cans on the chassis of television receivers. Old, obsolete sets are a very fruitful source of this type of component, although such coil formers appear to be easily obtainable new at about 1s. each. The cores are not used but if experimental coils are wound then no reason exists why they should not be used to set on to a given frequency and then fixed, etc. The four small metal eyes in the base of the former through which the leads from the coil normally pass just about fit the corresponding four pins in an octal valve base. This therefore is a very convenient way of mounting a plug on the coil.

The remainder of the old valve base is sawn away carefully and filed up to make a neat job then fairly stout tinned copper wires are soldered into the coil former eyes and pulled through the four pins on the valve base. The wires are snipped off at the bottom of the valve base pins

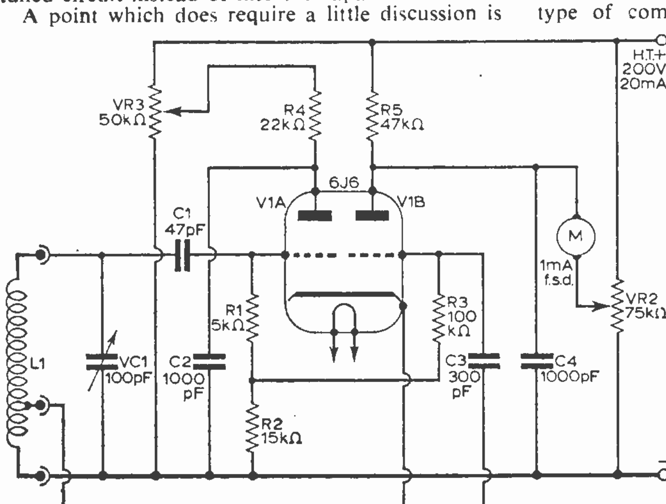


Fig. 1: Circuit of the redesigned G.D.O.

and neatly soldered into them (see Fig. 2 and Table 1). This method makes very good plug-in coils for all purposes, even when it is required to replace the can.

A standard octal socket is mounted on the "perspex" panel of the GDO in place of the original screw sockets. The appropriate tags of the socket are wired up to correspond with the coil connections. The actual pins used can be decided upon by the constructor but pin "6" is best avoided as it is missing more often than not as the writer found out! The ranges are calibrated using a receiver and/or other methods as described in the earlier article.

A good quality variable capacitor mounted in a box with a calibrated dial is a very useful piece of auxiliary gear to have in the radio workship. It can be used to insert a known value of capacitance into r.f. circuits (using short leads, of course) and to measure the value of small unknown capacitors. The photograph shows the general plan of such a component and the constructor could no doubt build up the device to his own requirements. No extensive description will be given here. Suffice it to say that a capacitor with semicircular plates—that is, one whose capacity varies regularly with rotation—is most convenient because it enables a linear scale to be used.

The matter of calibration is best carried out using a capacity bridge. Perhaps a local radio service station or the engineering department of a technical college will have such a bridge. Failing the availability of a bridge, the capacitor can be calibrated by using a technique very similar but used in reverse to the method of measuring the value of unknown capacitance described below.

Assume the capacitor is calibrated, and has an inductance placed across it thus forming a parallel tuned circuit. The value of the inductance does not matter as long as it resonates with the capacitor at a frequency convenient for one of the ranges of the GDO (around 1 to 2Mc/s is satisfactory). Place the variable capacitor dial at maximum capacity and couple the GDO to the inductance. Tune the GDO for a dip, keeping the coupling as loose as possible. If a small capacitor is now placed across the terminals the resonant frequency is altered and the calibrated capacitor dial can be turned until the dip is again seen. Of course the setting of the GDO is not altered while the other adjustments are being made. It is seen that the reduction in capacity of the calibrated variable capacitor must be exactly the same as the added unknown value, which is now read off the dial.

Using a procedure similar to the above the variable capacitor can be calibrated. It is necessary, of course, to have a fixed capacitor of fairly accurately known capacitance (say 50 or 100pF ± 1%). The minimum capacitance point on the variable capacitor dial is assumed to be "zero", i.e. stray capacitance is assumed to be absent. With the dial at "zero" the known fixed capacitor is placed across the terminals and the GDO is tuned for a dip as described before. The fixed capacitor is now removed and the variable capacitor increased in capacity until the dip is obtained again. This point must be 50 or 100pF according to the fixed capacitor size. Leaving the dial at this position the fixed capacitor is added again and the GDO returned. The capacitor is removed, the variable again increased, giving another 50 or 100pF interval. This is repeated over the whole dial.

Naturally any errors introduced tend to add up using this method and a good plan would be to have another accurately known fixed capacitor whose value was different and to use this to check the appropriate points on the dial.

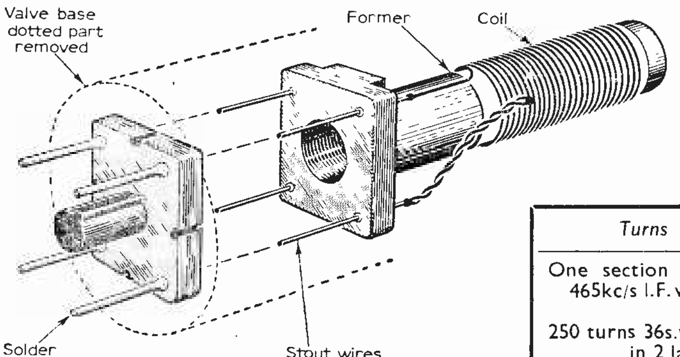


Fig. 2: Constructional details of the coils and winding information.

TABLE 1

Turns	Range	
One section of a 465kc/s I.F. winding	I.F. Band	All tapped at half-way point
250 turns 36s.w.g., in 2 layers	Medium waves	
150 turns 36s.w.g., in 2 layers	1·4 to 2·7Mc/s	
75 turns 36s.w.g	2·7 to 9Mc/s	
25 turns 28s.w.g.	8·5 to 30Mc/s	
2 turns self-supporting $\frac{1}{2}$in. diam	30 to 100Mc/s	
$\frac{1}{2}$ turn loop, $\frac{1}{2}$in. diam.	85 to 160Mc/s? (according to construction)	

GENERAL USE OF GDOs

One finds two general methods employed to couple the GDO to external circuits. On the one hand, the magnetic field can be linked directly with the circuit or via a loop system (see Figs. 3a and b). On the other, the coupling can be electric via capacity, stray or otherwise (Fig. 3c). In both cases overcoupling will detune the GDO and inaccurate readings obtained. Therefore whenever the instrument is used the final reading should be taken with the coupling loosened as much as possible consistent with seeing the dip. This requirement for small coupling means that the GDO should be removed as far as possible from the circuit being investigated.

If a number of tuned circuits are clustered together then the field of the GDO may link with more than one of them and a confusion of dips obtained. It is necessary to couple close to the required tuned circuit and gradually "follow the dip" as the GDO is removed. It should be moved to give minimum coupling with the other circuits. By the way, to tell whether the GDO is oscillating it is only necessary to take hold of the coil and at the same time notice the meter. Also if there is doubt concerning the dip this can be resolved by tuning the GDO over the range away from any resonant circuits, etc. If the tuned circuit being tested is inaccessible then the extension link can be used, but its own resonance dip should be determined before using it.

The above deals with the general use of the instrument to check resonances in receiver tuned circuits transmitter tank circuits and especially when "pruning" v.h.f. tuned circuits in 2m converters or television tuners, etc.

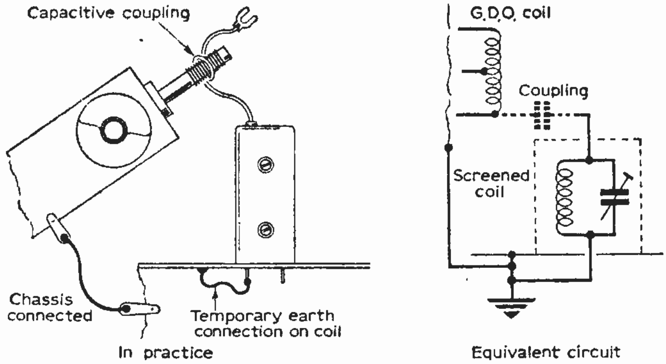


Fig. 4: Checking an i.f.t. using the G.D.O.

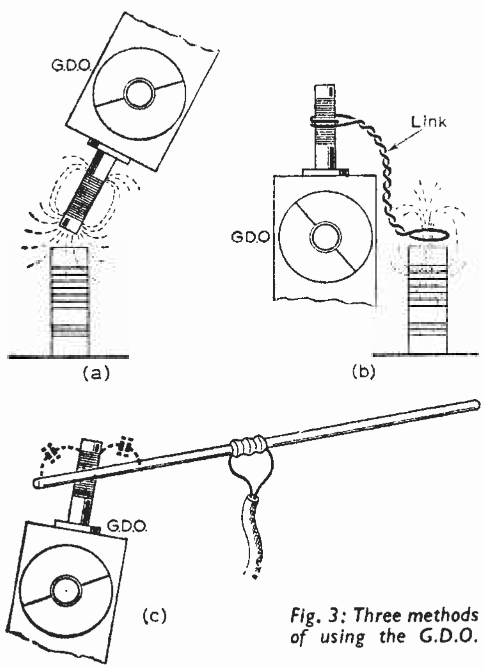


Fig. 3: Three methods of using the G.D.O.

The GDO can be used to check aerial resonances. If a voltage point is thought to exist at the point of testing then the "hot" end of the coil should be brought near for maximum electric coupling (Fig. 3c). If, on the other hand, a low-impedance point is expected the GDO coil should be placed to give magnetic coupling—a loop can be made in the wire and the GDO coupled to that. Checks on aerials should be made as quickly as possible with loose coupling to avoid the possibility of radiating strong interference.

Sometimes it is required to check an i.f. transformer or a coil inside a screening can. This precludes the direct coil-to-coil coupling normally used, but the writer successfully measured the resonant frequency of such a unit by using electric coupling into the "hot" side of the winding as shown in Fig. 4.

When checking aerials in position outside it is much more convenient to use a battery or some other portable supply to cut out the trailing power leads. The problem can be nicely overcome by using a transistor oscillator (M. R. Lord. "Transistorised Grid Dip Oscillator". PRACTICAL WIRELESS, March, 1962, page 1033). Although a transistor "dipper" (there is difficulty in justifying the word grid!) cannot be made to oscillate up to 2m and ITV frequencies (without expensive high-frequency transistors) the v.h.f. types such as the AFZ12 will oscillate up to 150Mc/s all right.

The GDO can be used as a signal generator. The tracking and trimming of a superhet can be roughly carried out before power is put on, using the GDO in the normal way, then if it is stood aside still oscillating it will produce a note for the final trim-up when the receiver power is switched on. Modulation has been applied in the ordinary way quite successfully, that is by applying the audio in series with the h.t.

Use As Absorption Wavemeter

With VR3 wiper placed at earth the oscillator stops as already noted. The instrument is now coupled near an energised tuned circuit such as a

—continued on page 875

Insensitivity in Transistors

diagnosis and cures

by G. R. Wilding

DIAGNOSING cases of low sensitivity or power is always more difficult than tracing causes of complete breakdown, particularly in transistor radios, where a succession of small defects instead of one clear-cut fault may be found and where even small voltage variations are indicative of possible trouble. However, in practice probably the first thing to do (after checking battery voltage on load) is to note if the insensitivity is confined to one band, if it increases towards one end and if it is also accompanied by any distortion.

If the alignment does not appear to have been tampered with, variation of gain with wavelength often indicates a faulty frequency changer or oscillator, while poor gain and distortion usually indicate incorrect emitter bias on an i.f. or audio transistor. However, before actually getting down to meter testing, check that there are no cracks in the ferrite rod aerial and that none of the aerial coils has become displaced.

The first meter tests undoubtedly should be to determine the voltage developed across the emitter resistor of each transistor, working back from the output stage. Any variation greater than 20% from the maker's figures should give cause for suspicion and merit a careful check on the two other transistor voltages. Incorrect emitter voltage does not, of course, indicate a fault in the emitter wiring such as a leaky or s/c bypass capacitor as the wrong emitter p.d. could well be caused by incorrect base voltage produced in turn by changed value or dry-jointed bias resistors. However, wrong value emitter voltage always indicates that the stage is not working properly and so pinpoints the area for especial consideration.

Assuming that all voltages checked are within the limits, what then? Obviously all the transistors and current carrying resistors are normal, so the fault or faults lie in those components associated only with the signal, r.f. or a.f., and not with the d.c. supplies, which means in practice the coupling, decoupling and fixed trimmer capacitors, the i.f. and audio transformers.

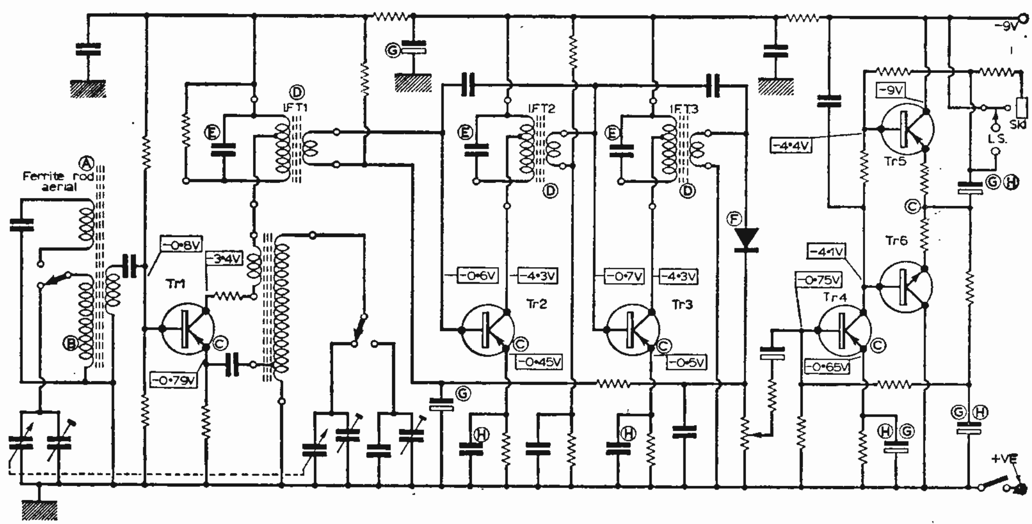


Fig. 1: Typical transistor portable (Ekco PT399), showing points to check when investigating lack of gain.

A CRACKED FERRITE AERIAL ROD
B DISPLACED AERIAL COILS
C INCORRECT EMITTER VOLTAGES
D O/C i.f. TRANSFORMER WINDINGS OR SHORT CIRCUITED TURNS ON TRANSFORMERS
E REDUCED CAPACITY FIXED i.f. CAPACITORS
F DEFECTIVE DIODE DETECTOR
G REDUCED CAPACITY ELECTROLITICS
H O/C OR DRY JOINTED BYPASS CAPACITORS

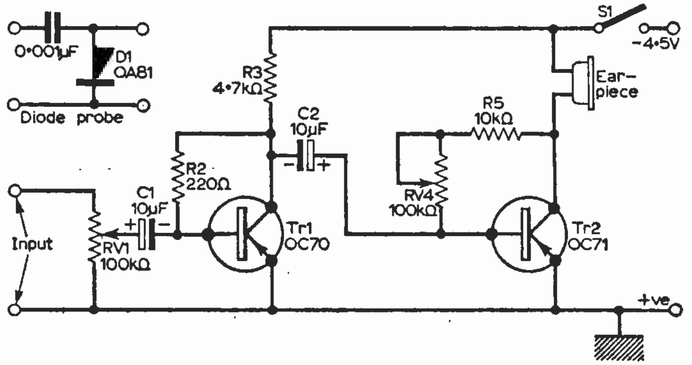


Fig. 2: Inexpensive signal tracer with probe; a two-stage R-C coupled amplifier operating from miniature 4.5V battery and requiring the minimum of components. RV4 sets the operating level of Tr2 (3mA)—courtesy Mullard Ltd.

For instance the secondary of a transformer feeding both the base voltage and the signal to a transistor could have many shorted turns, thus greatly loading the stage and decreasing gain without producing any effect on the voltages of the transistor. Similarly the miniature high-value electrolytics, if of reduced or even negligible capacity, produce no noticeable effect on rated test point voltages unless, of course, they instigated self-oscillation or motor-boating.

A short-circuited or leaky capacitor, depending on its position in the circuit, would almost certainly influence some transistor voltage but in practice, due to the very low voltages employed, develop mainly a loss in capacity. The simplest way of checking this possibility is, of course, to add a known good equivalent across the suspect and note results, but where it is feasible that some deterioration may have occurred inside the capacity, due to the ingress of moisture or salt water, it may be advantageous to simply replace it as any slight leak present would still be in circuit when the replacement was added.

If after checking or replacing all relevant capacitors and finding gain still below normal it may well pay to check the d.c. resistances of the various transformer windings. Although this is a useful test it is by no means conclusive, since perfect transformer windings may have a d.c. resistance substantially different to that of the maker's figure, so that short-circuits involving only a few turns will not show up. However, the test does show up gross variations from normal and, of course, completely o/c windings.

Most i.f. transformers in transistor radios feed the following stage from a tapping on the secondary so that it is very possible for a complete break in the secondary winding not to show up on the transistor voltage tests, since the break may not be in the section carrying the d.c. base current.

Similarly if the primary is tapped a break could well develop in the section not carrying the collector current from the preceding transistor and here again would produce no voltage indication on that transistor.

It should be mentioned at this stage that breaks in such transformer windings very frequently develop if the set has been dropped and usually where the fine leading-out wire joins the exterior soldering tag. While therefore one cannot be dogmatic about interpreting variations in measured to stipulated d.c. resistance when checking push-pull audio transformers, whatever their value, the main point is that both halves should be really close.

Capacitors often overlooked in practice are those fixed i.f. trimmers shunted across the primary and secondary transformer windings and usually mounted inside the i.f. can. Often about 250pF in value and with only a 2% tolerance any small reduction in their capacity drastically reduces gain by mistuning the stage to a higher i.f. frequency. When tracing insensitivity such capacitors would not be o/c but only partially deficient, so that a quick test is to add a small value picofarad capacitor across each suspect and note if gain increases. Values of 10 to 25pF should be ample to show up any loss of capacity without at the same time running into the danger of over-correcting by mistuning to a lower than specified i.f. If such action increases volume and the receiver is a normal peak-tuned model it can be taken as certain that the fixed trimmer under test is defective, always assuming, of course, that the i.f. slugs are still sealed. If the slugs have been readjusted this test would more likely indicate that a realignment was necessary.

Of course all such tests are static and very often the dynamic method of fault location, either by injecting a suitable r.f. or a.f. signal into each stage or by means of a signal tracer and probe determining just where the signal loses ground, is more to be preferred. Such a signal tracer, easily constructed and designed by Mullard Ltd., is shown in Fig. 2. Employing only five resistors, two capacitors, an earpiece and two transistors, types OC70 and OC71, this device can prove very helpful indeed when tracking faults in transistor sets.

To trace h.f. and i.f. signals the simple diode probe inset can be switched into the front end. When constructing the probe everything must be concentrated on keeping its self-capacity and hand-capacity to the absolute minimum so that it will have no appreciable effect when applied to the various tuned circuits.

Finally, don't overlook the possibility of the receiver's diode detector being faulty and, if complete realignment is called for, follow the maker's instructions. ■

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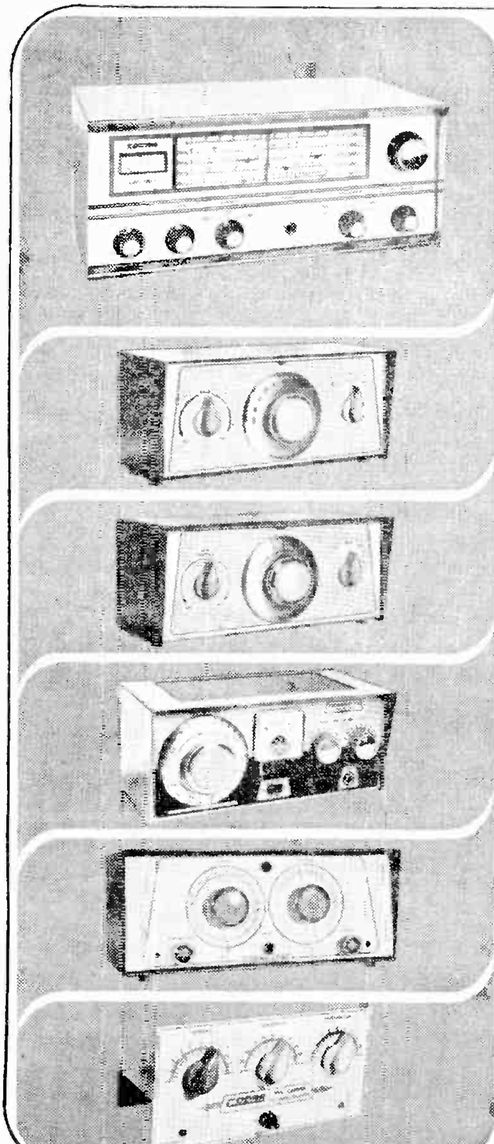

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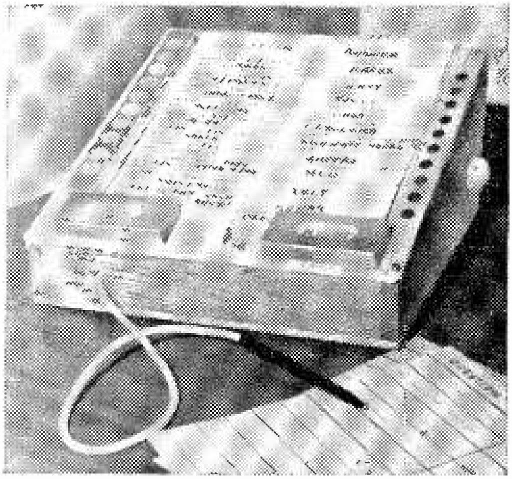


An Educational QUIZ MACHINE

A NOVEL PROJECT FOR EXPERIMENTERS, CLUBS AND SCHOOLS

by Michael J. Hughes M.A.

THERE has for some time now been a group of electrical educational toys on the market. One of these is that shown in Fig. 1. It consists of a card with a set of questions all of a similar nature on the left-hand side. For every question there is an answer on the right-hand side of the card but not necessarily in the correct place. Alongside each question and answer is a small electrical contact such as a piece of aluminium foil. These contacts are wired under the card so the contact representing a given question is connected to the one alongside the correct answer. The idea of the game is for the child to select a question in the left hand column and place a probe on the contact. The child then selects what it thinks is the correct answer and places a second probe on the answer contact. There will be a battery and a lamp or buzzer in series with the two probes and if the correct answer is chosen the circuit is completed, thus indicating on the lamp or buzzer.

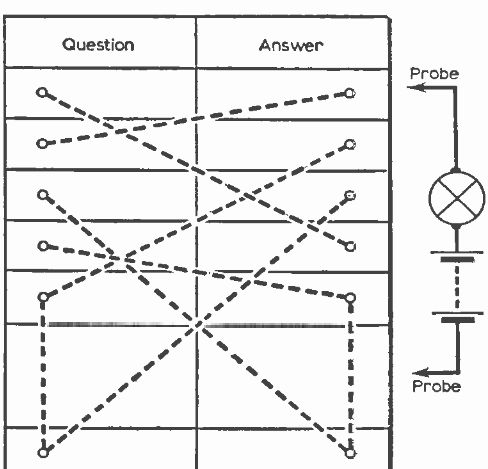


Fig. 1: Question and Answer board.

Some time ago the writer had occasion to make one of the above devices and in doing so found out that some of its obvious faults were:

(1) Difficulty in handling two probes.
(2) Lack of facilities to change programmes.
(3) The ease with which the correct answer can be found by a process of "trial and error", i.e. by sliding the answer probe down the answer contacts until the answer is indicated.
(4) The fact that recognition is only made of a correct answer and no indication is made of errors.

It was with these points in mind that the following instrument was designed. On the face of it this instrument gives the same results but it is much more sophisticated in design and, apart from forming the basis of a useful teaching machine, involves some quite interesting relay circuitry.

The circuitry requires 12 relays which may be of any type provided they have four double-throw contacts, 10 diodes capable of passing the holding current of the relays and having a reverse breakdown voltage greater than the voltage required to power the relays. In the instrument to be described indications were made with 6·3V bulbs and 13 of these will be required, together with suitable holders. Apart from the above components, most of which may be obtained cheaply from ex-Government stores, all that is required is a plentiful supply of connecting wire and patience as a considerable amount of wiring is involved.

Relay Circuitry

As a number of readers may not be fully aware of the way relay circuits are drawn a brief description of the notation used will follow.

One of the beauties of relays in application but also one of their drawbacks when drawing circuit details is the fact that the contacts of a particular relay coil are electrically completely independent of the controlling circuit, i.e. there can be no leakage or breakthrough between the controlling circuit and the controlled circuit. In a simple circuit such as an electronic timer, which has appeared many times in this magazine, the emphasis is in the control circuitry and the controlled half is usually left to the imagination of the reader. In the example quoted the controlled circuit may only be a simple make or break switch in series with an enlarging lamp. In a simple circuit it is easy to show the contacts in close proximity to the operating coil as shown in Fig. 2.

If, however, the same relay was to drive a more complex circuit, for example one which required four double-throw contacts, a total of 12 separate contacts would have to be drawn; this by itself might not seem a very great problem. However, if one continues this reasoning further to cover a circuit which includes a large number of relays and also a lot of the controlled circuitry the theoretical circuit would sooner or later start to resemble the Hampton Court maze.

To prevent this happening a standard form of circuit is drawn with the relay coil forming part of the control circuit and the contacts are drawn completely separate in their correct positions in the controlled circuit: it only remains to identify each set of contacts with their controlling relay coil. There are various ways of doing this and the notation in this article is to label the controlling relays RLA, RLB or RLC, etc. The contacts controlled by relay RLA are numbered A/1, A/2, A/3, etc. If the contacts are double throw they are designated A/1a, A/1b, A/2a, A/2b, etc. This type of notation coupled with the fact that normally closed contacts are shown completely black and normally open ones are left white (see Fig. 3) gives a much clearer representation of the circuit.

Operation of the Instrument

Before any attempt is made to describe the circuitry, it will be best to aquaint the reader with the external appearance of the instrument, and the way in which it would be used.

The front panel consists of a board, on which a set of questions and answers may be rested in accurate location with a series of 10 contacts down each side of the question sheet. Each question sheet is given a "programme number" which corresponds to a position on the programme

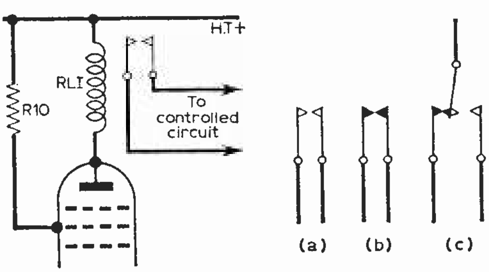


Fig. 2 (left): Part of electronic timer circuit.

Fig. 3 (right): (a) normally open contacts. (b) normally closed contacts. (c) changeover contacts.

switch (this varies the order of the answers) which is on the side of the instrument.

To operate the instrument, the child selects himself a question from the left hand column. He does this by touching a probe on the respective contact. Immediately he does this, a lamp will light alongside that particular question. It is now impossible for the child to change the question asked without answering it, or resetting the instrument. If he tries to probe another question nothing will happen.

The child must next decide which answer he thinks is the correct one: he then touches the same probe on the contact next to that answer. If correct, a lamp will light up indicating "Right", but if the incorrect answer is chosen, a second light will indicate "Wrong". It is impossible for the child to have second thoughts and try a second answer until he has reset the instrument, and started again. This discourages the "Trial and Error" method as described for the simple toy.

Most of the complexity of the circuit is due to the fact that the machine is both cheat proof, and fool proof to operate.

The Circuit

The diagram is shown in Fig. 4 There are several distinct sections to the circuit, these are:

(1) The main control circuit.
(2) The question illumination circuit.
(3) The "Right" "Wrong" illumination circuit.
(4) The "Reset" illumination circuit.

The method of indicating right or wrong is entirely up to the reader, it may be by illumination, as in the prototype, or by a bell and buzzer system. Likewise the reset warning light, which may be omitted altogether, if desired.

To ask a question, the probe is placed on one of the contacts connected to diodes D1—D10. The negative power line is coupled via the normally closed contacts A/4a to J/4a (which are all connected in series) to the probe. One end of each of the relay coils RLA—RLJ is connected to the positive line, therefore when the probe is placed on any of the question contacts, the respective diode is forward biased, and conducts, passing a current sufficient to energise that particular relay coil. As an example, assume the probe is placed on question contact 3, D3 conducts, and RLC is energised, the action due to the energising of RLC is to close the contacts C/1 which then applies the negative line immediately to the coil, when the probe is removed, the relay holds in. The relay is now "self-locked". C/3 closes lighting the lamp referring to that question. Simultaneously the change over contact C/4a is opened, thus breaking the negative supply to the probe, and C/4b is closed, which applies the positive line to the probe. C/2a, which keeps the potential at contact 3 in the answer column normally negative opens, and C/2b closes, connecting number 3 contact via contact W/2 to the energising coil RLR, which if operated in the process of answering will operate the "Right" lamp. It should be noticed at this stage that all the other answer contacts are connected via R/2 and RLW to the negative line.

If the probe, which is now negative is placed on the correct answer, RLR will be energised, closing R/1 which locks the relay in, it also opens R/2 which breaks the circuit to all the other possible answers, thus preventing a second choice without resetting. The right answer is displayed by contact R/3 closing, thus lighting the lamp. If the wrong answer is chosen, i.e. any contact other than 3 is touched, current flows through R/2 and energises RLW which locks in with W/1, and kills the possibility of selecting the right answer by opening W/2, it also closes W/3 which illuminates "Wrong".

After an attempt to answer the question whether

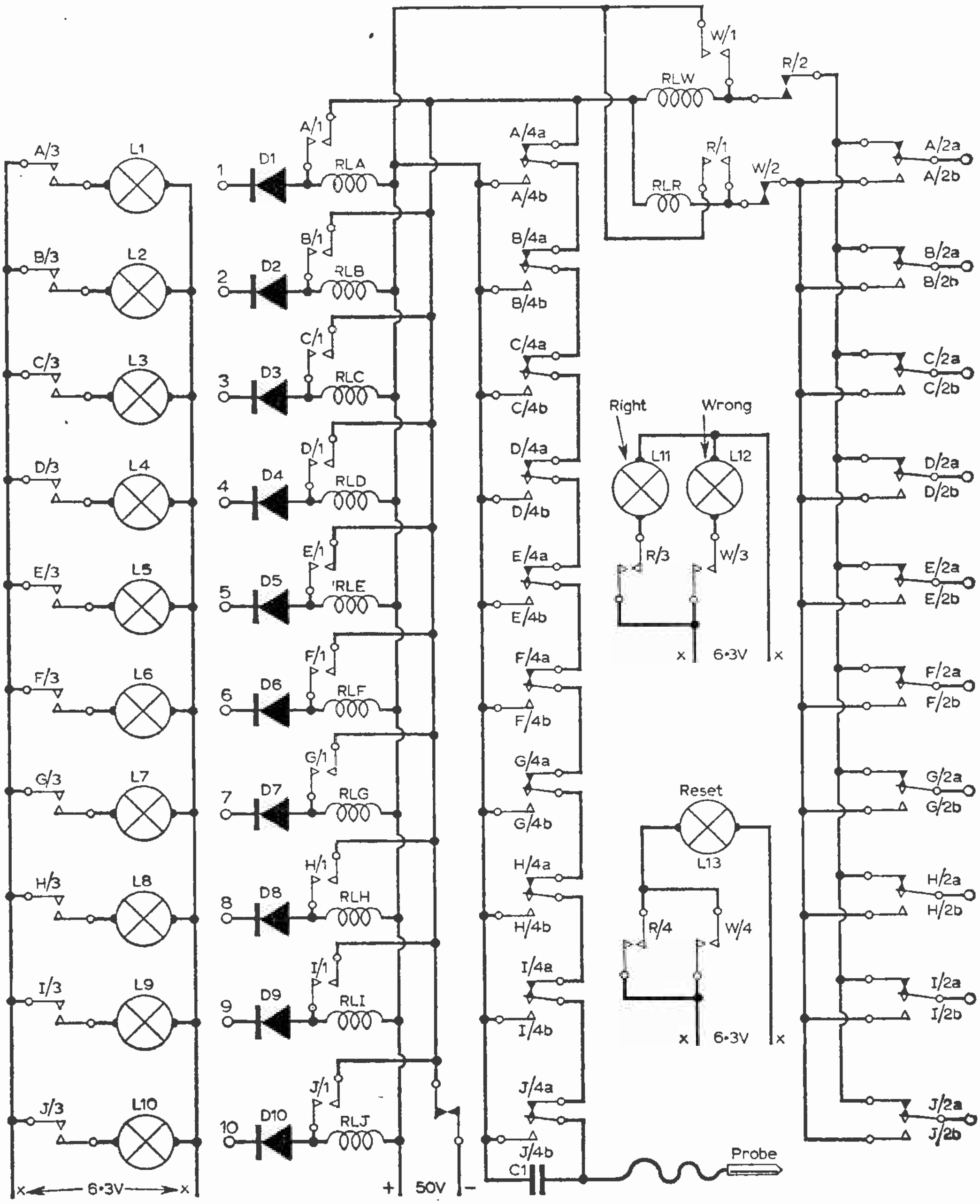


Fig. 4: Circuit diagram of the quiz machine.

right or wrong, the instrument must be reset. It was thought desirable to display a reminder of this, and this was readily done by using contacts R/4 and W/4. If either RLW, or RLR is operated, the reset lamp will light.

To reset the instrument, it is necessary merely to momentarily break the power supply to all the locked relays, this is most easily done by pressing the push button S1, situated in the main power line.

It should now be pointed out that if the probe is placed on any answer contact without asking a question, nothing will happen, as the probe which is initially negative is at a common potential with all the answer contacts. The polarity of the probe is changed only on asking a question. Likewise, when a question is asked, the probe is made positive, and if placed on any other question, will not operate any other relay because the diodes will be reverse biassed.

Because of this change over of polarity of the probe, there is a danger that one of the relays may begin to oscillate at its natural mechanical frequency, in much the same way as a buzzer. It is therefore necessary to prevent this happening, and to do this, a capacitor of about 1μF must be wired between the probe, and one of the supply lines. This capacitor is shown as C1.

For the sake of simplicity in drawing, and explaining the various functions, the answer contacts have been shown in the same position as their respective questions. There is no reason why the positions should not be jumbled up in any random order. The writer gives a word of warning here, and recommends colour coded wiring for the answer contacts, as he himself forgot which contacts were connected to which relay. This was also complicated by the programme switch which is described later in this article. It is therefore necessary to use as clear a layout as possible, and use labels on the ends of the respective wires, so that there is no chance of an error when wiring up.

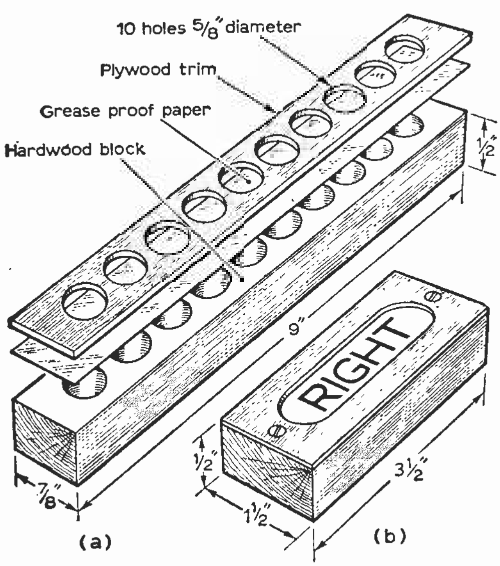


Fig. 5: Method of making the lamp covers.

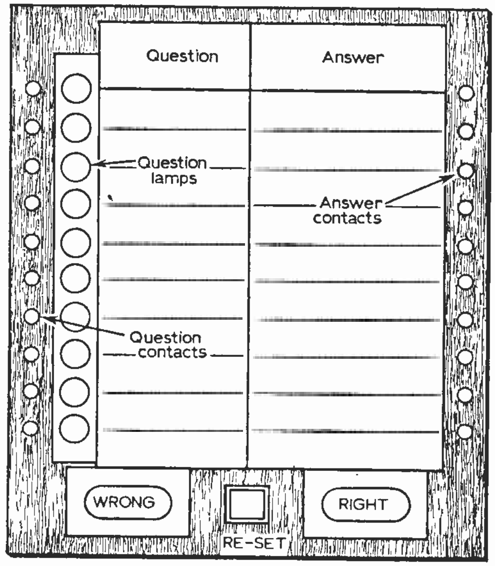


Fig. 6: Front panel layout.

Constructional Details

Most of the intricate wiring is between the contacts of the relays and for this reason it is suggested that either a small chassis be made to hold the relays, or that some of the modern miniature plug-in-relay be used. The latter were used in the prototype, so it was possible to strap all the sockets together on two bars, thus forming a compact unit. Layout is not at all critical as all the circuits are low impedance operating on d.c., however it is suggested that a neat symmetrical system is used, as this will greatly simplify the wiring.

The two relay banks are screwed to the baseboard, the programme switch is bolted to one of the sides, and the " Reset " button to the front.

The sloping front panel holds the two rows of contacts, and the indicator lamps. The wiring from these are terminated at two long tag strips which are connected in turn to the relay banks by bundles of colour coded flexible wire. The sloping panel is hinged to the main cabinet, and the bundles of coupling wires should be long enough to prevent any strain on the soldered connections when the panel is opened.

COMPONENTS LIST

12 Relays and Sockets 4 contact with 50 volt coil. (Woden Transformer Co. Ltd., Moxley Road, Bilston, Staffs.)
1 Illuminated Key switch. (T.M.C., Martell Road, West Dulwich, London, S.E.21.)
10 Diodes Ferranti type 10AS (or similar).
1 Switch 4 bank 3-pole 3-way.
12 6·3V. bulbs. (M.E.S.)
C1 1μF 150V paper

Cabinet

The size of the cabinet depends largely on the type of relays used. In the author's case miniature relays were used, and this enabled quite a compact unit to be built, the overall dimensions being:

Width	12in.
Depth	12in.
Height at front ...	2in.
Height at rear ...	6in.

$\frac{3}{8}$in. soft wood was used for the sides, and 4 mm plywood for the sloping panel, and the base.

The front panel was drilled to accept the twelve lamps. For economy, the author dispensed with bulb holders by drilling holes which would hold the shanks of the bulbs tightly, and soldered connections directly to the bulbs from the underside of the panel.

Long brass plated drawing pins were found to be the most readily available items to make the contacts. They were fitted by drilling small holes with a fine drill in the respective places, and pressing the pins tightly home. The pins should be long enough to allow soldering to the shank on the reverse side of the panel.

A hole must be cut in the front of the panel to allow the reset button to protrude.

Covers for the lamps were made from hardwood. The cover for the question lights was made as a single unit 9in. long x $\frac{7}{8}$in wide x $\frac{1}{2}$in. deep. Ten holes $\frac{5}{8}$in. diameter were drilled through this piece to coincide with the positions of the bulbs. A piece of greaseproof paper was stuck over the surface to cover all the holes and a trim of thin plywood, suitably drilled, was pinned over the top of this paper, see Fig. 5. This figure also shows the type of cover made for the "Right" "Wrong" lamps. The method of making these was identical to that already described, except that the words "Right" and "Wrong" were printed on the paper.

When the bulbs had been inserted, these covers were screwed to the panel and apart from making inexpensive covers, formed good registration jigs for holding the question sheets in position. Fig. 6 shows the layout of the completed front panel.

WIRING DETAILS NEXT MONTH

No. 18 If you Insist

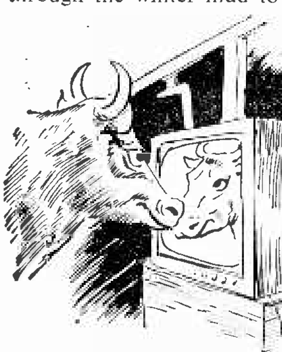
DESPITE the doom-laden warnings given out in the October 1965 contribution to this column "On Turning Pro", the feeling that the professional radio repairman is in a gilt-edged occupation appears to persist.

Not only do some readers request further advice on getting into the trade but others, grinning, no doubt, into their ink, relate how successful their step from amateur to professional turned out to be. Apart from the observation that some chaps would make a success whatever they turned their hands to and others as inevitable fail, there is little point in continuing my argument.

So Henry bows to the wind of opinion and devotes a few remarks to the practice behind the practice of radio repair.

Unless one begins as an apprentice and is inaugurated into the art of making the tea and sweeping the workshop floor, the usual point of entry is as a "field engineer". This is the rather high-flown term for the activity required by some firms, who require only valve and chassis changers, with a minimum of easily acquired knowledge and a penchant for working long hours.

The important word, though, was that little adjective, "field". In many cases, it is all too true. The poor chap has to trudge through the winter mud to some isolated farmhouse to change a battery in a transistor radio or instal a TV in the byre to keep the cows happy.



A TV in the byre

No, I am serious. More than one milking shed in Henry's patch has soft music laid on. And humidity plays havoc with tapes and mechanisms.

Life in the built-up areas is by no means all beer and skittles. There being less distance between calls, the serviceman will be expected to rush around a lot more. He has traffic to contend with instead of livestock—and it's an arguable premise whether a sheep is more intractable than a bus driver, or a hen less predictable than a flustered L-driver.

In addition to an ability to tackle any kind of electronic repair, the serviceman has to deal with people. Or, more accurately, with customers.

The distinction becomes obvious when the smiling housewife who greeted you at the door turns into the snapping virago whose receiver you are attempting to remove for workshop repair.

It is all very fine fiddling about with the innards of some receiver, with PRACTICAL WIRELESS at your elbow; quite another matter to crouch behind an alien radiogram, wheedling toffee-papers from the mechanism while Mrs. Customer flips around you with a duster. Mr. Customer grumbles morosely about the impending bill. Customer Junior surveys each move with the cynicism of an embryo astronaut, and the dog searches for bones in your tool-box.

You may have taken note of a couple of graphic libels perpetrated by my friend Pax (Nov. '65). The radio repair trade does not—despite popular belief —treat sets with such cavalier abandon! Where one would hack away at a recalcitrant chassis in the seclusion of one's den, the method of treatment "in the field" depends on a bit of extra showmanship—dusters on the floor, tools laid out in neat rows, valves tapped only when the client looks the other way, etc.

Flips around with a duster

All this assumes that you have got there! Very often, it takes as long to locate the address as to service the set.

A while ago there was a snide account in most newspapers of Mr. Henry Pound's defiance of Havant Urban Council. He wanted to retain the name of his house, "Beechlands"; they insisted he post up the number—49. He did, on the *inside* of a door-post where it could not be seen from the street. He was taken to court and fined £2. Mr. Pounds could afford to shrug it off. My paper described him as a "wealthy ship-breaker". Any field serviceman who has groped up drive-ways on a dark or foggy night and barked his shins on unnumbered gates can think of other things to call him.

These are only some of the factors to be considered on entering the trade, Joe. Messrs. Mullard have summed them up beautifully in an illustrated poster and booklet, whose theme is: "There's more to service than repairing the set".

I agree, wholeheartedly, and wish there were space to reproduce their humorous advice.

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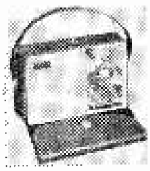

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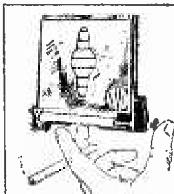

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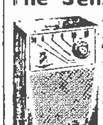

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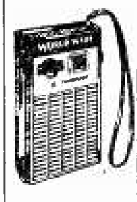

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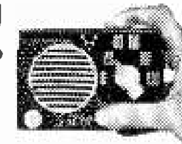

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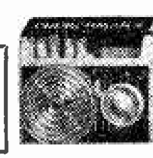

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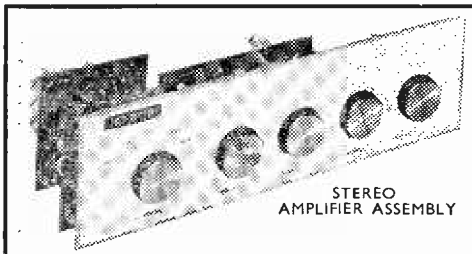

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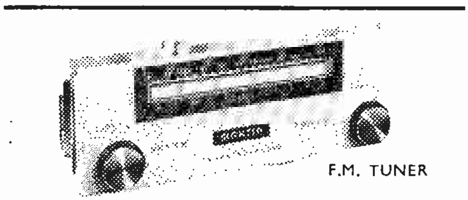

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The Walter "Metropolitan"

K. T. WILSON

MODIFICATIONS TO IMPROVE PERFORMANCE OF THIS TRANSISTOR TAPE RECORDER

THE Walter "Metropolitan" Transistor Tape Recorder first appeared at the 1960 Radio Show, and was one of the first all-transistor tape recorders to offer all the facilities now accepted as standard on good quality machines. The tape speed was fixed at 3¾in./sec and the maximum reel size was 5¾in. Recording was twin-track, to CCIR characteristics, and both high and low level input sockets were provided. The amplifier could be used for monitoring during recordings, and could also be used separately, though with some inconvenience. Sockets were provided for external loudspeakers (muting the internal speaker) and for connecting to external amplifiers. Separate motors were used for record/playback and for wind/rewind.

Shortly after the introduction of the "Metropolitan", the Walter Company went into liquidation and the entire stock of the "Metropolitan" Tape Recorders was sold off at a very much reduced price. As some 6,000 machines were involved, many of these instruments must be in the hands of readers of this magazine, who will undoubtedly be interested in the modifications which can be carried out to improve the "Metropolitan".

The Motors

The Metropolitan, in its original form, is a mains/battery recorder using a 9V supply taken from 3 PP9 batteries or from a mains transformer and rectifier unit. The change from battery to mains or vice versa is by a switch which also blanks off the mains socket in the battery position.

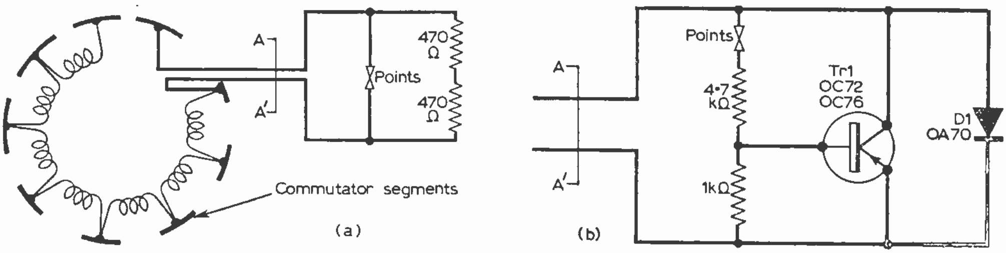
The motors are small 9V d.c. units made by Greencoat Industries under the trade mark "Staar". The record/play motor is fitted with a governor which limits its speed to 3,000 r.p.m., and is also suppressed, although the suppression is not so effective at Television Band III frequencies. Ferrite beads (from Radiospares) fitted on the leads as close to the motor as possible will cut out this interference. The wind/rewind motor is not suppressed at all, and to avoid interference it is advisable to fit a 1μF 25V capacitor across the leads as close to the motor as possible. This capacitor is already fitted to the record-play motor.

The main trouble with this otherwise admirable system is that the governor contacts of the record/play motor wear and become pitted to such an extent that the action of the governor is completely upset and the result is severe speed fluctuations. In its early stages this can be confused with wow caused by an eccentric capstan idler wheel. Since the motors cannot be replaced directly, they must either be repaired or the recorder modified to take a different type of motor. Small shaded-pole AC mains motors are cheap and easily obtained and it might be thought that one such could be fitted. It is certainly possible, but there are several great disadvantages. The facility of battery operation is lost, to start with. More serious is the point that the capstan flywheel is intended to smooth the impulses due to the cutting in and out of the governor, a process which is said to take place at a very high frequency, and is much too light to cope with the power pulses of a two-pole shaded-pole motor. The result is severe flutter, even 100 c/s hum.

The most serious disadvantage is the difficulty of fitting a shaded-pole motor, which is usually a large unit. Very few motors of adequate power will fit in the space vacated by the original motor, and since the drive is by a brass wheel against a rubber tyre on the rim of the flywheel, a change of motor position involves a change in the method of driving. It is just possible to fit a shaded-pole motor in the space between the speaker and the control stick and drive by elastic belt, using a V-cut pulley and having a suitable V cut in the capstan flywheel. The motor pulley should be twice the diameter of the existing brass wheel, since the motor speed is now 1,500 r.p.m. This method is open to the objection that the shaded-pole motor is now rather near to the early stages of the amplifier, and there is considerable hum pickup, which can be only partially reduced by magnetic screening.

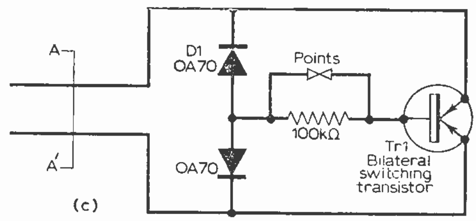
Fitting New Motor

The best course, if the original motor is beyond repair is to fit a similar type of motor. The name and address of a supplier who can frequently be helpful in this respect is given at the end of the article. If the motor has not had too much use, or if the governor points can be rebuilt by electroplating with silver (not an expensive operation) then a long life can be ensured by modifying the governor to a transistorised system. The point of this method is that the transistor handles the motor current and the governor points handle only the transistor base current, which will be $1/\beta$ times the collector current. Since the β of suitable transistors is of the order of 70—100, the governor points will last indefinitely. The original and modified circuits are shown in Fig. 1.



Since all the circuitry has to be fixed to the motor shaft and rotate at 3,000 r.p.m., small components and good fixing are essential. The motor is dismantled by removing the leads, taking great care not to lose the brushes (phosphor-bronze) which are attached to the terminal screws. The motor can then be slipped out of its foam-rubber casing and the remaining screws removed to allow the armature assembly to be removed. Connections to the governor leads should be made as far from the governor points as possible to avoid changing the speed by a mechanical loading on the governor. A useful tip is to secure every point of the circuitry with Durofix, which can readily be softened with acetone if replacements are required.

Fig. 1: (a) original motor circuit. (b) modified circuit. (c) alternative circuit.



Amplifier Mods.

Having attended to the motor, the remaining modifications concern the amplifier. In the original circuit, the first three transistors are common to both record and replay circuitry. The collectors are earthed, and bias is by a feedback resistor between collector and base in each case. The recording feed to the head is taken from the third transistor via a 1μF capacitor and a bias trap (a simple L-C trap). With this sytem, the recording level is very low, and leakage in the coupling

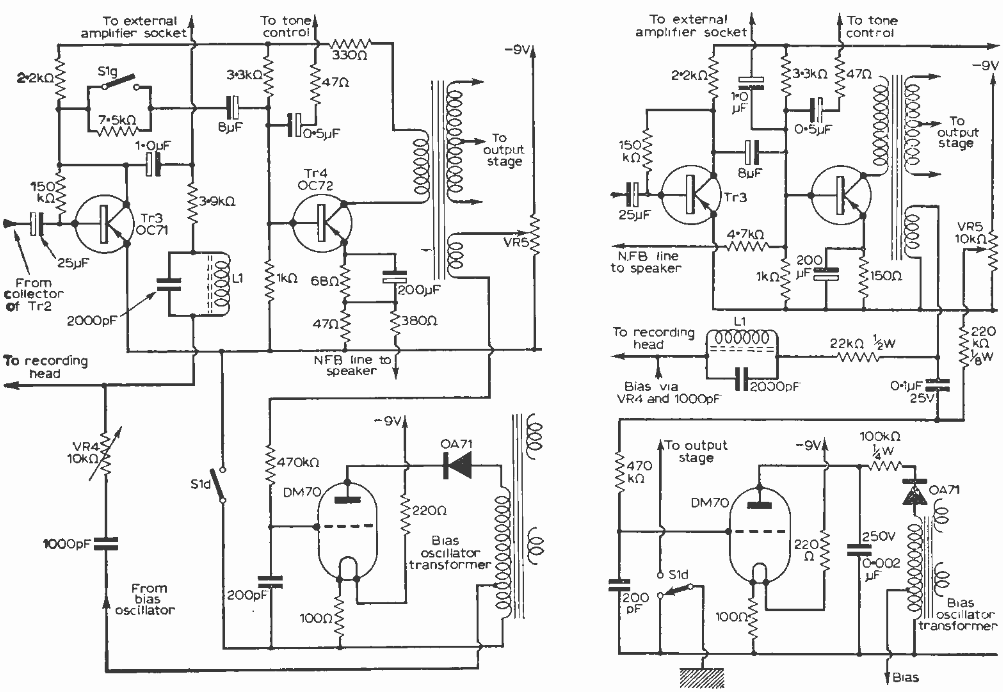


Fig. 2 (left): original stages before modification, and (right) after modification.

capacitor causes the head to become magnetised; this raises the noise level considerably. Very much better results can be obtained if the recording head is driven from the next stage, which in the unmodified recorder is the driver stage for the output transistors. Incidentally, the circuit of the original recorder, together with a practical layout diagram is obtainable, priced 7s. 6d., from J. E. Sexton Ltd., of 162 Grays Inn Road, London, W.C.1.

The modified stage is shown in Fig. 2 along with the modifications also needed to the recording level indicator. The driver transformer has an extra winding which on the original circuit is used to feed a.f. voltages to the grid of the DM70 recording level indicator. If this winding is used for feeding the recording head through a much higher series resistor, the high frequency response of the recorder will be considerably improved as the CCIR recording characteristic assumes that the head is fed from a resistance which is high compared to the head impedance at the highest frequency of interest. The recording level indicator can now be fed through a simple R-C coupled circuit as the grid impedance of the record level indicator is high.

Record Level Indicator

Some modifications can now be made to the record level indicator itself. In the original recorder, the level indicator is barely satisfactory; the indicator, which is of the "exclamation mark" type, appears closed all the time, and only a very slight overlap can be seen at the correct recording level. The reason for this is not hard to find on the original circuit; the anode of the indicator is supplied with 90 volts by rectifying the voltage present on an overwind of the bias oscillator coil. The reason for the erratic behaviour of the indicator is that the rectified 40 kc/s is not smoothed in any way. The addition of a 100kΩ resistor and 0·002μF capacitor completely cures this. During this modification, do not forget to remove the 7·5 kΩ resistor which in the original was used to cut down the drive to the output transistors during recording. This was originally necessary as the first three stages had to be run at full gain, and some attenuation was required to avoid overdriving the output transistors. The potentiometer which acts as a treble cut during replay also serves as a volume control during replay, but it acts by adding series resistance to the speaker and is therefore incapable of reducing the drive. When the 7·5kΩ is removed the wiring should also be removed from the associated switch section to be used later. Note that the potentiometer VR5 is used to set the initial position of the column of the record level indicator. This must be set so that 100% recording level corresponds to the column meeting the dot underneath.

Output Stage

The next modification concerns the output stage. In the original, the output stage is stated to be a Class B transformer coupled stage with 2-3W output. As the output transistors are OC26's or their Ediswan equivalents, using the chassis of the recorder as a heat sink, this ouput seems very modest. In actual fact, the standing current in the output transistors is very high, corresponding more to class A operation, and causing restricted output, low volts on the mains unit (along with considerable hum) and very short battery life. Higher outputs can be obtained by reducing the base bias current in this stage, and the circuits of original and modified stages are shown in Fig. 3. It can be seen that the emitter circuitry has been altered to. During replay the 1·5Ω resistors are in series with the emitters to give a measure of feedback and to aid thermal stability. During record, the 10Ω resistors are also in series to reduce the dissipation in the output transistors since (as explained earlier) the drive is no longer attenuated during record. The portion of switch previously made redundant is now pressed into service along with the portion used to earth the bias oscillator circuit during recording. Note that in the original circuit, the feedback loop is disconnected during recording. This avoids feeding any harmonics produced by the output stage back into the recording head. For feeding external speakers, and where the highest output is required, the 10Ω resistor across the output transformer should be replaced by 33Ω.

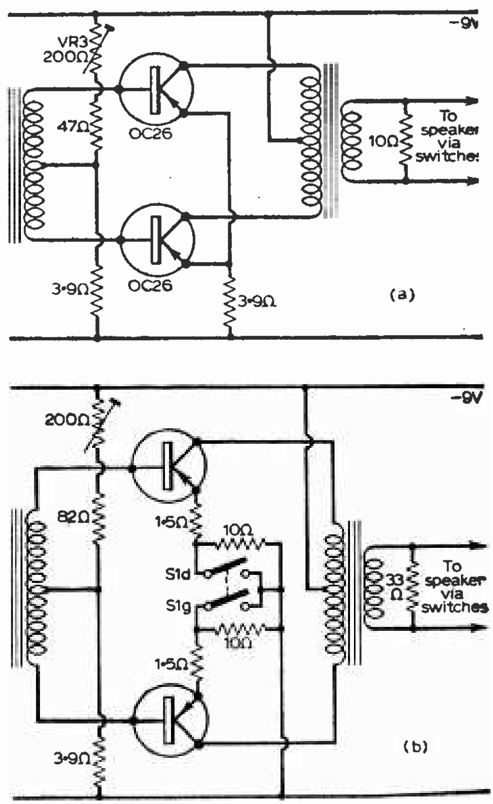


Fig. 3 (a) Unmodified circuit of output stage. (b) modified.

Other Modifications

Two other modifications are very much worth while. In the original, in order to use the amplifier separately it was necessary to switch to record, having removed the tape spools or set the "pause" control, so as not to record on a tape. It is often inconvenient to run the recording motor during periods of use as a straight amplifier, apart from considerations of wear and tear on a valuable motor, and furthermore, the treble boost is in circuit during this time, making the output unnecessarily shrill. It is a simple matter to add a switch to cut the recording motor and the treble boost when the amplifier is being used alone, and this simple modification adds considerably to the versatility of the machine.

The other useful modification concerns the erase arrangements. Permanent magnet erase is used on the "Metropolitan", but the system used, a Walter patent, is a great improvement on earlier systems. A short bar magnet is used and is swung into position by a pivoted arm when the joystick control is in the "record" position. It will be found, however, that recordings made using the original system are by no means consistent in background noise level; this is almost invariably due to the amount of slack in the mechanical coupling from the joystick to the magnet. Good, noise-free erase is obtainable at only one setting of the angle between the magnet and the tape; the angle is about 5°. The amount of slack in the mechanical coupling is usually enough to make it impossible to achieve this setting consistently. The erase magnet is mounted on a bell-crank, the other end of which engages in a forked lever. It is this joint of bell-crank and forked lever which is the main source of trouble, and two remedies are possible. The forks of the forked lever may be bent into each other so that they grip the end of the bell-crank more firmly in the "record" position. A better method is to put some rubber tubing (of the type used for cycle valves) over the prongs of the fork and, if necessary, over the end of the bell-crank as well. The fit of the bell-crank on its pivot should be checked also, slackness here is more difficult to take up without making the whole assembly too stiff, in which case the arm carrying the magnet may not move into the tape at all, as it is connected to the bell-crank by a spring, this arrangement allows the erase head to be swung aside for superimposing recordings. By carefully filing the hollow spindle which passes through the bell-crank, the fit can be improved, but only a minute quantity of metal at a time should be removed, checking the fit each time. This concludes the description of the modifications, and we pass to a few notes on the practical aspect.

Practical Notes

First of all, the lid should be removed. For work on the motor and the erase head, the deck cover must also be removed. Remove tape reels, and pull off the small plastic cover which shields the heads. The flat-headed screw under this cover should now be removed together with the other two above the tape-spindles. The volume-control knob is removed, and the knobs on the joystick and the "Push-to-record" safety switch are unscrewed. The plastic deck-cover can now be lifted clear, although it may be rather stiff due to the retaining clip fitted at the centre of the loudspeaker side. For working on the motor, it is desirable also to remove the speaker, which involves unsoldering the leads and unscrewing the retaining Philips screws. If the external loudspeaker connection is now used, the recorder can be checked in this condition after modifications have been made. In this state, the adjustments to the erase magnet can be made. To reach the motor, rather more dismantling must be done. Remove the hairpin spring which holds the

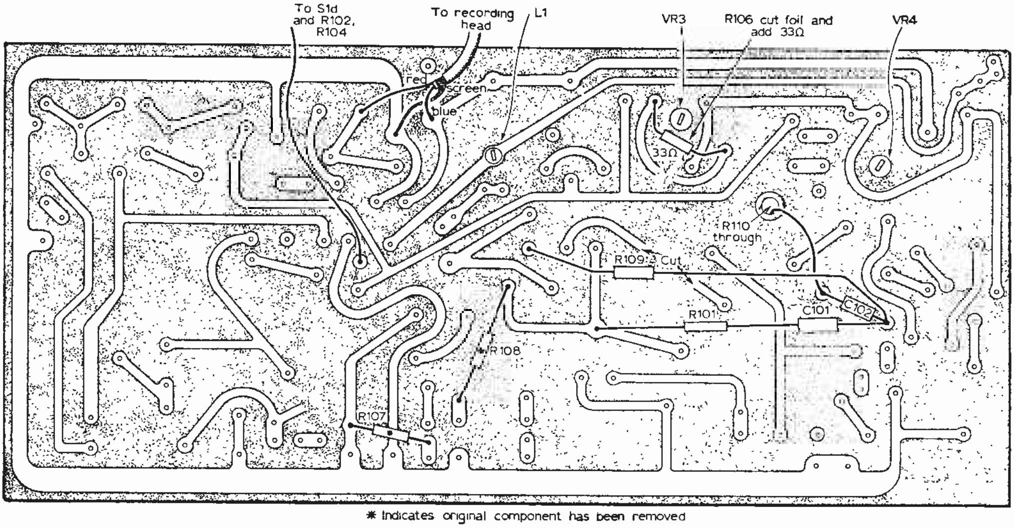
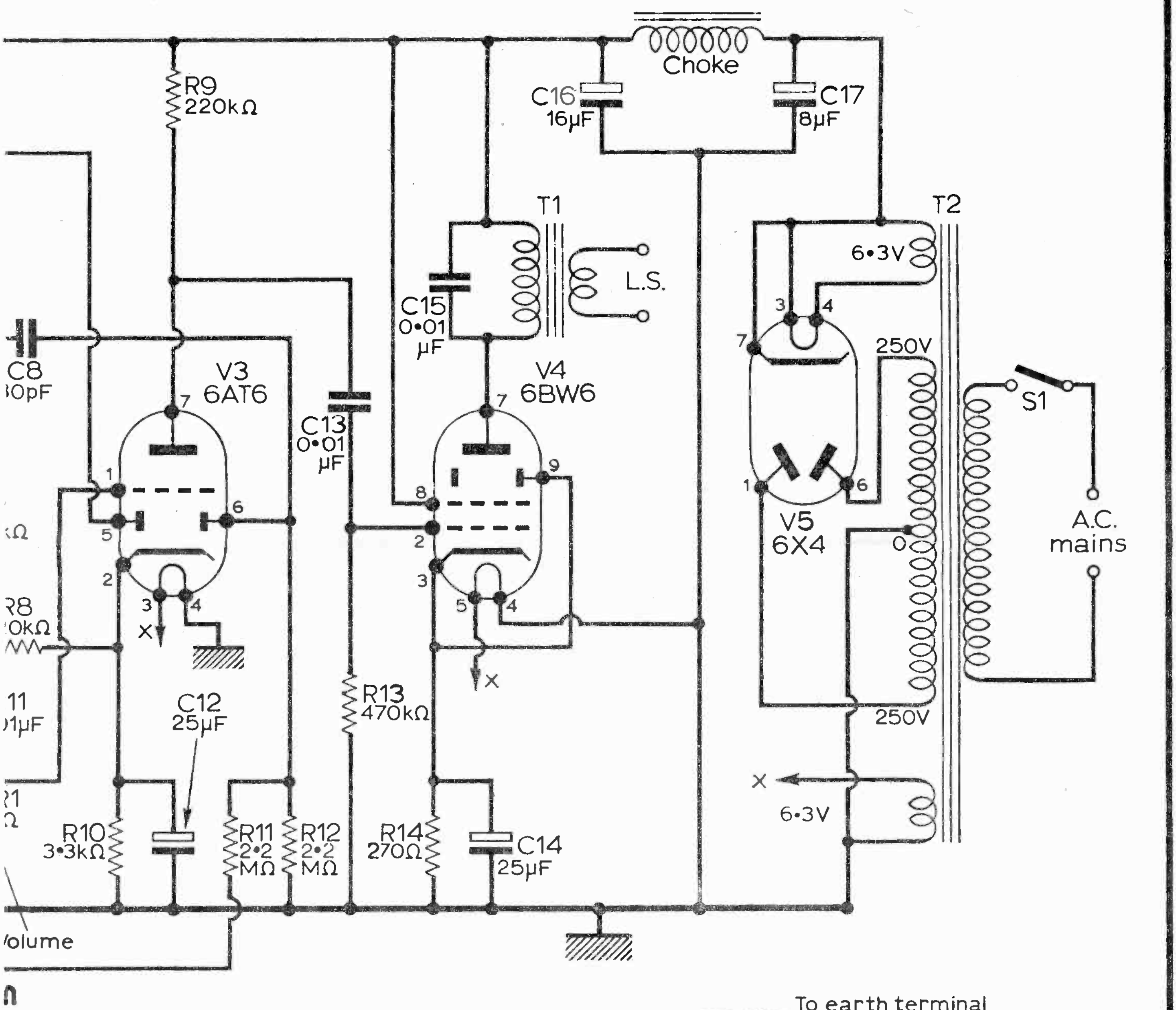


Fig. 4: Printed circuit board layout, including modifications.

PRICE 5/-

HORT WAVE RECEIVER

WER HOUSE, SOUTHAMPTON STREET, LONDON W.C.2.



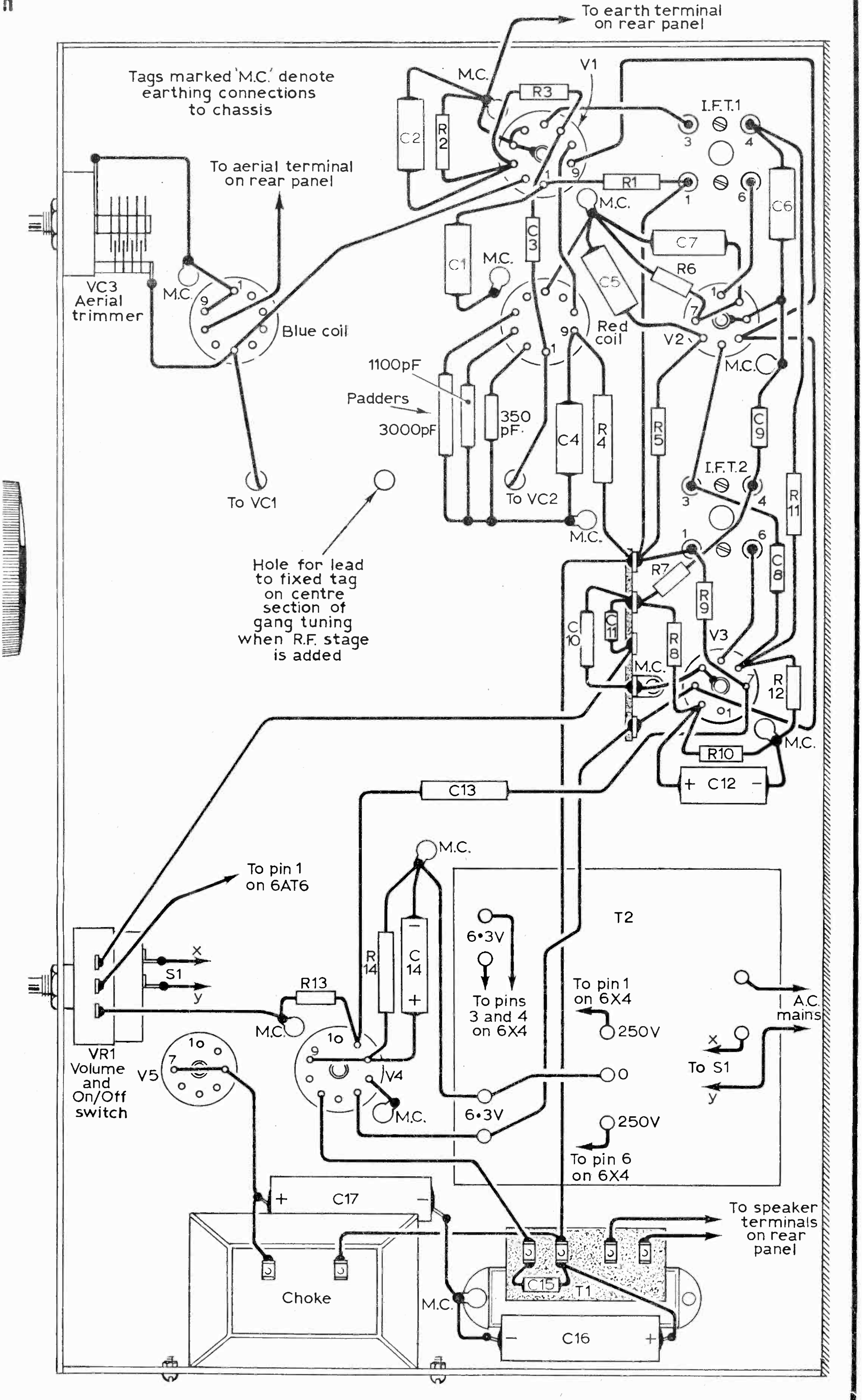


Fig.3. Under chassis wiring

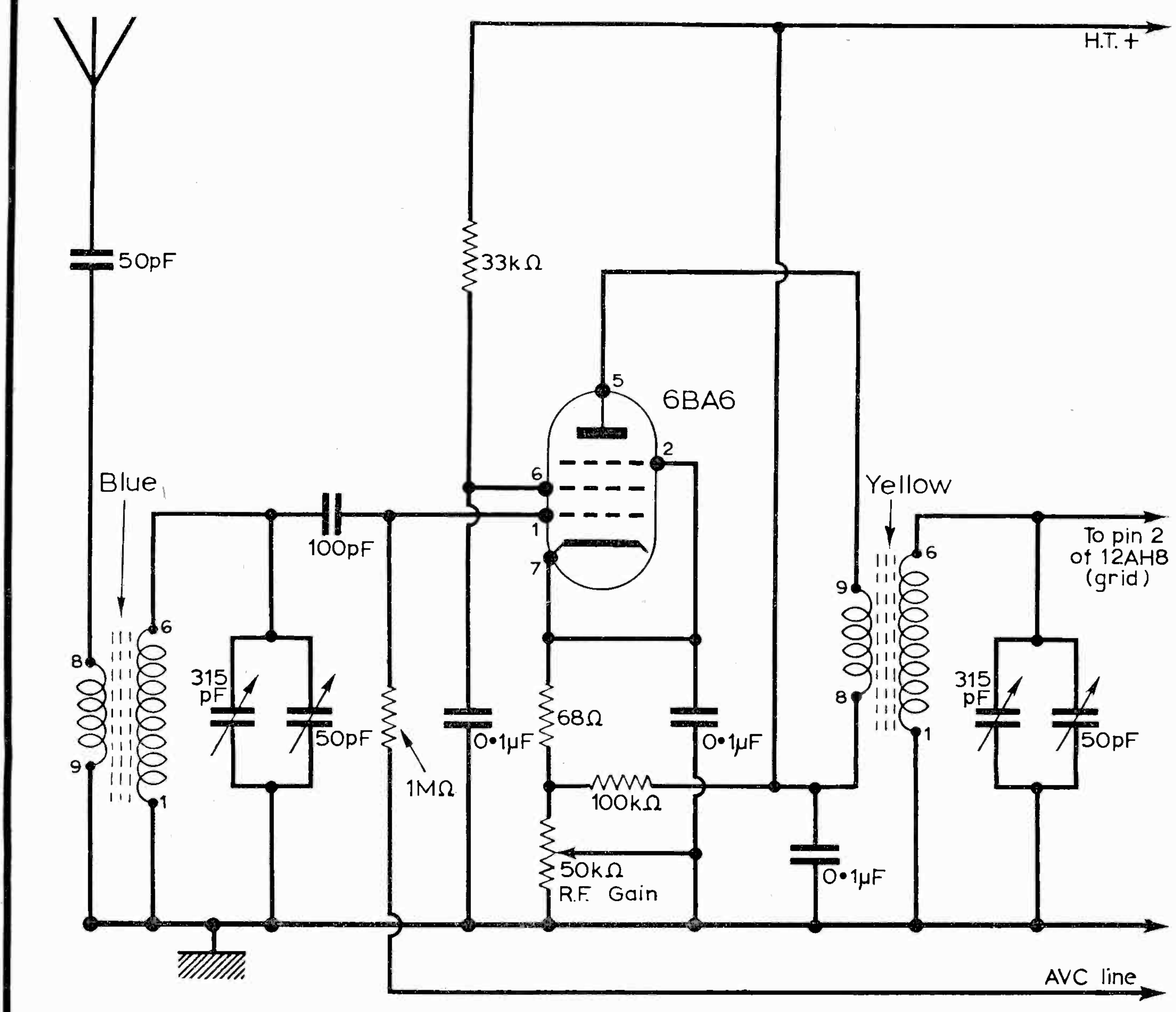


Fig. 4

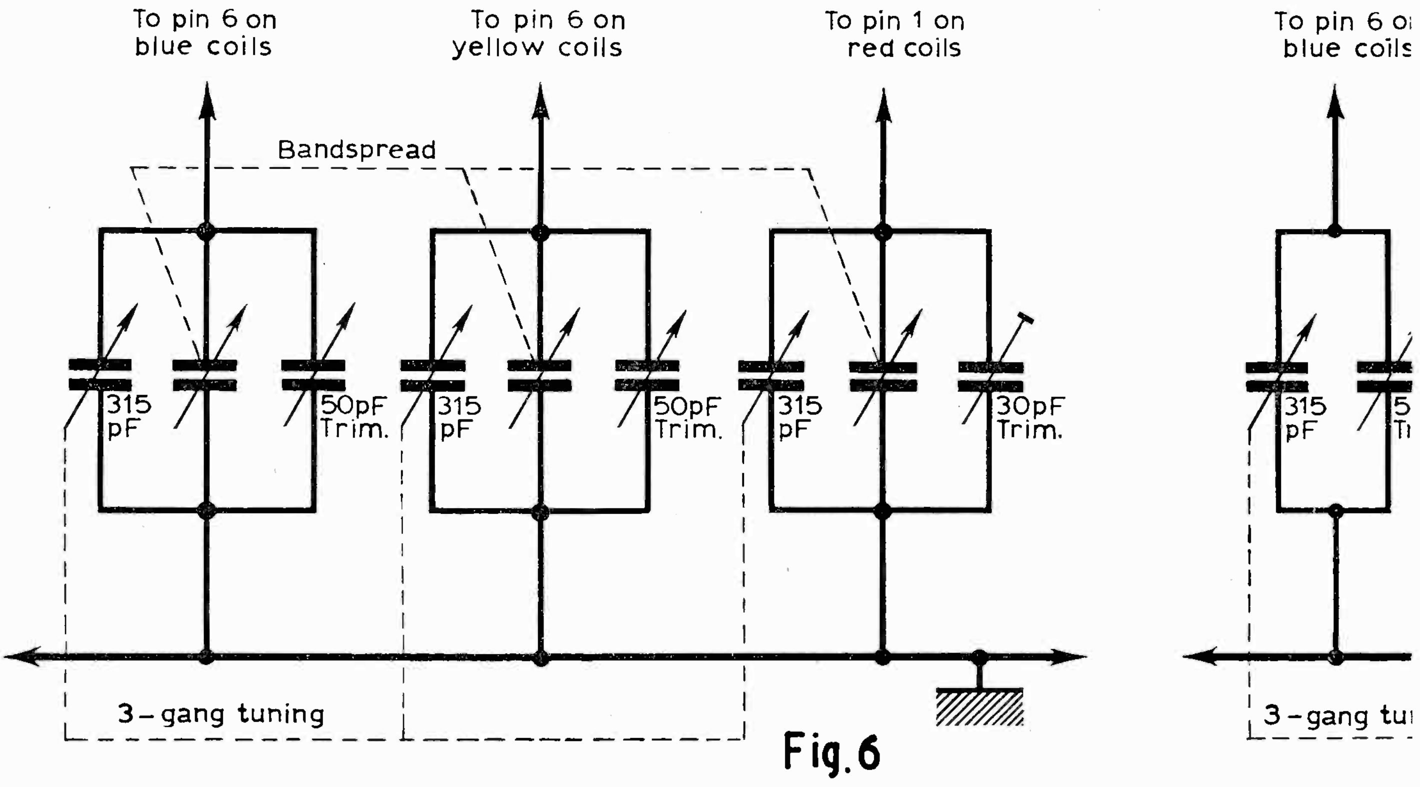


Fig.6

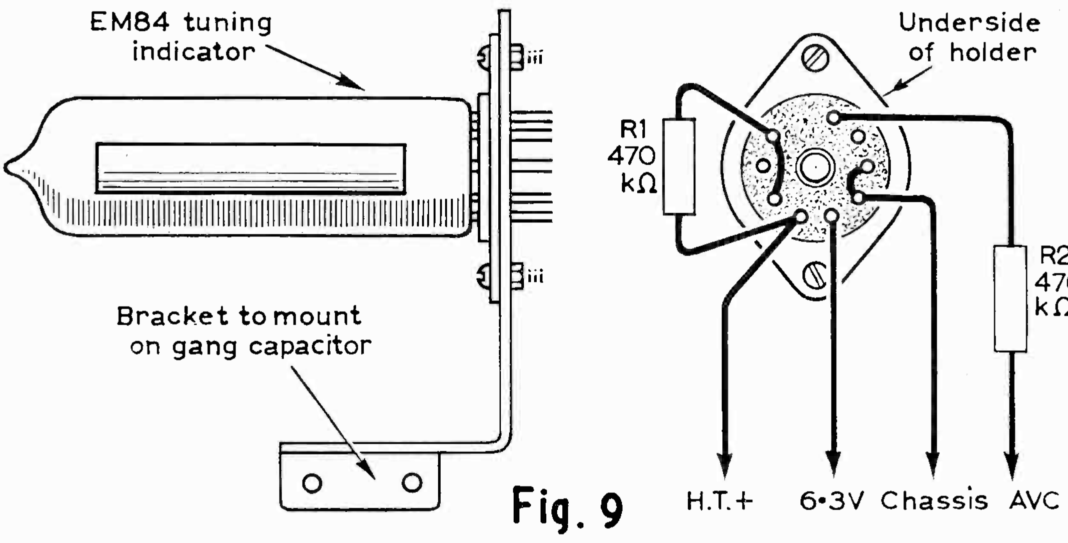
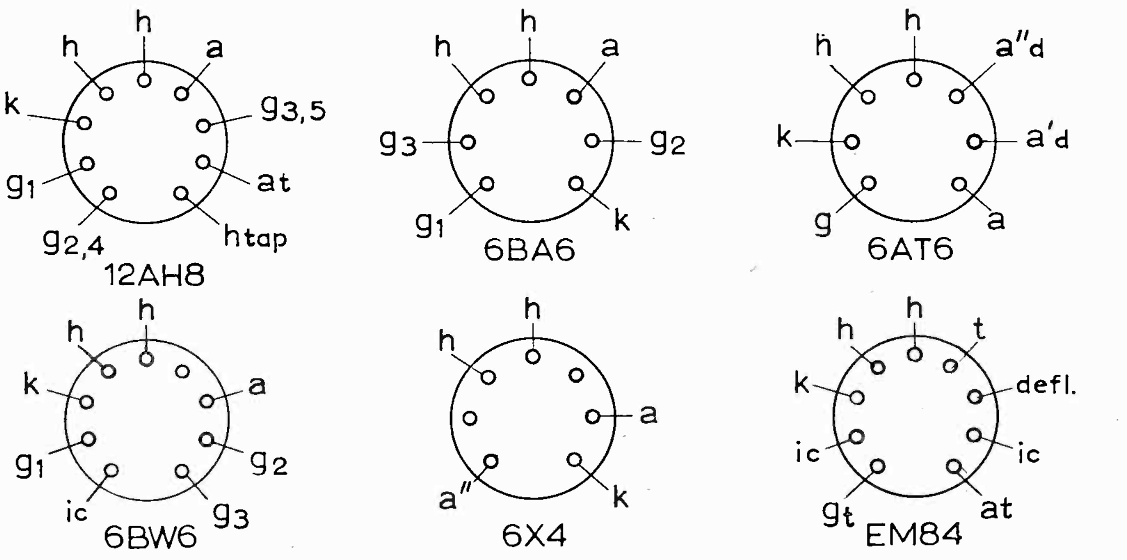
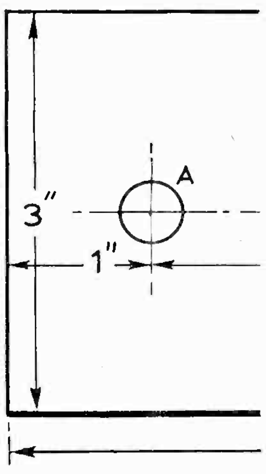


Fig. 9



Valve base connections



COMPONENT

Capacitors:
C1 0·1μF 350V
C2 0·1μF 350V
C3 100pF mica or ceramic
C4 0·05μF 350V
C5 0·1μF 350V
C6 0·05μF 150V
C7 0·1μF 350V
C8 30pF mica or ceramic
C9 200pF mica or ceramic
C10 200pF mica or ceramic
C11 0·01μF 350V
C12 25μF 25V electrolytic
C13 0·01μF mica or ceramic
C14 25μF 25V electrolytic
C15 0·01μF 350V
C16 16μF 350V electrolytic
C17 8μF 350V electrolytic

Valves:
V1 12AH8 V2 6BA6
V3 6AT6 V4 6BW6
V5 6X4

Transformers:
IFT1 IFT2 Denco IFT11 (465 kc/s). T1 5kΩ/3kΩ 60mA ratio 40:1. T2 6·3V 2·5A or 3A and 250/0/250V 70mA mains transformer.

Inductors:
Denco Maxi-Q miniat
ranges 2, 3, 4 and 5,
Red (465 kc/s Osc.). Ye
if added.

Resistors:
R1 33kΩ
R2 220Ω
R3 47kΩ
R4 27kΩ 1W
R5 33kΩ
R6 68Ω
R7 22kΩ
All 10% ¼W carbon u
stated

PRESENTED FREE
WITH
"PRACTICAL WIRELESS"
FEBRUARY 1966

Practical Wireless

Progressive Sł

PUBLISHED BY GEO. NEWNES LTD., TO

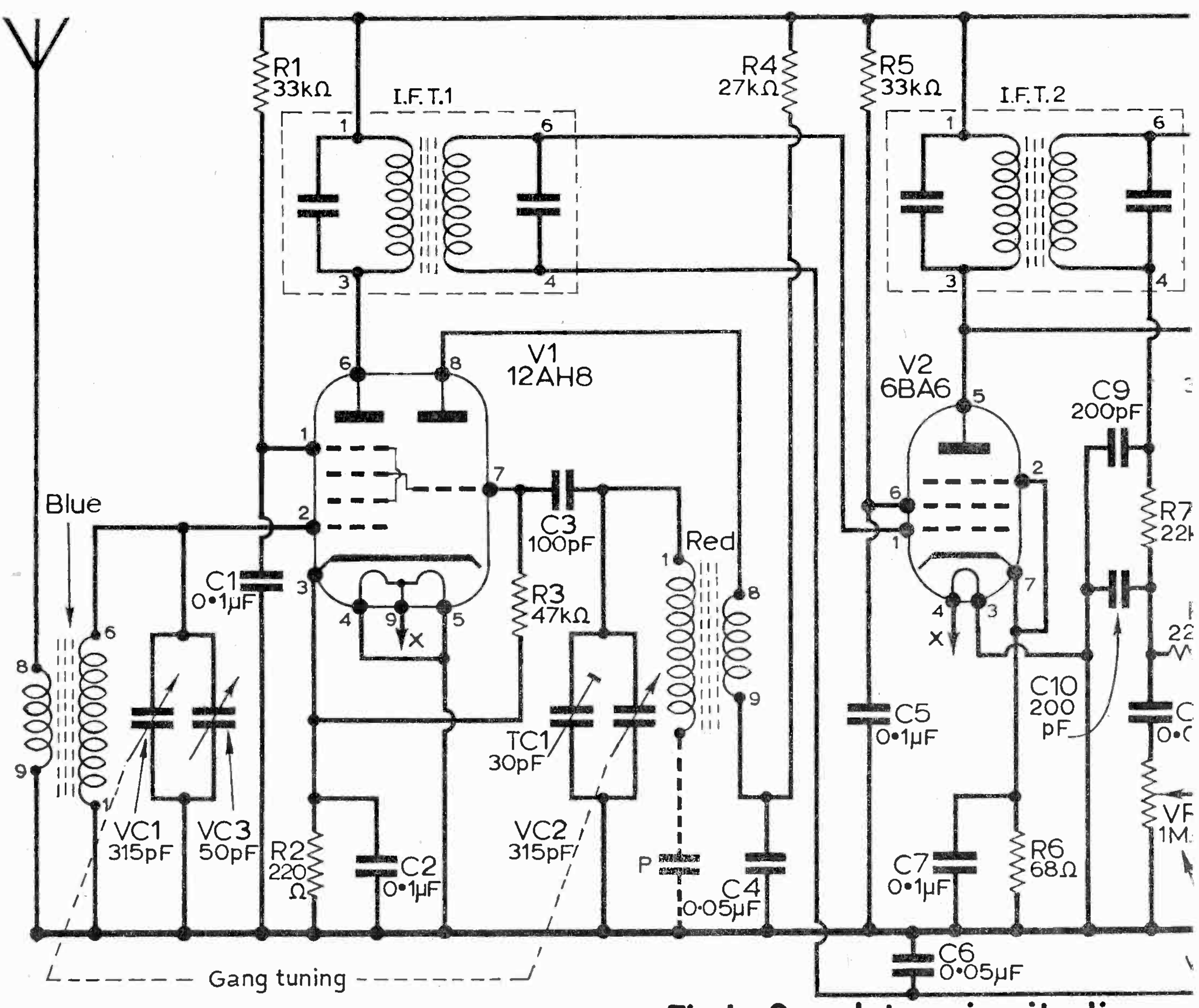


Fig.1. Complete circuit diagram

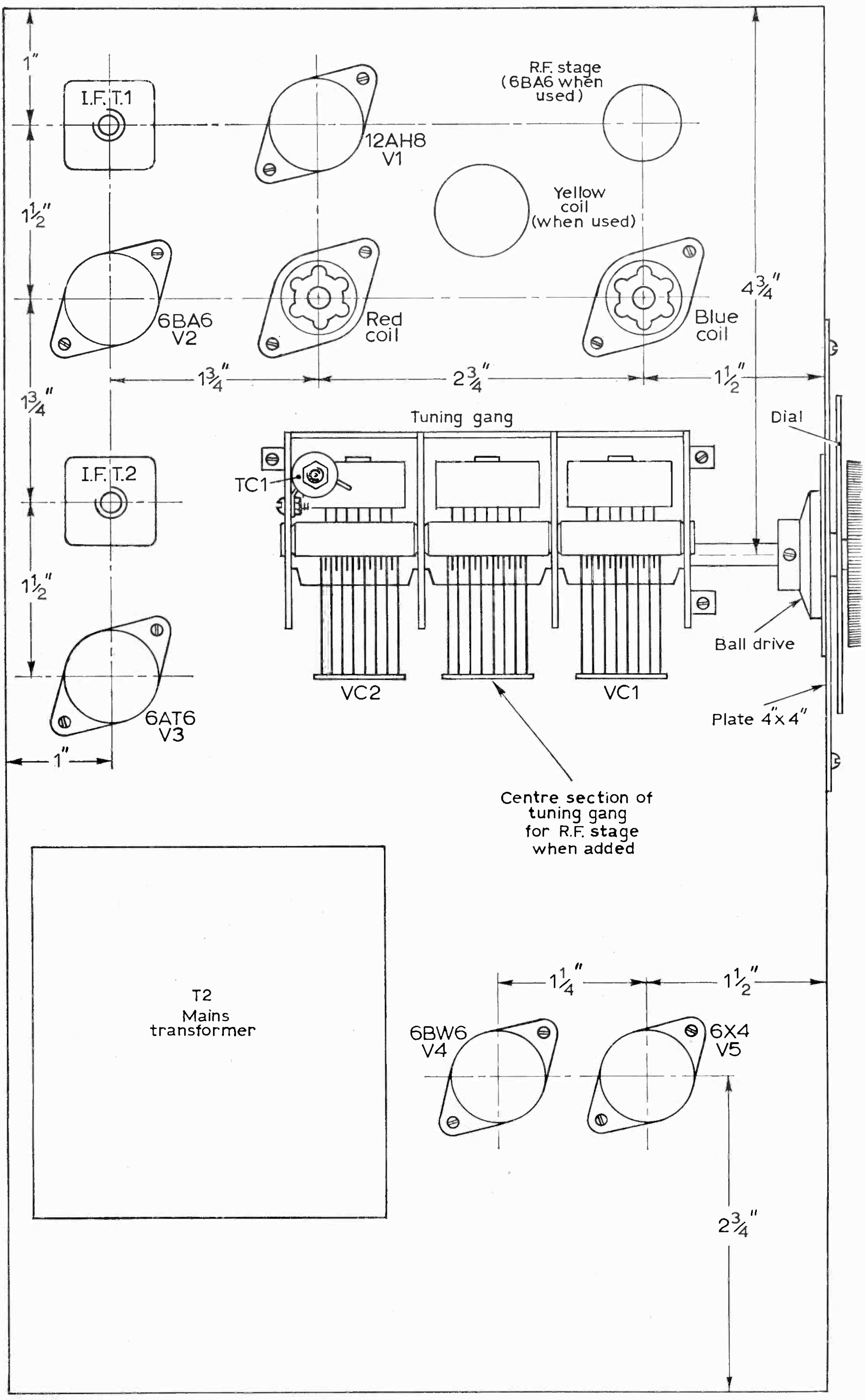


Fig.2. Top chassis layout

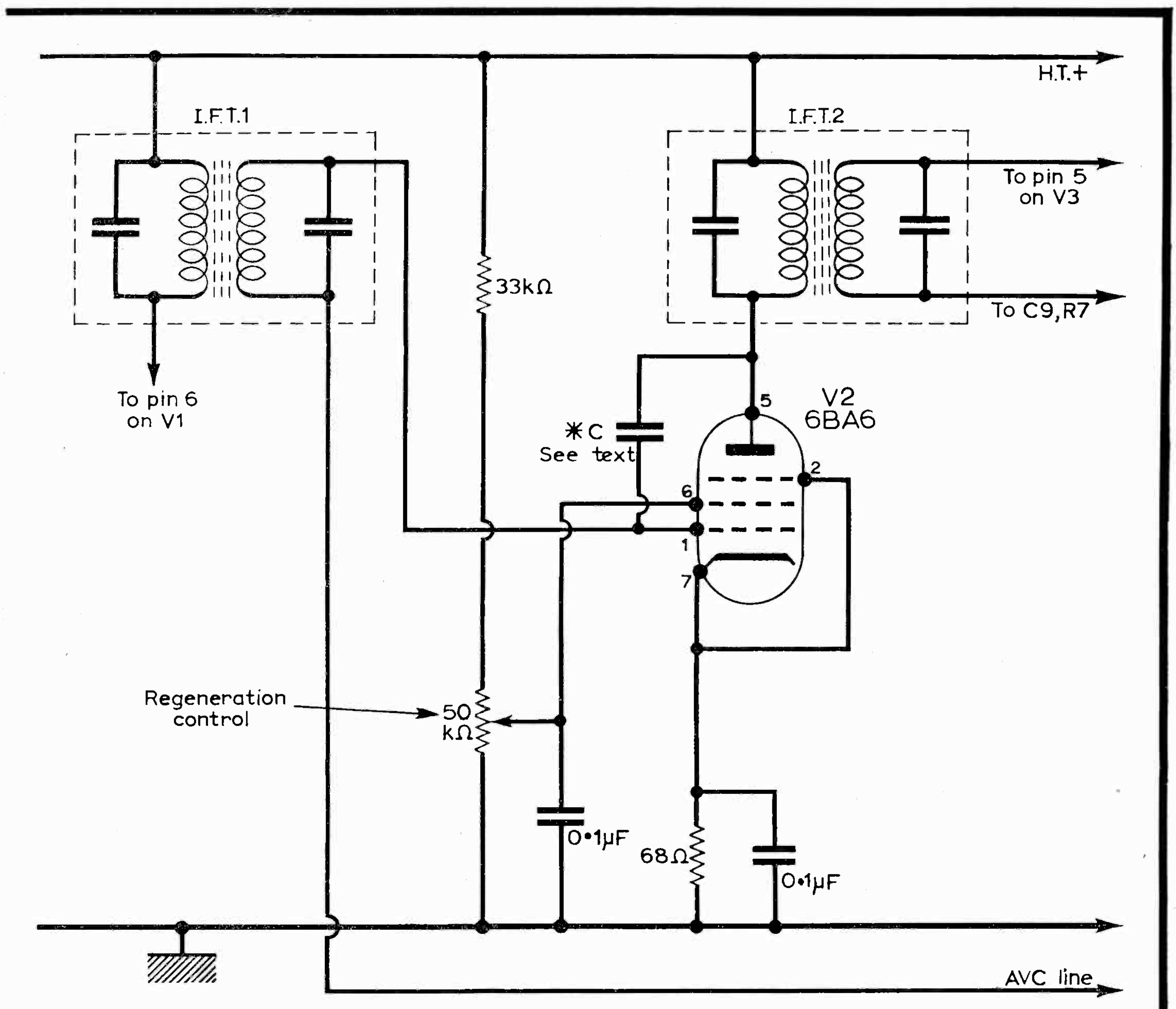


Fig. 5

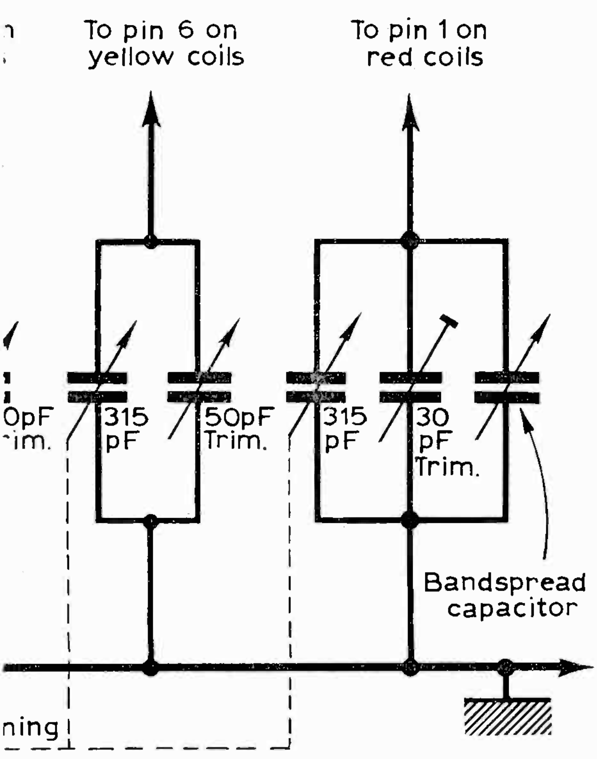


Fig. 7

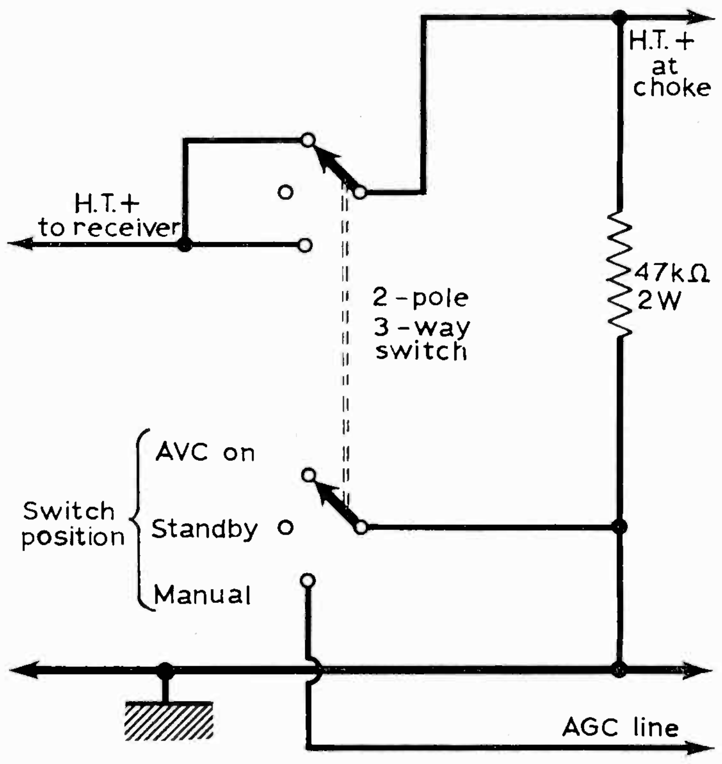
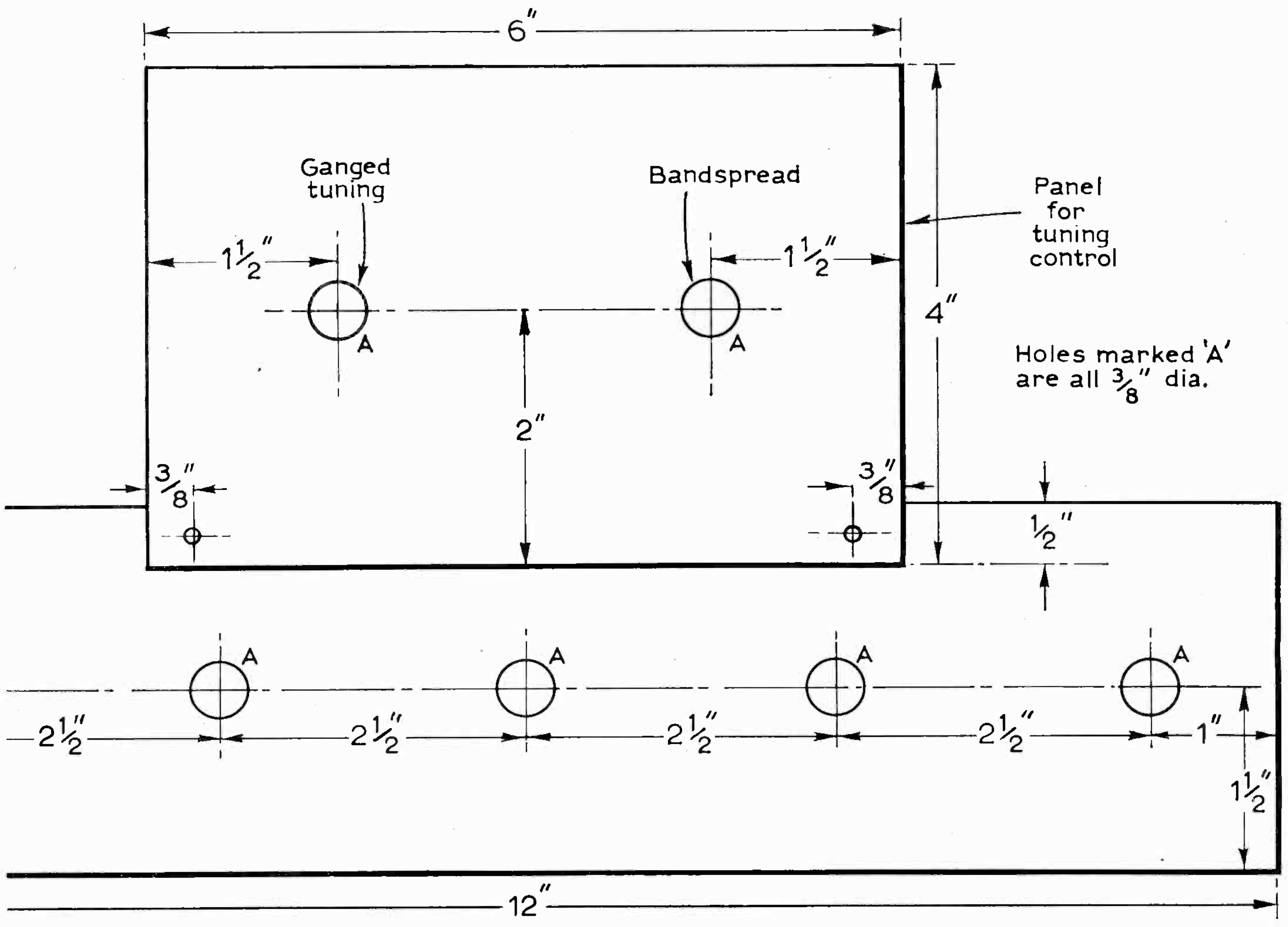


Fig. 8



Front chassis and tuning panel

...TS LIST

...ure plug-in coils, Blue (Aerial) and ...llow for r.f. stage

8 220kΩ
9 220kΩ
10 3·3kΩ
11 2·2MΩ
12 2·2MΩ
13 470kΩ
14 270Ω 1W
...nless otherwise

Miscellaneous:
Three B7G holders. Four B9A holders. VC1/VC2 3-gang 315pF capacitor. 6:1 ball drive. Bulgin scale and knob. Padders 350pF range 2, 1100pF range 3, 3000pF range 4. (Close tolerance silver mica).

VR1 1MΩ volume control with s.p. switch.

VC3 50pF air-spaced trimmer with knob. TC1 30pF beehive trimmer. Chassis 12 x 7 x 3 in. 60mA smoothing choke.

Additions:
Tuning Indicator. EM84. B9A holder. Two 470kΩ resistors.

Regeneration. 50kΩ potentiometer.

Standby/AVC. 2-pole 3-way rotary switch. 47kΩ 2W resistor.

R.F. Amplifier. 6BA6. B7G holder. Yellow coils. 50pF trimmer with knob. 50kΩ potentiometer. Three 0·1μF 350V capacitors. 50pF and 100pF capacitors. 68Ω 33kΩ 100kΩ and 1MΩ resistors. B9A holder.

Bandspreading see text.

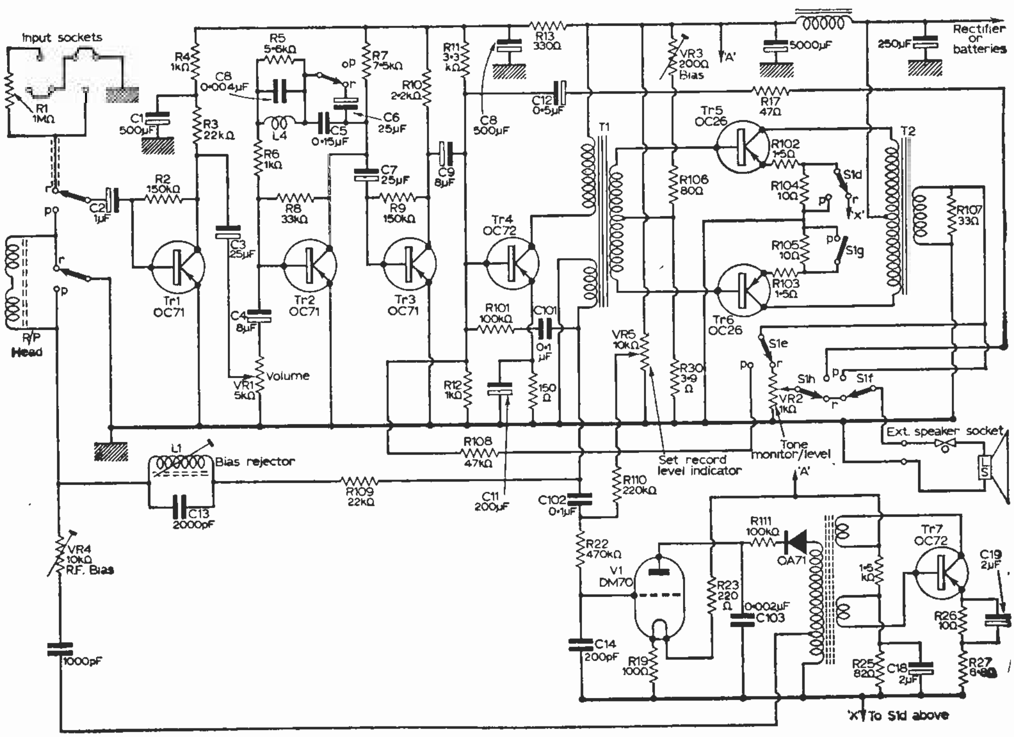


Fig. 5: Complete circuit diagram of the modified amplifier etc.

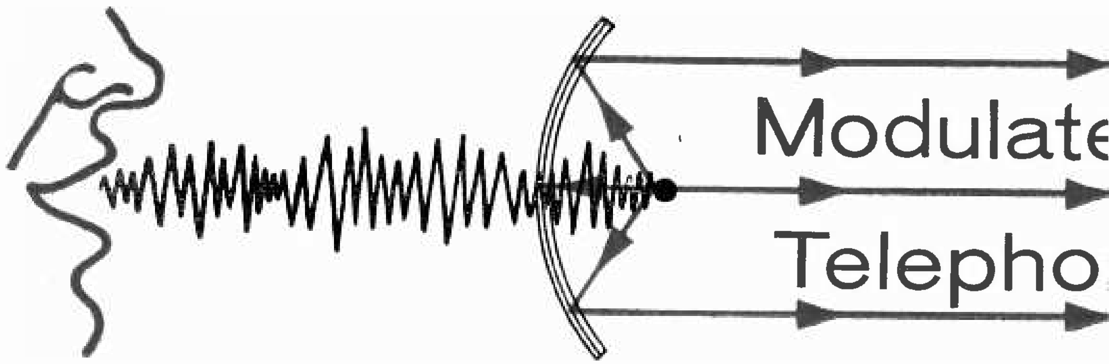
capstan idler wheel arm in position, and withdraw the split washer which holds the arm on to its pivot. Remove the arm and also the four Philips screws which hold on the sub-frame containing the motor, the recording head and the rewind idler-wheels. The erase head lever will have to be disengaged from its fork to do this. This procedure is not strictly necessary if the motor is being replaced by another identical part, but it makes work much easier.

Access to Amplifier

For the modifications to the amplifier, the back cover of the recorder must be removed. This is merely a matter of removing the four feet and lifting off the cover. The output transistors and the output transformer are at the input/output terminal side opposite the mains plug. With the exception of the power-pack and the running controls, all the rest of the components are on the printed circuit board. This board is removed by unscrewing the two retaining bolts at one end, lifting carefully with one finger holding the lever underneath which operates the record/play switch and, when the operating arm of the switch is clear, sliding the two pegs on the opposite end of the panel out of their grommets. It is important, incidentally, that these grommets should not be lost, as they act as insulators to prevent earth loops which would cause instability or excessive hum. The amplifier modifications can, however, be carried out without disturbing the board unduly, as the small parts required can be mounted on the printed side of the board—i.e., facing upwards. Fig. 4 shows the locations of the extra components. Fig. 5 shows the circuit diagram of the completely modified amplifier.

It is advisable to set-up the values of bias and head drive on the make of tape which will be most used on the recorder. A make of tape which seems very tolerant of set-up conditions, and which works very well with the Metropolitan is the American "Lafayette" tape, which is marketed over here as "International" Tape at about 12/6 for a 1,200ft. 5¾in. reel. Check that the head is perfectly clean, using nothing but a clean cloth to remove any oxide coating. First of all, set up the erase magnet position. Run a short length of tape through under recording conditions, but with no signal input and with the volume control turned down to prevent transistor noise being recorded. Note the position of this piece on the counter, replay at full volume and listen to the noise. Now make similar recordings on subsequent parts of the tape with the erase head slanted first one way then the other. The positions of the head can be charted by holding a straight-edge against the magnet and marking the line on the deck with a pencil. Now play back at full volume again and compare the three recordings for noise. If the initial recording was best, reset the magnet to this position. If one of the other positions was better, then another set of recordings must be made around that

—continued on page 906



THIS article describes an interesting method of obtaining a short-distance, one-way telephone link between two points where the conventional wire connection is not possible. It is not the most efficient but it is straightforward and needs little extra equipment outside the assets of most readers.

The schematic diagram of Fig. 1 is an ideal way to use this apparatus. The a.c. source can be a microphone or a crystal set (in fact any means of producing a signal, even prerecorded music, although results will not be as good as speech). Amplifier 1 need only have an output of about 3W but amplifier 2 should have a larger gain and output capabilities of about 10W.

A two-way system can be constructed, duplicating each piece of apparatus. Or a switching device can be devised to enable one amplifier only to be used at each end.

The system was used successfully over a range of some 40yd; any smaller distances than this will produce good results. Greater distances will produce a weaker signal requiring greater amplification at the receiving end.

Basic Principles

If a source of modulated light is placed at the focal point of a spherical mirror then a roughly parallel beam of modulated light is produced. If in the same plane another similar mirror is placed with a photoelectric device for converting the pulses of light received into similar pulses of electricity then a practical means of communication has been achieved.

Transmitter

This consists of a suitably chosen torch bulb connected across the secondary winding of an audio amplifier output transformer (Fig. 2a). It must be stressed that the right type of bulb is of the utmost importance. That is to say the resistance of the bulb should be in the same region as that of the loudspeaker removed from the amplifier; e.g. an output transformer needing a 15Ω speaker would require a 4½V bulb rated at 0·3A or a 9V bulb rated at 0·15A, etc.

It was found, however, that the temperature of the filament could not fluctuate fast enough to follow the complicated pattern of pulses fed into it from an a.c. source. This presented quite a problem until the idea of using a standing direct current was hit upon (Fig. 2b). This means that if pure a.c. is fed to a lamp the light output consists mostly of second harmonic distortion. This is because the filament heats up during each half-cycle. To avoid this frequency doubling it is essential to apply a d.c. bias equal to the peak a.c. input. Hence the use of s.d.c. In practice this was produced by placing a 3V battery in series with the output transformer and the bulb. The modulated light signal is then added to produce a small flicker of light on the basic s.d.c. Any large

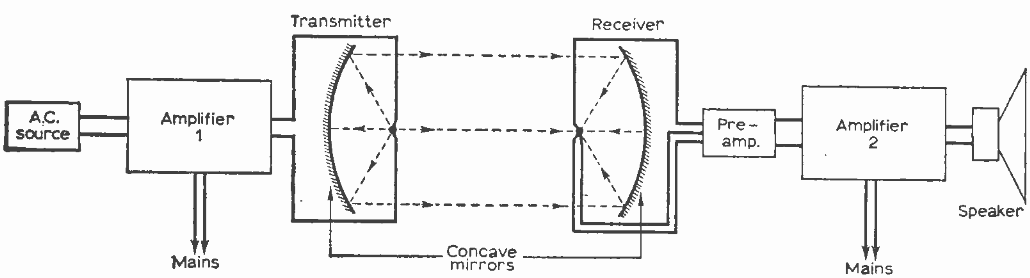
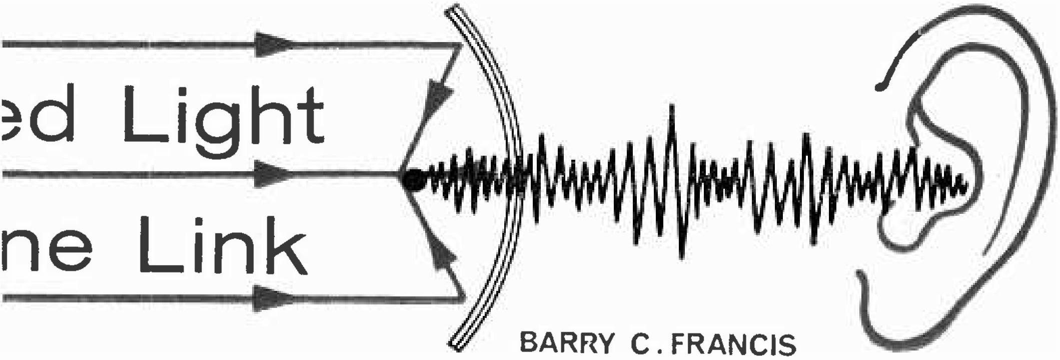


Fig. 1: Schematic diagram of the complete system.



ed Light
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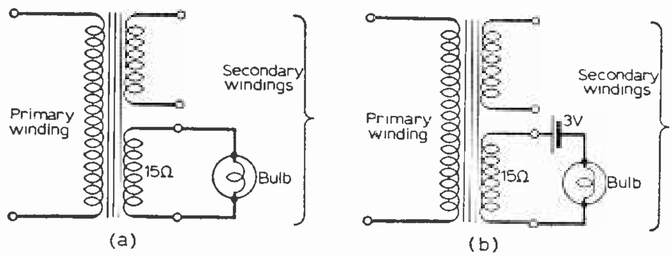
BARRY C. FRANCIS



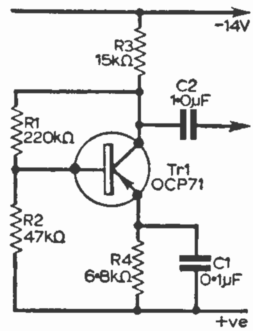


Fig. 2 (above): The transmitter circuit.
Fig. 3 (right): The receiver circuit.
Fig. 4 (below): Calculating focal length of mirror.

fluctuations were found to produce large amounts of distortion.

Receiver

The receiver consists of a Mullard phototransistor (OCP71) placed at the focal point of the second mirror. The associated light detector is merely for the conversion of the modulated light waves received into pulses of electricity ready for amplification.

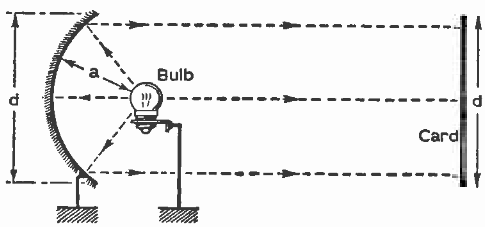
The components were mounted on a six-way miniature group board which was housed in the vicinity of the mirror. It was found necessary to place R4 and C1 directly under the phototransistor.

Constructional Details

The unit to be described was designed for a specific purpose to fill certain requirements and, while it has fulfilled these, it may not meet the needs of every particular constructor. However, there are a few points that will apply to anyone making even a vaguely similar instrument and so for this reason alone the complete apparatus is described.

Mirrors

The size of the mirrors used in each case will, of course, depend upon the distance over which

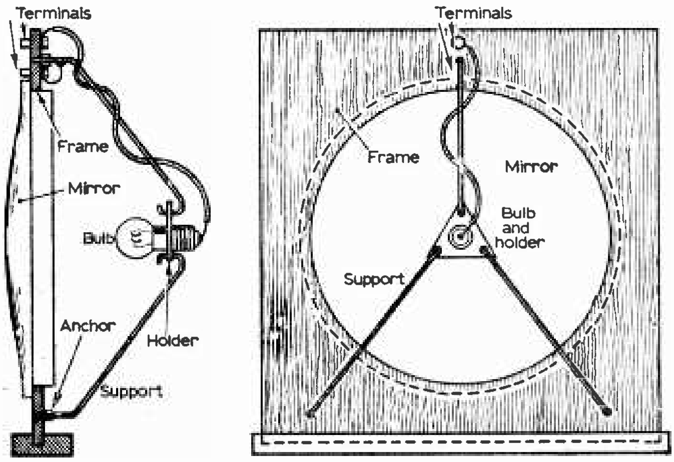


transmission is required. This is because the concave spherical mirrors used will give not a parallel beam of light but one that diverges. Therefore for the maximum amount of power to reach the receiver the transmitted beam should be as condensed as possible. The mirror that was found to be the most suitable for the transmitter had a diameter of 4in. The one used in the receiver had a diameter of 6in. and a focal length of 3in., the distance of transmission being 50yd.

The focal length of a concave mirror can be calculated roughly as follows (the focal length of each mirror is required for the positioning of phototransistor and transmitting bulb): Secure the mirror in the vertical position as shown in Fig. 4. Support the torch bulb so that its filament is directly in line with the centre of the mirror. This

continued over

can be done by obtaining a length of stiff wire and making a loop at one end to enable the bulb to be held by its base. The other end of this wire can be secured to a small block of wood to hold it vertical. Now place a white card with a circle the same size as the reflecting part of the mirror traced on it facing this mirror (Fig. 4). Switch on and move the bulb along a line parallel to both mirror and card until a circle of light of diameter "d" appears on the card. The bulb is now at the focal point of the mirror and the distance "a" from its centre can be measured and recorded.



(a) (b)

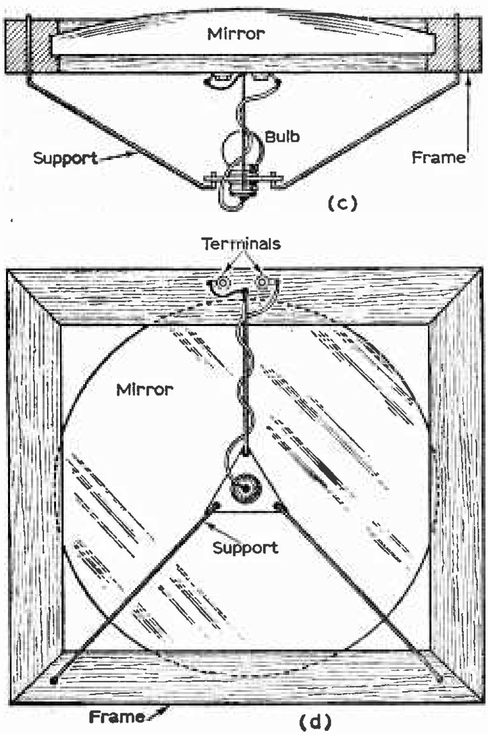
Fig. 5: Constructional details of the mirror unit.

Transmitter

Fig. 5a shows a side elevation of the completed transmitter. The concave mirror was mounted on a piece of five-ply (Fig. 5b gives a front view of Fig. 5a). This mounting may prove difficult for any mirror without a backplate and so an alternative mounting position is shown in Figs. 5c, d.

The sides for this case were made from strips of balsa wood $1\frac{2}{3}$in. square, glued together as shown. The actual bulb support was fashioned from an old piece of toothpaste tube that had been cleaned and battered into a triangle of side 9/10in. Three pieces of galvanised wire were constructed as supports and soldered to the triangular piece of metal, one at each corner, after a hole had been drilled to accommodate the bulb. The other ends of these pieces of wire were placed through holes in the mirror mounting. One of these supports formed the connection to the bulb case. The other connection (to the base of the bulb) was made by carefully heating the nipple and attaching to it a piece of wire. This wire was then twined around one of the supports and taken to the back of the mirror. The supporting wires were made about 10% longer than necessary (i.e. "a") so that final adjustment of the bulb could be obtained.

When this position was obtained the connecting leads to the centre of the bulb were strapped to the upper support. The supporting wires were then anchored by attaching insulating tape on their inside in the form of a role as illustrated in Fig. 5a.



(c) (d)

Receiver

The support for the phototransistor (Figs. 6a, b) is slightly different from that of the transmitter. The actual frame supporting the phototransistor was made from one piece of galvanised wire stretched across the full length of the mirror and attached at either end to the mirror frame as illustrated in Fig. 6b. A third piece of wire was then attached to the centre of this and to the base of the frame. The centre attachment was then effected, using a strong solder joint. For this the wire must be clean.

The transistor holder consisted of two pieces of aluminium about the width of the transistor base and measuring 1½in. long. This piece of metal is shaped so as to hold the transistor in a clamp.

CAUTION: The metal must not be wrapped too firmly around the transistor base.

The transistor was soldered, using a heat shunt, and the connecting wires attached.

The horizontal position of the phototransistor can be altered by adjusting bolt A (Figs. 6a 7a) and its distance from the mirror can be altered by moving the supports in or out. The part of the transistor facing away from the mirror was hooded as shown in Fig. 7b to prevent interference from unwanted sources.

The most sensitive part of the transistor is near the top directly above the words OCP71, but it should be moved about until, after focusing the best results are obtained. The connecting wires can be wound around any support in the same manner used for the transmitter. The two components mentioned earlier should be strapped to the centre support directly under the transistor.

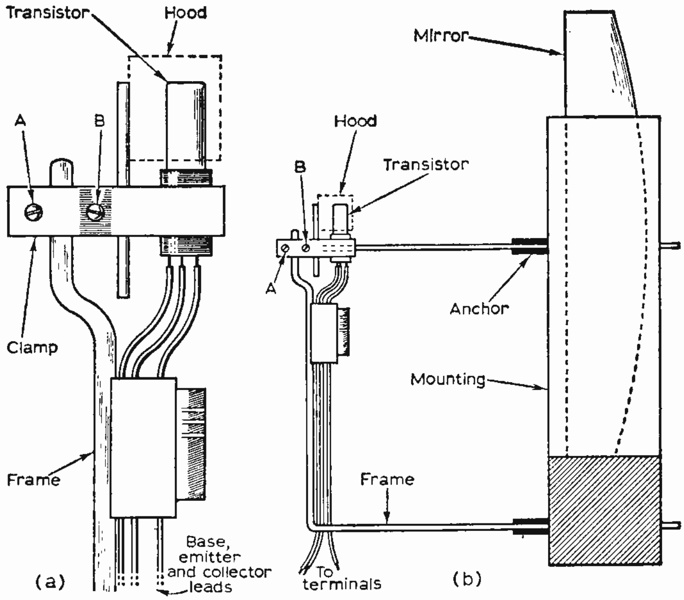
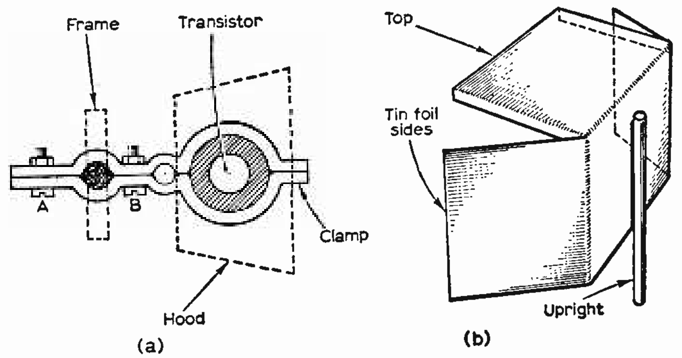


Fig. 6 (above) and Fig. 7 (below): Details of phototransistor support and transistor hood.



Lining Up

The process of lining up the transmitter and receiver is straightforward if carried out carefully. If the bulb used is rated at 4V 0·3A then an ordinary battery placed across it will give a bright enough beam to be seen. From the first mirror the spot of light produced by the second mirror can then be focused on the most sensitive part of the phototransistor. This lining up is best carried out under poor light conditions as the beam can be seen more easily. If the transmitter is for use out of doors then the best time would be around dusk.

When the lining up has been completed the 4V battery can be disconnected and the circuit connected up. ■

MEASUREMENTS WITH GDO

—continued from page 854

local oscillator in a receiver or a stage in a transmitter. With an appropriate coil in position the dial is turned until a *rise* is obtained on the meter. This indicates the resonant point and the dial reads the frequency. If it is suspected that the local oscillator of a receiver is inactive then the GDO can be tuned to about the correct frequency (i.e. signal minus the i.f. frequency) and made to oscillate, then when it is coupled to the local oscillator circuit the receiver should start to function, the GDO now supplying the local heterodyne signal.

These are a few of the uses of a GDO and if the constructor new to this type of instrument builds one, then a good idea is to set up odd tuned circuits, lengths of wire, etc., and practice using the instrument. After a short while the characteristics will be understood and it can be used on actual apparatus without much fear of false readings or whether in fact a resonance dip is being obtained. After some time it becomes possible to judge the "Q" of circuits by the sharpness of the dips. ■

Room for Everyone

FORTUNATELY there are always beginners in any hobby, but in an era of highly sophisticated and competitive telecommunications there is also clear need for those who wish to keep abreast with the times.

Those of us who have long since graduated from the breadboard and coffee-can stage cannot deny that the complexity of modern multi-band communications equipment, capable of reliable world coverage with minimum interference to other users, is beginning to place advanced design and self construction beyond the scope of most non-professional enthusiasts.

Constructor versus operator is a played out theme, damaging to the true image of the radio amateur. Given tolerance, there is still room for everyone in the game and it is perhaps sobering to reflect that the knowhow of getting a signal up and away counts for as much, if not more, than its mere generation.

Surely we are judged not by the equipment on our shack table but in what we say and how we behave whilst communicating.

T. S. Tatton, G2BSR.
Churchdown,
Gloucestershire.

P.W. Copies

I HAVE 36 copies of PRACTICAL WIRELESS complete (1962-3-4). If any of your readers are interested and wish to contact me, I will be willing to sell them at a reasonable price.

All enquiries must be accompanied by a stamped, addressed envelope.

G. N. Skinner.
29 Highbury Hill,
London, N.5.

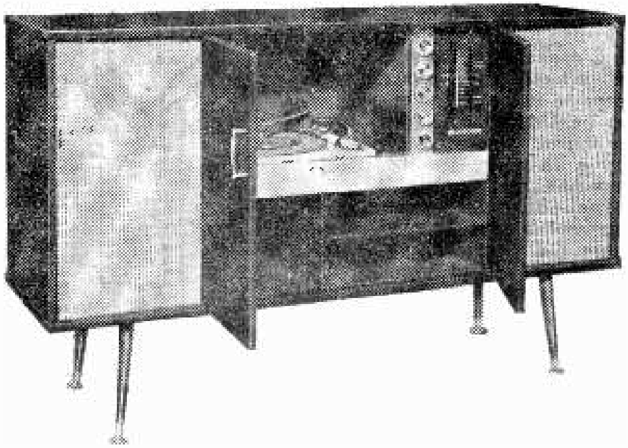
Tapespondent Wanted

I WOULD to tapespond with anyone interested in Short Wave Listening and who is about 15 years old. My tape recorder is a Cossor 1602/04, 4-track, 3¾i.p.s. and can take up to a 7in. spool.

David Griffiths.
18 Northwood Gardens,
Clayhall,
Ilford,
Essex.

NEWS AND...

BAIRD STEREOGRAM MODEL 102



From Baird TV Distributors Ltd., Empire House, 414 High Road, Chiswick, London, W.4, comes the 102 stereogram.

On opening the doors, the auto player is illuminated. Up to ten mono or stereo records can be loaded on to the record changer, and there is ample room for record storage.

This fully-transistorised a.m./f.m. radio has twin transistorised amplifiers. Separate bass and treble controls are provided and there is push-button switching between wavelengths and 'gram.

The size is 50¾in. wide x 16in. deep and 22½in. high (excluding legs). The circuit contains 19 transistors and four diodes and sockets are provided for tape recording and external speakers. The price is 85 guineas.

AERIALS FOR THE MINISTRY

The Ministry of Aviation have recently awarded two important contracts with Modern Aerials Ltd., a Member of the Controls and Communications Group of Companies. One for over £100,000 for the supply of a large quantity of their 27ft Telescopic Aerial Masts, and one for £26,000 for a larger quantity of "walkie talkie" aerials.

RADIOTELEPHONE SYSTEM TO BEAT CRIME

A new police radiotelephone system, the first of its kind in the world operating on a secret channel in the u.h.f. band, was officially opened today by the Glasgow police in their Pollok sub-division.

The use of this new frequency band means that police messages can be passed in secrecy because information transmitted on u.h.f. cannot be picked up by unauthorised persons listening on domestic radio receivers.

By utilising ultra high frequencies it has been possible for the first time to ensure highly efficient two-way radiotelephone communication between the police station and foot patrol men throughout the Pollok sub-division. All wires and cumbersome aerials previously associated with walkie-talkie equipment have been eliminated.

The equipment used is designed and manufactured by Pye Telecommunications of Cambridge.

..COMMENT

"PROTON-2" SPACE STATION LAUNCHED

A heavy scientific space station, Proton-2, has been launched in the Soviet Union.

In addition to scientific and measuring instruments, the space station carries a radio transmitter working on the frequency of 19·545 Mc/s. The information sent from the station shows that all scientific equipment on board is functioning normally. The telemetered information is then processed at the co-ordinating and computing centre.

STEREO MUSIC WHILE YOU DRIVE

A new car-stereo set, which plays continuous music from a wide range of pre-recorded tapes, is now on the market from Skytone Electronics Ltd., superseding the model introduced with great success some time ago.

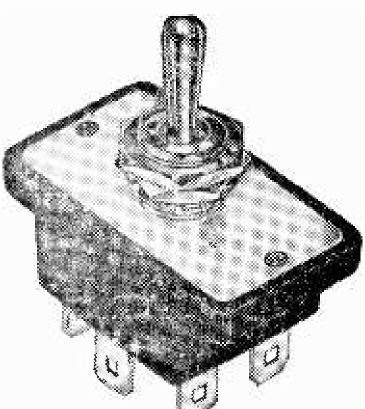
Called the Craig Car-Stereo, it is fully transistorised, completely self-contained with two speakers, and fits compactly under the dashboard. Because it is independent of a car-radio, the stereophonic reproduction is of superb quality, with no crackling or fading at any speed or over any surface.

You slip the cassette—with vocal, instrumental or orchestral tape—into the set, and it starts playing immediately. There are two pre-set playback heads, operated by a flick of a switch to change tracks. Tape cassettes can be changed with one hand. The tapes are of 30 minutes and one hour's duration and repeat until switched off.

Retailing at 46 gns., with tapes at £2 ($\frac{1}{2}$ hour) and £3.9.6 (1 hour), the Craig Car-Stereo is marketed by Skytone through Hasmick Promotions Ltd., 13 Elvaston Place, London S.W.7.

SPECIFICATION—Tape speed: 3·75in. per second. Playback method: Quarter track in-line stereo playback 2 head system. Drive motor: 12V D.C. brush type with governor. Output power: 8W (4W per channel) at 4 ohms. Frequency response: 100-6,000 cps + 3dB. Speaker impedance: 4-6 ohms. Power requirement: 12V d.c. (10·7-14·5V) 1 amp maximum, negative ground. Controls: volume, balance and tone. Amplifier: 12 transistors. Dimensions: $3\frac{1}{2}$in. (H), $9\frac{1}{2}$in. (W), $9\frac{1}{4}$in. (D). Weight: 11 lb.

NEW ARCOLECTRIC SWITCHES



Recent additions to the Arcolectric range of switches are the "27" and "28" ranges of lever and semi-rotary switches. The "27" range switches are normally assembled with nickel plated brass lever and fixing neck. Alternatively, switches can be assembled with black nylon fixing neck and nylon lever to meet double insulation requirements.

The photograph shows Cat. No. C273, a double-pole double-throw three-position lever switch with centre OFF position.—Arcolectric Switches Ltd., Central Avenue, West Molesey, Surrey.

Home-Built Equipment

Before too much printer's ink is spilled on the subject of home-built equipment, perhaps I may be permitted to express a point of view, from the outside fraternity, so to speak?

Many letters printed in your columns emanate from "call-signed enthusiasts" and the like—types who doubtless eat, drink and sleep radio! One wonders, sometimes, do they realise there *are* snags to home-building equipment.

I have been "doing it" and "making it" myself for as long as I can remember—woodwork, metalwork, pretty well anything that is going. Now, of latter years, influenced by P.W., P.E. and similar publications, I have built the "Citizen" transistor radio, a very good R-C bridge, several test meters and am now embarking on the Beginner's Short Wave Superhet.

For my part, building equipment can take months mainly due to the difficulty of obtaining components (without the expense of special journeys to suitable cities, of course). Given the tackle, I *can* build — so what about the chap who's not too good at it anyway. Don't be too hard on him with his factory-built set!

R. Brown.

Salisbury,
Wiltshire.

Any Offers?

I happened to read a copy of Practical Wireless, which is very interesting indeed! Although I would love to subscribe to P.W., it is rather difficult for us here to remit the subscription due to the recent foreign exchange restrictions.

I wonder whether any of your readers would be kind enough to offer a gift subscription which will be fully compensated by a similar gift subscription for any Indian publication of their choice. Alternatively, regular mailing of old copies of Practical Wireless would do.

B. G. Kamath.

7 Ramdevi Mansion,
10th Road, Khar,
Bombay-52, India.

Modifying Mains Transformers

B. C. MACDONALD

THE usual mains transformer has three output windings, and these are normally a high tension winding which gives say 350—0—350V, a valve heater winding giving 6·3V and a rectifier winding giving 5V. It is quite easy to alter either or both the 5V and 6·3V windings or to remove them both and put on a new winding. If the high tension winding is removed as well as the low voltage windings a new winding can be put on to give a variety of low voltage taps from 1V to 40V or more, in selected steps.

The work of rewinding is not tedious because the wire is thick and the turns comparatively few. A normal 6·3V winding only contains some 25 turns. Such a modified transformer is clearly useful and can be used as a filament transformer allowing high voltage valves to be run in parallel.

The first step in making the modification is to dismantle the transformer so that we can remove the coil. It will be found that the core laminations are held together by two screws, which also serve as fixing screws. If the nuts are unscrewed and the screws removed any screening cap that may be fitted can be pulled clear, if the transformer is not screened there will simply be two end rims to pull off. The core that remains is built up from a large number of thin iron stampings fitted, or laced together as shown in Fig. 1. These stampings must be prised apart to release the coil, use a small pocket screwdriver and release the long strips first, then withdraw the stampings out of the coil. Be very careful not to damage the coil and note the order of assembly, since it may differ from that shown, and must afterwards be replaced in the same way.

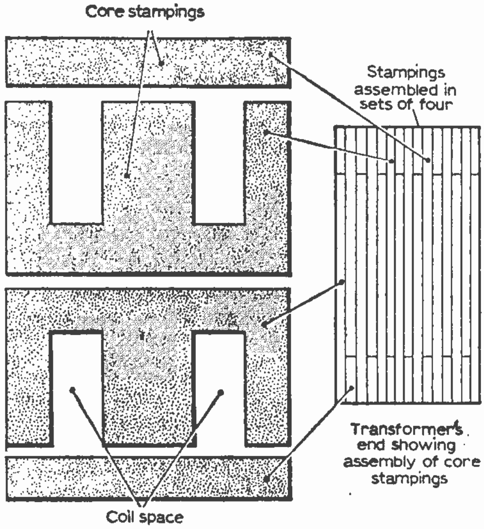


Fig. 1: Assembly of core stampings.

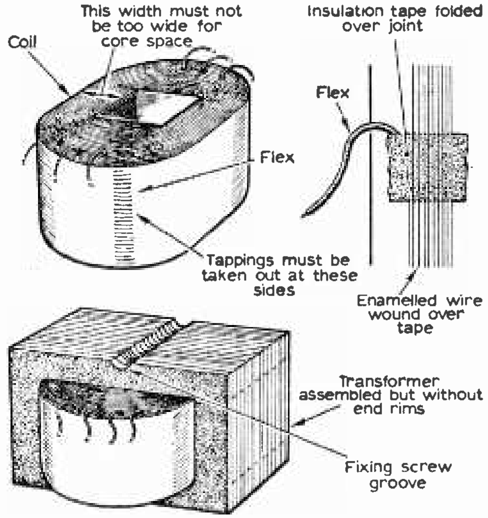


Fig. 2: Details of transformer construction.

The coil is usually wrapped in waxed paper and the outer covering of this should be torn away to reveal the top winding. This can then be removed to give access to the lower winding which, if desired can also be removed. Below this lies the high tension winding of a very large number of turns of very fine wire. This winding cannot be altered and unless it is intended to remove it, it should not be uncovered. If it is desired to remove the high tension winding, each layer should be cut through with a pair of nail scissors, great care being taken not to damage the mains winding which lies beneath. It is impracticable to try and unwind this winding, hence the reason for cutting through each layer.

This is how we dismantle the transformer, but it is essential before we remove the top windings that we should count the number of turns in them. This is best done by drawing the point of a pencil slowly across the wires and counting the "bumps". Make a note on paper of the result, 5V winding 19 turns or 6V winding 23 turns and so on.

Suppose we wish to add a 19V winding in place of the 6·3V winding. We know this latter winding contains 23 turns so we calculate thus:

$$23 \times \frac{19}{6{\cdot}3} = 69{\cdot}4$$

or nearly 69 and a half turns are required on the new winding, in fact the half turn can be disregarded. If we had wished to reduce the voltage of the new winding from 6·3V to 3V, the calculation would have been:

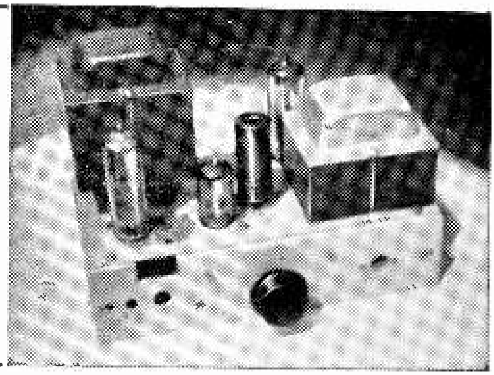
$$23 \times \frac{3}{6{\cdot}3} = 11 \text{ turns.}$$

—continued on page 904

Miniature Modulator

A SELF-CONTAINED
8·5 WATT UNIT

by A. Sydenham



THE ELL80 is a quite remarkable device, and it is surprising that greater use has not been made of it, certainly amongst the ranks of home constructors. The valve is no larger physically than the well-known EL84 yet it does contain within one "bottle" two complete audio pentodes, each of which can deliver some 3W of audio power. The sections each have a mutual conductance of 6mA/volt and screen and anode current demands are typically 4·5 and 24mA when the source voltage is 250V d.c. The cathode is common to both sections and 6·3V a.c. at 0·55A is required for the heater.

The valve may be used in single-ended mode for stereophonic reproduction (3W per channel) or the sections may be operated monaurally in either the parallel or push/pull connection. In Amateur circles the push/pull configuration is likely to prove most useful for the 8·5W obtainable can be utilised to modulate a "'Phone" transmitter. A transmitter in use a short time ago employed "controlled carrier" modulation on 'Phone. This was not entirely satisfactory and the circuitry was modified slightly so that external modulation could be applied; this proved completely satisfactory.

Circuitry

The circuit of the modulator constructed is shown in Fig. 2, injection being made at the cathode of the 6146 in the Tx. Running 50W good results have been achieved with excellent modulation and plenty of gain in hand, the potentials applied to the 6146 screen and anode being 140 and 630V respectively. For cathode modulation it seems that some 5W is adequate compared to the 25-30W that would be needed for similar plate/screen modulation. The modulator could be used in plate/screen circuits of course but a lower r.f. capability would then be necessitated.

Conventional speech amplifier stages (V1/V2A) furnish the voltage necessary to enable V2A to do phase-splitter duty. Anti-phase voltages are developed across load resistors R8/9 to feed the output pair (ELL80). Thereafter transformer T1 combines the signals and output is available at the secondary winding.

For cathode modulation a step-down ratio of about 5:1 seems right when Ra-a is 11,000Ω. For best results T1 would be made a multi-ratio modulation transformer but in the test model an American type mains transformer was utilised in reverse. Voltage-wise the centre tap of T1 is fed with relatively unsmoothed h.t. this allowing the ELL80 anodes to receive the maximum available positive potential and at the same time permitting resistor R17 to be of low wattage rating. No hum exists and decoupling is adequate.

Note should be taken of the two "stopper" resistors R15/16 and these should not be omitted or troubles due to parasitic oscillations will result. These resistors should be soldered at one end direct to their respective grid pins. Other critical items are resistors R8/9 and these should be bridge-matched to within 5% or better, their precise values being considered of secondary importance. Resistor R12 is merely a bias-fixing item.

Full wave rectification due to the EZ81 valve and its associated items is preferred since a short warming up period elapses at switch-on before the full h.t. is applied. Zero signal current drain is 65mA and although this rises on the application of signals no strain is likely to be felt, for the rectifier is capable of supplying up to 150mA at 350V from a r.m.s. supply of 350V per anode.

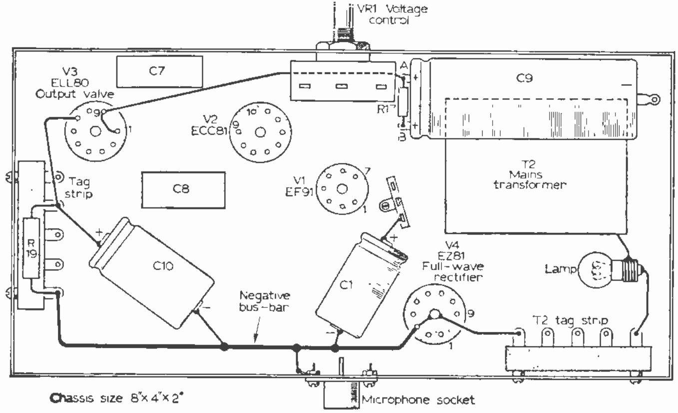


Fig. 1: Location of major components—underchassis view.

Constructional Notes

Plans showing the layout

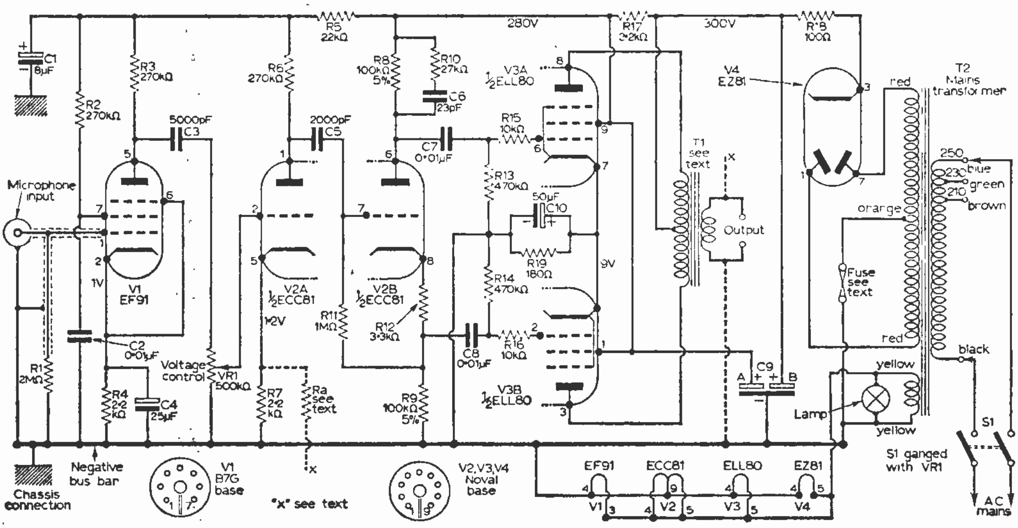


Fig. 2: Circuit diagram of the modulator.

adopted is shown in Fig. 1, this being the below-chassis diagram. The valveholders are preferably orientated as shown while, in the interest of hum elimination, the use of a negative bus-bar (to which all chassis returns are made) is recommended. The input lead to V1 must also be screened.

The chassis needs to be no larger than 8 x 4 x 2in., and three tag strips positioned as shown are adequate for lead and component anchorages. The fuse fitted to the centre tap of the mains transformer may consist of a small flashbulb and will rapidly burn out should a fault develop on the h.t. line in the form of a short-circuit. Mains fuses are hardly worth while when a fused plug is fitted.

Alternative Use

With a few small circuit changes the unit could be used to provide very pleasing results as an audio amplifier when used with a crystal pick-up, tape recorder, radio tuner, etc. Normally, V1 will not then be required, signals being fed to the top of **VR1** via C3. Capacitors C3 and C5 should then however be increased in value to 0·1μF and 0·01μF respectively whilst a normal multi-ratio output transformer such as the Osmabet MRT/10 should be used for T1. The taps on the transformer should then be selected as recommended in the maker's leaflet to suit the particular speaker impedance in use, i.e. 3, 7·5 or 15Ω. Tone control stages may also be fitted and degeneration applied to the cathode of V2A to improve the response. If degenerative feedback is so incorporated from the secondary of the output transformer one side of this will have to be connected to the negative bus bar as is indicated by the broken lines in Fig. 1. The value required for Ra will have to be determined experimentally but may lie between 5 and 22kΩ. If the phasing is incorrect positive feedback will result and cause howling; this can be remedied by reversing the connections to the output transformer secondary. ■

COMPONENTS LIST

Resistors:

R1	2MΩ	R10	27kΩ
R2	270kΩ	R11	1MΩ
R3	270kΩ	R12	3·3kΩ
R4	2·2kΩ	R13	470kΩ
R5	22kΩ	R14	470kΩ
R6	270kΩ	R15	10kΩ
R7	2·2kΩ	R16	10kΩ
R8	100kΩ 5%	R17	2·2kΩ 1W
R9	100kΩ 5%	R18	100Ω 1W

VR1 500kΩ log pot with DP switch.

Capacitors:

C1	8μF 350V electrolytic
C2	0·01μF
C3	5000pF
C4	25μF 6V electrolytic
C5	2000pF
C6	23pF
C7	0·01μF
C8	0·01μF
C9	32+32μF 350V electrolytic
C10	50μF 25V electrolytic

Valves:

V1	EF91 (6AM6)
V2	ECC83 (12AX7)
V3	ELL80 (Mullard Ltd.)
V4	EZ81

Transformers:

T1	Modulation transformer
T2	Mains transformer. Secondaries: 250-0-250V @ 100mA, 6·3V @ 3·5A. Drop through (R.S.C. Ltd.)

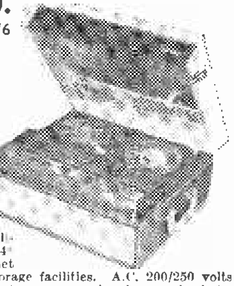
Miscellaneous:

Chassis 8 x 4 x 2in. Valveholders—Noval (3), B7G (1), Coaxial socket, panel lamp, etc.

26½gn TAPE RECORDER for ONLY £19.10.

carr. 12/6

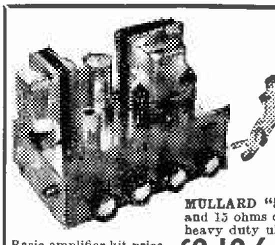
Bargain of the Year Offer —cancelled Export Contract



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. take 7" reels, mike and gram input. Straight through amplifier facilities. Output sockets for ext. speaker, monitor or external amplifier. Super-imposed switching magic eye recording level and mains neon indicator. Volume and tone controls 7" x 4" speaker. Attractively styled cabinet with detachable lid mike and reel storage facilities. A.C. 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 7 gns. Carr. 7/6. 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 9 x 6 x 2¼in. Ready Built £7.19.6, Carriage 3/6.

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PROFESSIONAL GRADE DOUBLE-SIDED

(each side coated) 5¾" reels only

Special price offer 1,450 feet (2 reels) **20/-**

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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.

SPECIAL OFFER 3" Message tape 150', **3/9**; 3" L.P. 225', **4/9**; 3" D.P. 300', **6/6.** P. & P. per reel 6d.

TAPE REELS. Mnfrs. surplus 7", **2/3**; 5¾", **2/-**; 5", **2/-**; 3", **1/3**; spool containers, 3", **1/6**; 5", **1/9**; 5¾", **2/-**; 7", **2/3.**

Alumin. Chassis. 18g. Plain Undrilled, folded 4 sides, 2" deep, 6" x 4" **4/6**; 8" x 6", **5/9**; 10" x 7", **6/9**; 12" x 6", **7/6**; 12" x 8" **8/-**, etc.
Alumin. Sheet. 18g. 6" x 6", **1/-** 6" x 9". **1/6**; 6" x 12", **12/-**; 12" x 12" **4/6**, etc.

Jack Plugs. Standard 2½" Igranic Type, **2/6.** Screened Ditto. **3/3.** Miniature scr. 1½", **2/3.** Sub-min. **1/3.**
Soldering Irons. Mains 200/220V or 230/250V. Solon 25W Inst., **24/6.** Spare Elements **5/6.** Bits, **1/3.** 65W, **29/6**, etc.

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. 12/6 Ready wired **30/-** extra Illuminated perspex control panel escutcheon, **7/6** extra. Four contemporary mounting legs 6in. **10/6**; 9in. **11/6**; 12in. **12/6** extra.

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s 9/16in. diam. first, second or third. **5/6**
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Condensers 150 v. working: .01 mFd., .02 mFd., .03 mFd., .04mFd. **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. ⅞in. Dilemin 100 pF, 300pF, 500pF, **7/-** each.

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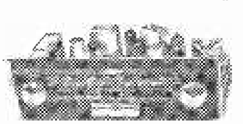
Midget Vol. Control with edge control knob, 5 K/ohms, with switch **4/9**; Ditto less switch **3/9.**

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

Ear Plug Phones—Min. Continental type 3ft. lead, jack plug and socket. Hgh Imp., **8/-**. Low Imp., **7/6.**

Phono Plugs, 9d. Phono Sockets (open), **9d.** Ditto (closed), **1/-**. Twin Phono Sockets (open), **1/3.**

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"x5¼".

A recommended Fidelity Unit for use with Mullard "3-3" or "5-10" Amplifiers. Now available as complete kit as illustrated, inc. power unit.

£10.19.6 Carriage 7/6.

Ditto, but less power unit, **£9.19.6** carriage 7/6.
Circuit and construction details, **4/6**, free with kit.

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, **5d.**, 2W. **9d.** **Hi-Stab.** 5% ¼W **6d.** (100 ohms-1 meg). Other values **9d.** 1% ½W. **1/6** etc., etc.

Volume Controls—5K-2 Meg. ohms. 3in. Spindles. Morganite Midgt Type 1¼in diam. Guar. 1 year. LOG or LIN. ratios less Sw. **3/-**. DP. Sw. **4/6.** Twin Stereo less Sw **7/6** 100k to 2M ohms with DP Sw. **9/6.**
WAVECHANGE SWITCHES. 1 p. 12-way 2p. 2-way, 2 p. 6-way, 3 p. 4-way, 4 p. 2-way, 4 p. 3-way, long spindle, **3/6** ea.

JASON FM TUNER UNITS. Designer-approved kit 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.

TRIMMERS. Ceramic (Compression Type)—30pF, 50pF, 70pF, **9d.**; 100pF/150pF. **1/3**; 250pF, **1/6**; 600pF, **1/9.**
PHILLIPS. Bee Hive Type (conc. air-spaced)—2-8pF, **1/-**; 3-30pF, **1/-**.
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LARGE SELECTION AVAILABLE.
METAL RECTIFIERS. STC Types—RM1, **4/9**; RM2, **5/6**; RM3, **7/6**; RM4, **16/-**; RM5, **21/-**; RM4B, **17/6.**

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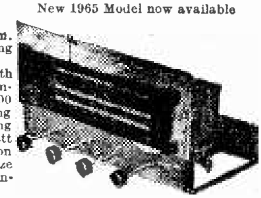
25/25v 50/12v. 1/9; 8+8/450v. 4/6; 50/50v.100/125v.2/-;32+32/275v.4/6 8/450v. 4/350v. 2/3; 50/50/350v. 6/6; 16+16/450v. 5/6; 60/250/275v. 12/6; 32+32/450v.6/6; 100+200/275v. 12/6

7 VALVE AM/FM RADIOGRAM CHASSIS

New 1965 Model now available



Valve line-up ECC85, ECH81, EF89 EBC80, EL84, EM81, EZ80.
Three Waveband and Switched Gram. positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. 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 11½ x 3½in.
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. sp'k'r and P/U sockets and indoor F.M. aerial and 4 knobs—walnut or ivory to choice. 3Ω P.M. Speaker only required. Recommended Quality Speakers 10" R.A. **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 (1 in. thick approx.) 18 in. wide. any length cut. **2/3** per ft., **6/-** per yard. **TINNED COPPER WIRE,** 16-22g. **4/-** ½lb. **ERSIN MULTICORE SOLDER.** 60/40 **4d.** per yard. Cartons **6d.**, **1/-**, **2/6** etc.

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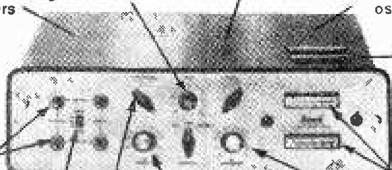

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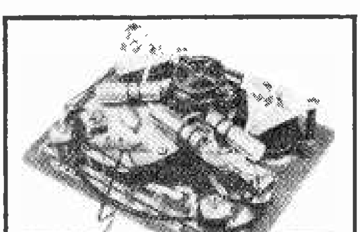

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SINGLE CIRCUIT PANELS

★ by W. Groome

designing and making economical circuit panels without acid

COMPARED with the slight cost of wire, single panels of printed circuit character seem to provide our conductors rather dearly and, with the acid-etch process, inconveniently. Recent bargain offers of copper-clad plastic suggest that the first objection may not always apply, in which case the very cheap alternative included in this article will cease to be of interest. On the other hand, the methods of forming circuits "dry" could be of lasting benefit. Our main concern, however, is design, for by whatever method a panel is made it presents very little scope for the correction of errors. It discourages the "lash-up" approach and imposes the discipline of thoughtful layout planning.

Basic Idea

As practical people we would rather begin with a basic idea than work entirely at random. I suggest, seriously, that the basis of a panel layout

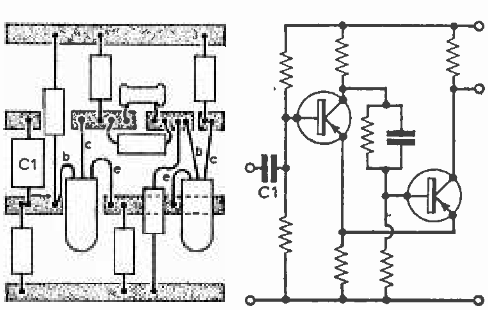


Fig. 1: Schmitt trigger circuit diagram and layout plan of circuit panel. Note similarities.

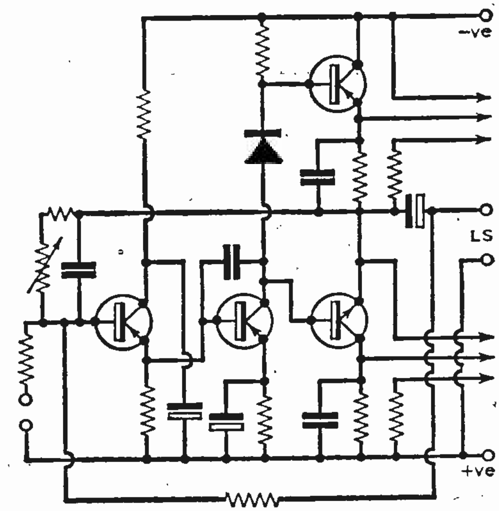
often exists ready made in the theoretical circuit diagram. The idea would have been ludicrous in the chassis and group board era but we are dealing with thin plastic panels and little wire-ended components that can be anchored almost anywhere we wish. Consider the circuit diagrams in this journal. Symbolically the components have been arranged or grouped according to function. Circuit sequence and signal paths have been clarified, power and earth lines clearly distinguished, all with an economy of line that aids scanning and with the minimum of crossings. The draughtsman's aim has been "readability" but the sorting out process has produced something close to a "map" of a circuit panel as we shall see.

Example

Compare, in Fig. 1, the diagram of a Schmitt trigger with the panel layout alongside and showing physical component shapes in place of symbols. The conductors (shaded) are facing us, while the components are to be taken as being on the other side with only their wire ends brought through holes for solder connection. One component (C1) has been reorientated, otherwise the two drawings are closely comparable. The layout is rather open for clarity and indeed I suggest that the first sketch for any circuit should be made without regard for ultimate compactness so that a good idea of arrangement and connection points can be formed. In the next sketch you can close the ranks while retaining the same general arrangement, shorten the conductors to suit and bring them to within, say, $\frac{5}{16}$in. apart. Omit connections because they will be effectively the same as in the first sketch and will be difficult to show in the close drawing. Applied to Fig. 1 this compression would reduce the panel size from $1\frac{5}{8}$in. x 2in. to $1\frac{1}{4}$in. x $1\frac{7}{16}$in. Finally by setting the components perpendicular to the panel the conductors can be brought to $\frac{1}{8}$in. apart and the panel size will become about $1\frac{1}{4}$in. x 1in. Such economy of area may not be essential physically but it helps to reduce the expenditure on copper-clad material.

Parallel Rows

A noticeable feature is the simple arrangement of the conductors in parallel rows achieved by using the circuit for guidance. It is, of course, only a two-transistor circuit but the observation is equally true of four-stage, six-transistor panels shown in the diagrams of Figs. 2 and 3. The simplicity is due largely to the geometrical fact that any point in an area can be reached by moving in two directions at right-angles. Generally but not as an unbreakable rule the components span the panel vertically (as viewed in the drawings), while the conductors advance the circuit horizontally. They are on opposite sides of the panel and can cross without touching. The amplifier panels described here comprise six rows, of which some have yet to be divided into separate conductors for the sake of further points to be mentioned later. The rows are: (1) Negative line, (2) collector networks and one push-pull phase,



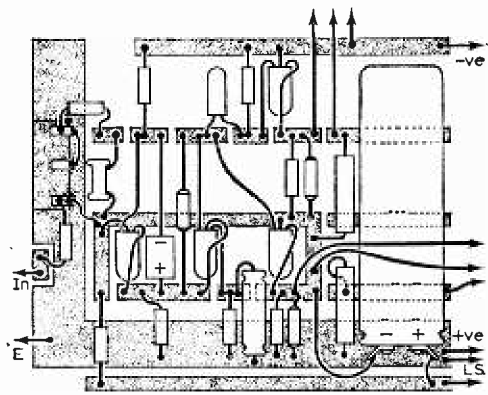


Fig. 2a (above): Circuit panel layout for the push pull amplifier of Fig. 2b (left) using the circuit diagram as a basis for the physical arrangement.

(3) mid-phase busbar, (4) emitter networks, (5) earth busbar and (6) feedback line. The practicability of the two-directional principle is demonstrated by the popularity in industry and elsewhere of ready-made striped panels in place of printed circuits.

Amplifier Circuit

The amplifier circuit of Fig. 2 includes all components except the output transistors, which are mounted separately on heat sinks and connected by wire as indicated. A larger panel is used, which has bare areas to accommodate the heat sinks—to be fitted on spacers, of course, to permit air circulation. Circuit and panel plan have been brought together in Fig. 2 for ready comparison. The potentiometer should be fitted on a small bracket screwed above the broad earth area on the left, the feedback resistor has been moved to the left (without electrical change) to enable it to hop over the earth line, while the position of the output capacitor is dictated by its large size.

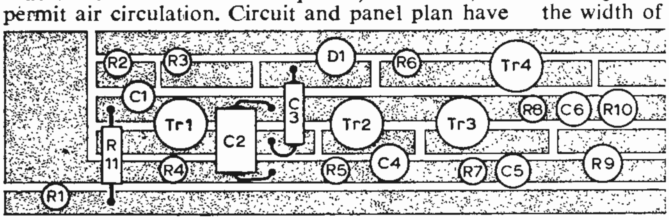


Fig. 3: Reduction of the panel area of the circuit panel of Fig. 2 effected by mounting the components vertically.

These variations are practical. In other respects the diagram and layout correspond. Here again we see the simple straight line conductor arrangement. The size of the circuit area, 4in. x $3\frac{1}{2}$in., is reasonable compared with the heat sinks and the volume of most domestic cabinets, but many constructors will look askance at the large bare areas representing dearly bought copper that must be thrown away with the acid. Economy, more than space considerations, can drive us to a more compact layout with a smaller proportion of waste foil. By upending the components and fitting the output capacitor elsewhere the circuit area can be reduced to 4in. (the length of the heat sinks) x $1\frac{1}{8}$in. The component arrangement of this small panel is indicated in Fig. 3. Note the improved layout.

Width of Conductors

One more design aspect to be considered before turning to methods of making the circuit panels is the width of conductors. With the thinnest copper foil (0·0014in.) a line 0·015in. wide can carry 1A with only a few degrees' rise above ambient temperature and a $\frac{1}{8}$in. line 4A for 8° rise. On this basis we are not likely to produce by hand lines too narrow for the milliampere range. Narrow lines, more prone to failure than broad ones, are justified only in crowded areas. In any case they have to be broadened at connection points and, while the necessary rings, "cushions" or "blobs," have a nice space-age look, they are tedious to produce by any hand method. Most often the area demanded by the components is large enough to accommodate $\frac{1}{8}$in. lines to which connections can be soldered at any point. Use wider lines, of course, for really heavy currents and always make the earth lines as broad as space will permit.

Why use acid?

We turn to practical matters with a question. Why dabble with acid? Commercial panel material has a copper-to-plastic union capable of

withstanding considerable stress in tensile or shear but it is by no means proof against a deliberate peeling action that breaks the adhesive layer in an advancing narrow line. This, fortunately, is an abuse rarely met by panels in normal service but it is a weakness that we can turn to advantage.

The straight conductors that seem so suitable for many circuits are easy shapes to outline with a sharp knife and a straightedge, cutting the thin foil (which gives in easily) right through to the plastic base. Having isolated an unwanted area in this way you can ease an edge free with the point of the knife and peel the foil away, leaving the wanted conductor intact and neat on the panel. Keep the knife stoned to a keen edge. Score the outline lightly at first to make guide lines that will control the blade during subsequent heavier cuts. Try this method on a scrap piece and then ask yourself: Why dabble with acid?

Good Economy

The idea of making your own clad panel material is good economy but perhaps of greater interest is the fact that it leads to another simple way of forming shaped conductors. Laminates of the Formica type are suitable for the low voltages and impedances of transistor circuits. The small pieces we need are scrap offcut sizes to the ordinary user; they lie in abundance in many home workshops or can be bought at give-away prices. I have used the plain laminate sold cheaply as a balancer veneer, while at the other end of the quality range there are the paxolin types of sheet. For a few shillings the non-ferrous metal merchant or electrical trades stockist can supply enough 0·0014in. or 0·003in. copper foil to make a dozen or more radio panels.

The Adhesive

The main problem is the adhesive. The industrial hot-setting types are not available by retail and would be inconvenient to use if they were. Evaporation types are obviously unsuitable. Epoxy resin, excellent for steel and aluminium, has low-peel strength with copper unless a special primer is used. This leaves the impact types, of which I prefer "Fastbond 10" because it can be spread thinly and bonds copper to laminate with a tough neoprene rubber layer that withstands heat (the maker's claim) as well as the plastic.

Most laminates are lightly and evenly shotblast on the non-decorative side, to which our foil is to be attached. If you have a rough specimen it can be sanded smooth. Incidentally, a quick way of cutting this material is to score both sides and then break it.

The copper must be quite clean: I use hot water and a "Brillo" pad stolen from the kitchen. Apply glue to the panel and to the copper and avoid prolonging this to the point where it thickens and pulls. It is better to go back to a bare spot after the adhesive has dried. Allow ten minutes' drying for "Fastbond 10" and perhaps longer for other makes as instructed on the tin, then the two dry layers will bond instantly and permanently upon contact. Apply pressure for a minute or so to squeeze the glue layer to a thin and even line and if you use the vice, as I do, remember to protect the copper from marking by covering it with another piece of plastic. Alternatively use a hard roller.

Bare Panel

This quick and easy method produces panels suitable for many circuits for only a few pence each. Returning to Fig. 2 and the waste when copper has to be removed to create large bare areas, the answer (you've guessed it!) is to begin with a bare panel and add only the wanted conductors, which can be first cut to shape with knife or scissors. This method was to make the larger panel for the output transistors and heat sinks. On the other hand, the close conductors of the smaller panels are easier to make by cutting and peeling and the waste is very small. In either case a row of short conductors is most easily produced by first forming a continuous line, and dividing this subsequently with about $\frac{1}{16}$in. space between each.

Here I offer some astute manufacturer a suggestion without any hope of an early retirement on the royalties. Self-adhesive metal nameplates and instruction plates are already well established in industry and have a tenacity that withstands the shocks of transport and rough service. It should therefore be possible to produce self-adhesive copper strips or rolls of conductor width with a peel-away protective backing to enable circuit panels to be made quickly as required in experimental establishments, schools and amateur workshops. Is anyone listening?

Drilling, etc.

As with commercial panels the work of drilling, piercing, fitting and soldering should be contrived to aid the adhesive union rather than stress it. Drill from the copper side with a bit just large enough to make clearance for the component wires and to prevent the bit from wandering start the hole by indenting the copper with a fine awl.

Soldering has presented no problems. All the panels in the photograph have been tested by soldering a component in place before sending them for the editor's inspection. Draw the wire end through with just enough tension to hold the component against the panel on the other side while the solder end lies flat on the copper. This ensures that the component is supported by the panel without strain on the foil. Alternatively press the wire flat against both the plain and the conductor sides to form a clench that will support the component. Then solder it. Clean copper solders very readily and the spot joint can be made in a second with a hot small iron and good radio quality cored solder, and the heat is dissipated all over the conductor area before it has time to affect the adhesive or the plastic. This brief heating of spot areas is a technique that must be acquired in any case for soldering semiconductors and their associated components.

The panels were made with the thicker gauge of foil, 0·003in., and it will be appreciated that easier and neater work is possible with the thinner material, 0·0014in. ■

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

AFRICAN stations in the 41 and 31 m.b. are providing fair reception in the early evening at present for those with the patience to seek under the strong Europeans.

Switzerland: *S.B.C.* (3000 Berne 16) will transmit in English as follows until May: 1145—1315 9,665/11,865; 0115—0245 6,080/9,535/6,120; 0415—0545 6,120; 1330—1500 21,520/17,845/11,865/15,305; 1515—1645 9,665/9,655/11,865; 0830—1015 17,830/15,305/11,865/21,520; 0700—0830 9,670/11,865; 1515—1645 11,715. Unbeamed European service programmes on 6,165 and 9,535 now use 250kw transmitters.

International Committee of the Red Cross (7 Avenue de la Paix, 1211, Geneva I) will have transmissions over the 7,210 transmitter of S.B.C. on the following dates in 1966: January 10, 12, 14, March 21, 23, 25, May 9, 11, 13, July 4, 6, 8, September 19, 21, 23 and November 21, 22, 23. Transmissions, lasting one hour, will be at 0600, 1130, 1500, 2100. Reception report forms are available. Regular listeners will be given a special diploma.

U.S.S.R.: *Radio Moscow* (Moscow) transmits to Europe in English until April 1966 at 0700—0730 on 9,740/9,480/7,280/7,240/5,980; 1200—1230 15,480/15,170/11,930/11,830/11,740; 1900—1930 7,330/7,280/6,150/6,050/5,980/1,320; 2000—2030 7,330/7,280/6,200/6,150/6,050/1,380, 2100—2200 7,330/7,280/7,260/6,060/6,050/1,490; 2200—22307, 7,330/7,280/6,050/5,960/1,490/1,380/1,320.

Congo (Rep.): *Radio Brazzaville* (B.P. 108, Brazzaville) transmits at 1400—1700 over 3,332/7,105/11,710/17,720/21,500 and 1730—2100 on 3,332/5,970/7,105/9,730/9,730/11,930/15,190. News in English at 1915.

Ghana: *Radio Ghana* (P.O. Box 1633, Accra) has new English schedule. 0330—0430 6,110; 2000—2100 11,800/9,700; 0430—0515 9,760/9,545; 0600—0645 9,760; 1500—1545 17,910/21,545/21,720; 0300—0345 6,130/6,070; 1330—1430 17,910; 1815—1900 15,285; 0530—0730 3,240; 1400—2015 6,130; 1945—2215 3,240; 0645—0730 and 2045—2215 to Europe on 9,545. Full QSL verification is given.

Portuguese Guinea: *Emissora Provincial da Guine* (Avenue da Republica, Bissau) can be heard signing on at 1800 on 5,041.

Afghanistan: *Radio Afghanistan* (Ansari Wat, Kabul) has stopped its external broadcasts in German. They will resume over two new 100kw TX in May 1966.

India: *All India Radio*, New Delhi, transmits in English to Europe from 1945—2045 over 11,630/7,235/9,515.

Israel: *Kol Israel* (Broadcasting House, Jerusalem) has a new English transmission from 0900—1000 on Sundays over 11,910/9,009. The evening transmission is now from 2040—2100 on 9,725/9,009.

Macau: *Emisora Vila Verde* (Macau) has been *reported audible* at 2100 over 755 (medium wave)—a real DX feat this.

Turkey: *Radio Ankara* uses 15,160 for its 2200—2300 English transmission. This outlet is also used for the 1915—1930 French transmission. The home service appears to be relayed throughout the day on 9,515.

Canada: C.B.C. (P.O. Box 6000, Montreal) Caribbean transmissions (English 2300, Portuguese 2330 and Spanish 0000—0045) are now on 15,190/11,725/9,625. From January 2 15,190 will be replaced by 5,990. The 0230—0700 *Northern Canada Service* English service is on 5,970/9,625.

U.S.A.: *Radio New York Worldwide* (New York 19, N.Y.) has a slightly different frequency utilisation to that given last month. Details are 17,845 1200—1945; 17,730 1200—2145; 15,440 1400—2130; 15,385 1200—1445 (weekends only); 11,970 1900—2145; 11,905 2145—2400; 11,880 2000—2145; 9,740 2100—2400.

Netherlands Antilles: *Trans World Radio* (Bonaire) has German transmission until 1950 on 11,840 where there is English identification before close down.

Argentina: R.A.E. (Sarmiento 151, Buenos Aires) reported with English from 2300—2400 on 11,700 and in the 31 and 49m.b.

Bolivia: *Radio Altiplano* (Avenida Camacho de 1468, La Paz) has been heard with Latin American pop music until 0600 on the new frequency of 5,045.

Brazil: *Radio Brasil Central* (C.P.330, Goiania) can be heard from 1955—2045 on 11,815. *Radio Mayrink Veiga* (Rua Mayrink Veiga 15, Rio de Janeiro) may be occasionally heard on 9,575/11,775.

Chile: *Radio Nuevo Mundo* (Casilla 9255, Santiago) gives good reception at 0230 on 11,740. *Radio Sociedad Nacional de Minoria* (Casilla 2626, Santiago) can be heard with weak signal after 2130. Identification at 2200.

Peru: *Radio Universidad* (Casilla 23, Avequipa) is using the new frequency of 6,242.

Uruguay: *Radio Libertad Sport* (Difusoras del Uruguay S.A., Soriano 1287, Montevideo) can be heard over the El Espectador transmitter CXA19 on 11,835 at 1700.

Radio Oriental (Olimar 1364, Montevideo) can be heard at 2300 on 11,735. *Radio Sarandi* (Corporacion de Publicidad S.A., Enriqueta Compte y Rique 1282) has German test transmissions from 2030—2130 Tuesdays on 15,385. This channel can be also heard in Spanish from 2300—2400 sign off.

Czechoslovakia: *Radio Prague* (Prague 2) transmits to Europe in English from 1200—1230 in the 31, 25 and 19m.b.

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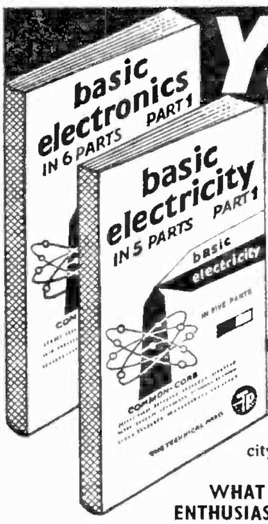

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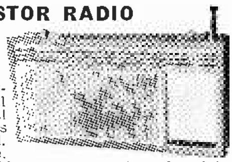

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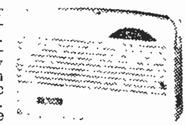

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A special vote of thanks this month to those who answered the appeal for information on South American stations. Reporters this month are Middlesbrough High School S.W. Club, T. E. J. Toth, P. J. Quinn, A. Newman, J. E. Snoad, H. P. Meed, J. M. Richardson and S. Ormerod.

The Amateur Bands–by David Gibson G3JDG

ALL sorts of stories coming in this month and one or two peculiar ones are confirmed by reports from so many different sources that they look like being true. To begin with, although it must be admitted that we are still very close to the worst 10 metre conditions (sunspot-wise), there are numerous reports of great activity on the band already. All three modes are in evidence as are VK stations—yes Australians romping in on a.m. phone.

Queries and stories from a number of sources about the mysterious voice on top band signing NSI or NS1A. This character is apparently located on board one of the oil drilling rigs at work in the North Sea, hence the call NS1A. He has been heard giving out his week-end shopping list right in the middle of top band much to the indignation of licensed Amateurs in the vicinity. However the G's appear to be having the last laugh because as NS1A pauses in his weekly order—other voices take over for him and proceed to order quite a wide variety of objects.

Quite apart from NS1A, top band has its transatlantics in session at the moment offering a good chance to hear a bit of DX. Dates are January 16, February 6 and 20, all from 0500—0730 hrs., but any time after midnight is usually the beginnings of activity. Remember W's and VE's are on c.w. right down the bottom, 1800-1825kc/s. For the optimistic, the JA frequency is 1880kc/s.

The L.F. Bands

Some very good openings down near mains frequencies this past month. **R. Iball** (Worksop), SX28, PR30, 80ft. l.wire logged W1BB/1 and W1HGT both on top band, whilst on 7/Mc/s his best were 4X4—FA, QT. **Steve Wilson** (Ossett), 19 set, 180ft.l.w. 1.8Mc/s—DL1, EI, GI, GW OK1, PA. On 3.5Mc/s, VE1—KGF, CN, AA, APO, AR, AFK, VE2AE, VE3-SS, HF, VO1-GW, DD, GC, JW, W1MKK, POY, EVT, AW (ARRL HQ) W2-JAE, AU, GO WA2-BMP, RIB, 2BFM, W3TAF, DKT, WA4FFW, WA5SOX/P/VO2, 9H1AB. **James Brown** (Cardiff), 19 set, dipole, shows what can be done with determination. So good was this log that I thought it was for 20 or 15, but NO! 80 metres—CN8AW, I1ZSQ, K8YWG, KX6VQ (Marshall Is.), MP4TBO, many VE's, VK2AVA, VP7NS, VS6AJ (Hong Kong), many W's, YV5BTQ (Venezuela), ZB2AO, 9M4LP. **Chris Peel** (Stoke-on-Trent), S750, 90ft. l.w. 80 metres, MP4-TBO, BAA, VE, VO, VP9FK (Bermuda), W's, K's, W1/KP4, 4U1ITU, 5VJBTQ, 7X2AH, 7X2BA, 9M4LP (Singapore), all s.s.b. and between 2300-0200 hrs. 40 metres raised mainly EU's like CT1, DL, EA, I1, LX, ON4 SM, UA1, YU, etc. **I. Black** (Gillingham), HE30, W6BCX, Multee antenna for 3.5 and 7Mc/s. numbers are standard RST, F9RY/P/FC 59, HB3ITU 59, HV1CN 59, IØFGM 56, K2GL 53, VE-1AHP 56, 3KH 43, W-1IIM 57, 2ZPL 56, ØZPL 58, YU4FD 54, YV5BPJ 57, ZL5LM 32, 4U1ITU 59. On 40 many EU's plus OX3JV 58, SV1BH 57, VK2MO 45, YV-1II 56, 1PW 54, 3FQ 55, 5BPJ 58, 9AA 55, ZC4MO 55, ZL2BCG 56, 4X4FA 57, 7X2AH 53.

Late flash. Last night and early this morning, December 4/5, I listened with the **Verulam A.R.C.** and took part in the transatlantics on top band. The following stations were logged: VO1FB, DL1FF, OL1AEF, W1HCH, W2EQS, VE3DDR, VE2UQ, W8HG, K8CRJ, VO1HN, W1BU, OX1LM, OL1AEE, K1LMO, OK1AMK, W1HGT, OL5ABW, VE3AGX. After a time it was decided to try our hand at working across the pond and the following were worked, your faithful scribe accounting for three scalps: W1BB/1 579, W1HCH 559, W2EQS 449, VE3DDR 569, VE2UQ 449, OL1AEF 559, VO1HN 569. The latter station also received us on sideband at 55, but we were not able to resolve VO1HN on a.m.

The H.F. Bands

Twenty metres, back to its seasonal "dying" at 20.00 hrs., seems to be providing quite a bit of activity during the hours it is open. Best listening times appear to be just after lunch. **H. P. Meed** (Poynton), HRO + pre-selector, 40ft. l.w. SE/NW. IS1VAZ (Sardinia), KR6-DI, UL (Okinawa), KX6OR (Marshall Is.), OD5BZ (Beirut), UO5PK, VE3WQ ZD8RD (Ascension Is.), ZL2JO (Wellington, N.Z), ZL3DX, 5Z4-EC, IR, 5T5AO. **Stephen Beal** (Muswell Hill), uses a simple t.r.f. with an indoor antenna, some 60ft. of wire in fact. Home-brewed and working well as the following evidence suggests: EP2AX, FG7XL, FK8AC (New Caledonia), HI8RSD, KL7EBC, KP4BKP, KR6UL, SU1IM, TF2WG, VP9AK, VS9AE, WB6GCD, W7THX, 3A2BF, 7Q7PBD. All these on twenty, while on 15 Stephen's best were CN8BB, ZE2JJ, 5N2FEL and VK-2NN, 3ACD. **L. Dettman** (Hull), xtal controlled converter into a 19 set, 132ft. l.w. 21Mc/s, CN8FT, EP3USA, K6BPE/MM, KP4AXC, KV4CX, OA8V, OHØNI, 9K2AD (Kuwait), 9G1FV, ZS1TV, ZS6AOU, ZE1AC, VS9AWR, VK5KM, PY1CK, OX3JV, 7Q7BN, 7X2BB, 5N3JRM. **I. Black** again reports 20 very lively with CR3GF, CR6DA CR9AI (Macao), CN8BB, JA3ARA, KZ5PW, OA4OA, PJ3CV, TI2DA, VE3CVL/P/SU, W8CJY/P/KP4, 39 VK's (yes, thirty-nine), VK9-JO, XI, both on Cocos-Keeling, VP2SK, VP6KL, VP7CC, VU1BA,

—continued on page 894

Add-in Transistor Stage

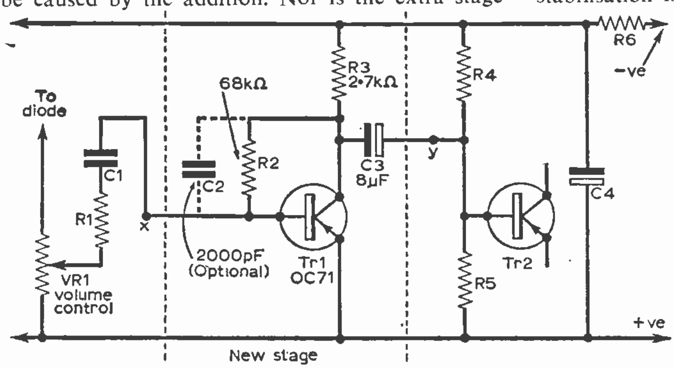
EXTRA AUDIO GAIN FOR SMALL TRANSISTOR RECEIVERS

Many popular transistor receivers have a combined audio amplifier and driver stage, followed by push-pull output. With this circuit, the driver immediately follows the diode detector, in superhets. An audio amplifier, placed between detector and driver, will then give a considerable increase in volume from weak transmissions.

The additional stage is normally not required in receivers which already have an audio amplifier before the driver, and instability would probably be caused by the addition. Nor is the extra stage intended as a cure for low sensitivity and poor results caused by wrong alignment, or any other receiver fault. But when the receiver is in proper order, conversion from six transistors to seven, by including a low level a.f. stage can greatly improve results.

Fig. 1 shows a suitable circuit, needing few parts. R1 and C1 will be present, and point X will be connected to Y, Tr2 being the combined audio amplifier and driver. Point x is disconnected from y, so that Tr1, R2, R3 and C3 can be added. Base stabilisation is provided by R2 from the collector of Tr1. C2 is optional, and can be included to reduce hiss and emphasise lower frequencies, often poorly reproduced in miniature receivers.

In this circuit, the resistor values are generally not very critical. R2 may be 100kΩ while R3 can be 3·3kΩ or 3·9kΩ. Tr1 should be in good condition to avoid noise. The few items required can be assembled as a small packet, then inserted by soldering the appropriate leads to x, y, earth (positive) line, and negative. Leads from x and y, and also Tr1, should be short and direct. ■



Circuit diagram of the complete unit.

ON THE SHORT WAVES

—continued from page 893

XW8AX, ZL-1KG, 2UW, 3AB, 3MN, 4X4, 5T5, 5Z4, 6Y5, 7Q7, 7X2, 9G1, 9H1.

Ten Metres

Yes, its own heading. Many logs for this band, far too many to print, unfortunately. If ten sounds dead at your QTH—start checking the gear. The following log from **Alex Thurlow** (Croydon), SX101A, 3 ele. beam. Such a huge list that only the prefixes are mentioned, but all heard between 0900—1800 hrs. CR6-7, CX2-4, DL, EA, F, I1, LU2-3, 7, 1, 4, LA1, OH5, OZ1, PY1-2, SM, UT5, UL7, UY5, UB5, UA4, 6, 9, UQ2, UP2, ZC4, ZE2, ZS1, VK6QL (1024 hrs.), 7X2, 9J2, 4X4, 9H1, 7Q7, all on a.m. too. **Stephen Beals's** t.r.f. raked in CR6, DL, IØ, OH, OE, SM, UA, UB, UP, ZE, 5A3, 9H1.

Here and There

Sharp ears, keen s.w.l., rig in working order? If the answer's "Yes" then you are invited to listen out for the following: VKØTO Macquarie Is. 20 c.w., FB8WW Crozet 15 and 20, WAØBDM/KG6 Mariana 20 s.s.b., JT1FM Mongolia 20, VR6TC Pitcairn Is. 20 c.w., YJ8BG 15 s.s.b. Notes for the diary, KG1 callsigns are now out and the sole prefix for Greenland will be OX. Watch for the call FR7ZI who hopes to do a jaunt around Comoros, Glorieuses, Juan de Nova and Europa, and Reunion Is. Dates in January for the contest minded include: 15-16th, Affiliated Societies Contest; 29-30th, CQ WW 160 metre DX Contest; 30th, First 144Mc/s Contest (c.w.).

PRICE CORRECTION

Will readers please note that the total H.P. price of the Imperial Hi-Fi Stereophonic Radiogram Chassis advertised by Lewis Radio, appearing in the issues dated November, December, 1965 and January, 1966, was shown as £44 4s. 6d., instead of £49 4s. 6d.

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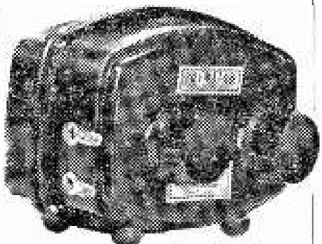

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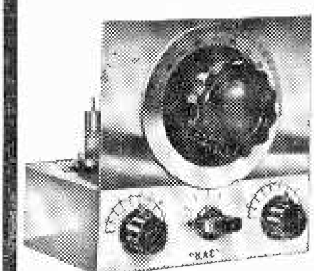

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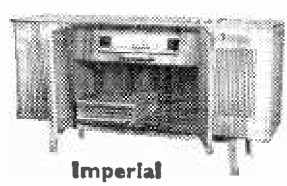

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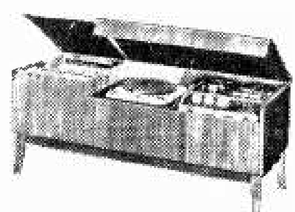

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NOISE ABATEMENT

TRACING AND CURING NOISE FAULTS IN RECEIVERS

by K. Royal

PROBABLY one of the worst radio faults to diagnose and cure is that of noise. Noise in this context does not include those noises brought on by external interference but embraces all those noises which are created in the set itself by a host of fault possibilities.

Noise is made even more difficult to trace when it stops and starts at random intervals. This is often the case, and the fault tracing exercise is made really frustrating when it is found that the noise ceases temporarily for hours on end by the application of an instrument test prod or by operating the wavechange switch!

Often it happens that the set works for hours noise-free and then develops a bout of bad noise which more often than not stops before one has a chance to perform any detailed tests. Set noises range from distinct crackling to more subtle fizzing and frying effects emanating from the loudspeaker.

What can be done to trace this sort of noise and how do the professionals tackle the problem?

Do Not Disturb

The very first step is to locate the approximate whereabouts of the noise in the set with the very minimum of disturbance, for if the chassis is removed from the cabinet and the set generally subjected to vibration the noise may stop for many hours or even weeks.

The thing to do, then, is to get to know as much about the noise while it is actually present. Then, if the noise happens to stop one has at least made a good start on locating it next time it occurs.

Many crackling noises are caused by electrical interference picked up by the aerial, and to see whether the crackles, plops or fizzles are due to this cause the first thing to do is to remove the aerial from the set.

If the set is tuned to a station, removal of the aerial will, of course, stop the set from working or reduce its volume, but if the noise remains at its original intensity, one can be fairly safe in assuming that it is resulting from a set fault.

When the aerial is removed the noises may not disappear completely, neither may the programme signal, for modern sets are very sensitive and will often pick up signals—wanted and unwanted—without an aerial. Nevertheless, the point to note is whether the interference reduces in volume. If it does, the aerial is guiding the noise signals into the set, so they must be radiated by something outside.

If the noises are developed by the set they normally continue at the same strength without the aerial connected.

Dealing With Portables

At this stage we must consider the portable or transistor set which employs a ferrite rod aerial or loop. This cannot be disconnected because it represents the aerial tuned circuit. What, then, can we do to prove whether or not the noises are coming in from outside?

We can often get a clue in this respect by tuning the set off a station and orientating it through 360° to see whether the noise intensity varies.

If it remains the same at all directions it is likely that the noise is occurring in the set itself, for if the intensity of the noise rises and falls as the set is rotated it means that the set is responding to an external signal.

In passing, it is interesting to note that a transistor portable can be employed to locate a noise source. A ferrite rod aerial is extremely sensitive to direction, especially from the aspect of **minimum** pick up. Maximum pick up occurs when the ferrite rod is in line with the signal field. The rod concentrates the signal field into the aerial windings, as shown at (a) in Fig. 1.

Pick up continues over a relatively wide arc, but when the field is at right-angles to the rod there is virtually zero signal induction and this happens only over a few degrees. Thus, by orientating a portable with a ferrite rod aerial for minimum signal or interference pick up, one can be sure that the signal or interference source lies somewhere on a line which is at right-angles to the ferrite rod, as shown at (b) in Fig. 1. This is the basis of radio direction-finding.

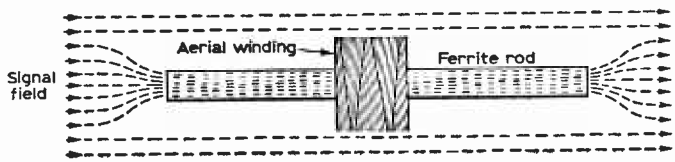
Another way to ensure that noise from a portable is occurring in the set is to screen it thoroughly by very fine wire netting or perforated zinc sheet Before the screen is applied, the volume should be turned to maximum and the set adjusted to give maximum noise output. If the noise level remains the same with the set embraced by such a screen, something inside the set is undoubtedly responsible.

Once we have established that the set itself is responsible for the noise, the next move is to discover the approximate area within the set where the noise is being generated. Remember to do this with the minimum of disturbance to the set.

Three Main Sections

There are three main sections in a receiver. These are (i) the r.f. signal stages, including the i.f. amplifier and detector; (ii) the local oscillator; and (iii) the a.f. stages. The simple block diagram in Fig. 2 shows these. Without taking the set from its cabinet we can get a very good idea as to which of these three sections is responsible for the noise.

In all receivers the radio signal is changed to an audio-frequency signal at the detector, and the signal is then passed on to the a.f. stages via the volume control, as shown in Fig. 2. It follows, therefore, that if the noise continues with the volume control turned right down (so that the signal and oscillator stages are effectively isolated from the a.f. stages), then it must be generated somewhere in the a.f. stages.



(a)

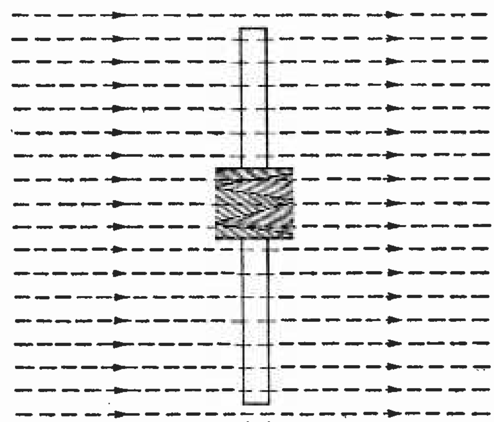

(b)

Fig. 1: The action of a ferrite rod aerial when at (a) it concentrates the signal field along its length to fully embrace the aerial winding (thus maximum pick-up occurs when the rod is in line with the field) and at (b) where there is virtually no pick-up with the rod at right-angles to signal field.

Conversely, if the noise intensity rises and falls as the volume control is turned up and down and ceases when the control is turned right down, then the noise is undoubtedly being produced some where in the signal stages. At this time we have not isolated the oscillator.

Let us suppose that the noise intensity varies as the volume control is operated. We have now to find out whether or not it is coming from the local oscillator. This section of the receiver is often overlooked and yet it is a prolific noise source as it deals with relatively high amplitude r.f. signals which are likely to cause components to fail in such a way as to become noisy.

It may be wondered how on earth an oscillator can be tested for noise without dismantling the set or connecting instruments. Fortunately, there is a simple, though not very often used, method.

Oscillator Noise-test

An oscillator in a radio set is really a very small transmitter. It radiates radio signals to a small extent, although of course its purpose is to inject an oscillatory signal into the mixer section of the frequency changer so as to beat with the incoming signal to form the intermediate-frequency (i.f.) signal.

The frequency of the oscillator signal is adjustable by the set's tuning control, and over the various bands its frequency is "held-off" the signal frequency by the i.f. difference.

The oscillator frequency is mostly the i.f. **above** the signal frequency as tuned by the set. This means that a set tuned to say, 1Mc/s (300m), will produce an oscillator signal the i.f. above that frequency. As ordinary broadcast a.m. sets nowadays have an i.f. of 470kc/s, this would put the local oscillator at 1·470Mc/s.

If there were a transistor capable of tuning to that frequency any modulation on the oscillator signal could, in fact, be heard.

Here, then, is how we can monitor the oscillator for noise. We simply set up a second receiver, preferably a transistor portable, close to the receiver under test and tune this to the frequency of the oscillator of the noisy set. As already described, the oscillator of a set tuned to 1Mc/s will push out a signal at about 1·470kc/s, and this is just a little above 200m on the m.w. band.

The thing to do is to adjust the tuning of the monitor receiver to a weak carrier or station around 200m and then tune the noisy set around 300m on the m.w. band until the oscillator is heard on the monitor set as a heterodyne whistle on the tuned station or carrier.

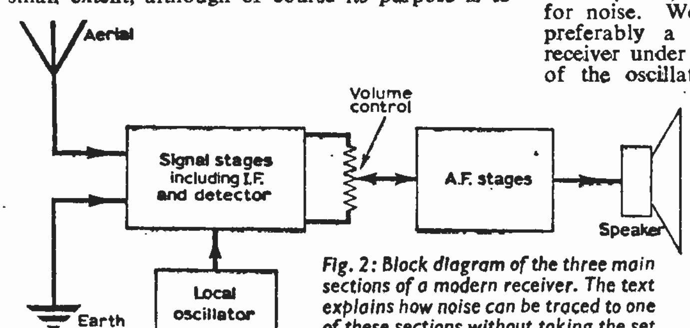


Fig. 2: Block diagram of the three main sections of a modern receiver. The text explains how noise can be traced to one of these sections without taking the set from the cabinet or connecting instruments.

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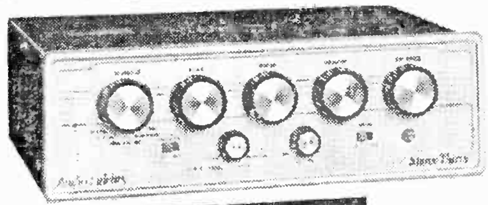

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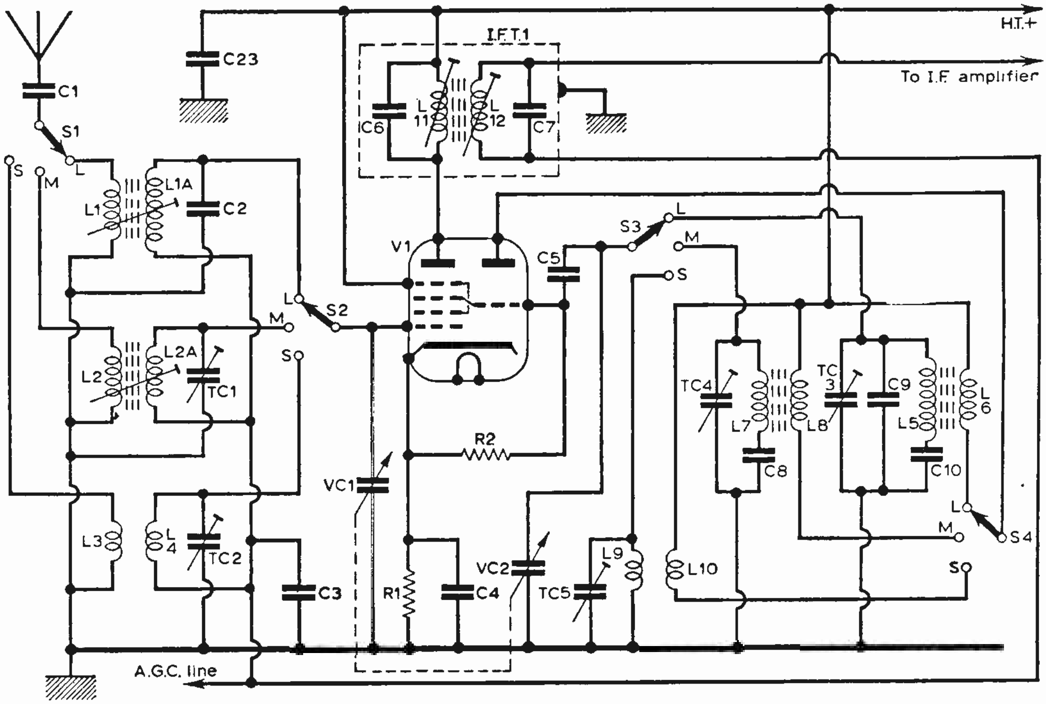

Fig. 3: The circuit of the frequency changer section of a receiver. The triode section of VI is the local oscillator.

Once the appropriate tuning points of the two sets have been established the monitor set can be tuned near to its original setting to a clear place on the band and the noisy set retuned correspondingly until the oscillator signal coincides with the tuned frequency.

That the oscillator signal is being picked up will be revealed by the background on the monitor set going quiet, for there will be no whistle this time if there is no carrier for the oscillator signal to beat with.

Oscillator Coupling

Just how obvious it will be that the monitor set is, in fact, responding to the oscillator signal will depend upon how near the monitor set is placed to the noisy set. If the monitor set is a small transistor portable with a ferrite rod aerial it can be orientated so that the ferrite rod end is close to the oscillator side of the noisy set.

The closer the coupling, the better for this test. When the oscillator signal has been established on the monitor set, the tuning should be critically adjusted and the volume control turned up high.

An ear held close to the speaker of the monitor set will then detect any slight noise on the oscillator signal. If the oscillator is responsible for the noise, the oscillator signal as being monitored will carry a noise pattern similar to that produced by the faulty set.

Of course, at this time the volume control of the noisy set will be turned right down to prevent the actual noise masking the possible noise on the oscillator signal. If there is no trace of noise on the monitored oscillator signal, yet the faulty set continues to produce a noise output, one can rest assured that the oscillator is not responsible.

Now, the simple tests that we have so far performed will tell whether the noise is external or in the set and they will also tell which of the three sections of the set (Fig. 2) is responsible for the noise. Once we have located the noisy section we are compelled to investigate further in greater detail.

Valve Noise

Before doing too much detailed work, however, it is as well to find out whether the valves themselves have some bearing on the noise. Valves can, indeed, be real noise producers after they have seen years of service.

At this stage in the exercise we should remove the back cover of the set without switching the set off if possible, for switching off and then on again may stop the noise for a while if it happens to be the intermittent variety.

With the back off, we should gently tap the valve (or valves) in the sections that we now know to be responsible. We should do that with the volume control at maximum and the set adjusted to give maximum noise output (i.e., we may have found that the noise is greatest on a particular waveband or at a certain tuning point).

If the noise ceases temporarily after a valve has been tapped loose electrodes are probably to blame. A replacement would almost certainly cure the trouble.

Old style valves with metallising on the outside sometimes lose electrical connection from their bases and they then become a potential noise source. This trouble can be remedied by winding several turns of 20 s.w.g. tinned copper wire between the top of the base and the metallised envelope, twisting the wire to lock it tightly in place and then covering the winding with several tight layers of insulating tape.

Another noise possibility around the valves is poor electrical connections between their pins and the sockets of the valve holders. This can be established by gently rocking the valves in their holders with the set switched on and the volume control turned up.

Crackling and frying noises will occur as a valve which is in poor connection is rocked. A cure may be effected either by cleaning the valve pins or closing the sockets for a tighter fit (or both). In bad cases a replacement valve holder may be necessary.

Bad Soldering

Noise in transistor models is rarely caused by noise in transistors. Nevertheless, a gentle tap on the side of those in a noisy section should prove this convincingly. Badly soldered connections on the transistor wires at the printed circuit are more likely.

Assuming that the valves are cleared of blame, it becomes necessary to delve into the noisy circuit section in greater detail. In the case of a noisy oscillator the components most likely responsible are those handling the oscillator signal. A simple frequency changer section is shown in Fig. 3.

Here the triode section of V1 is the local oscillator valve and vulnerable components are R3 and C5, particularly the latter. It pays to replace this straight off if oscillator noise is proved.

Some circuits have a resistor from the h.t. line to the top of the oscillator coils, the bottom of which go to the valve anode. This resistor is another noise source, as also is the associated capacitor.

If noise is troublesome only on one waveband, the corresponding oscillator coil is a very strong possibility. The insulation often weakens causing noise signals to be modulated on the oscillator signal. In this case a check should also be made of the capacitors associated with the noisy waveband. These would be T4 and C8 on the m.w. band and T3, C9 and C10 on the l.w. band of the circuit in Fig. 3.

Check Wave-change Switch

It should also be remembered that worn wave-change switch sections can also set up noise signals. However, this source is generally revealed by operating the wave-change switch or applying pressure to one side of the control knob when, if the switch is faulty, the noises will stop or start. Switch cleaner fluid injected on to the contacts

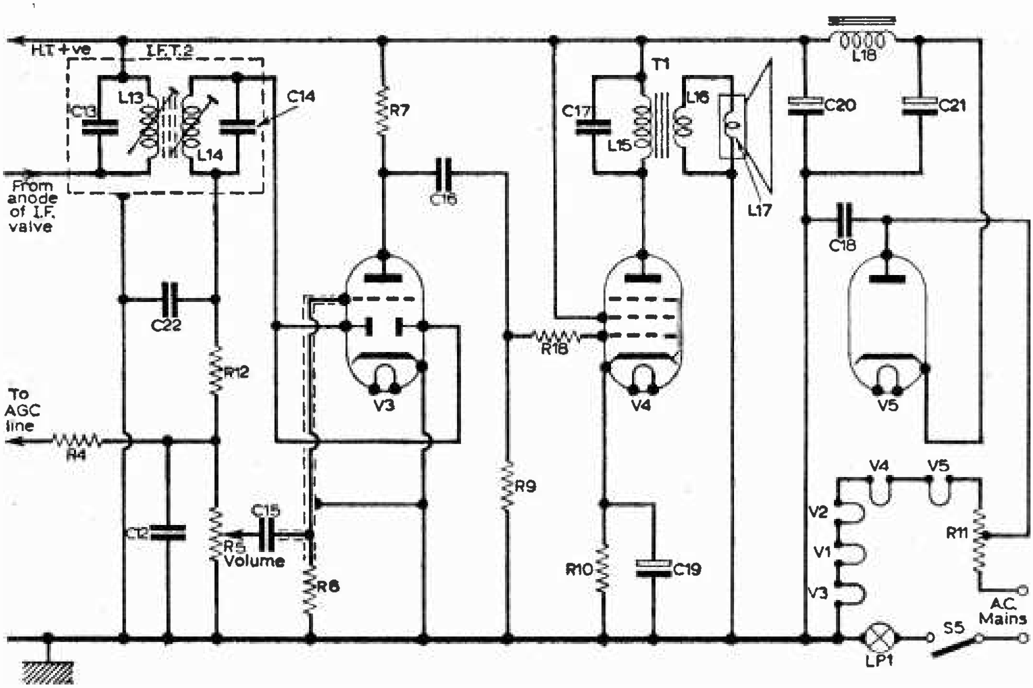

Fig. 4: Circuit of the a.f. sections of a receiver. Possible causes of noises originating here are examined in the text.

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3A5	6/9	10F1	9/9	DAF91	3/9	ECH42	8/3	PC84	5/6	U78	3/6
3Q4	5/6	10LD12	7/6	DAF96	6/-	ECH81	6/-	PCC89	9/6	U191	9/9
3S4	4/9	12AT7	3/9	DCC90	6/9	ECL80	6/3	PCC189	9/-	U301	10/9
3V4	5/6	12AU6	4/9	DF33	7/9	ECL82	6/9	PCF80	6/6	U801	15/-
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5Y3GT	4/11	12AX7	4/9	DF96	6/-	EF39	3/9	PCF84	8/-	UAF42	7/9
5Z4G/GT	6/9	12K7GT	3/6	DH76	8/6	EF41	6/3	PCF86	8/3	UBC41	6/6
6/30L2	8/9	12K8GT	8/6	DH77	4/-	EF80	4/9	PCF805	8/-	UBC81	6/3
6AL5	2/-	12Q7GT	3/6	DH81	12/6	EF85	5/-	PCL82	6/3	UBF80	6/-
6AM6	2/9	19BG6G	6/9	DK32	7/9	EF86	6/9	PCL83	8/6	UBF89	5/9
6AQ5	4/9	20L1	11/9	DK91	4/9	EF89	4/3	PCL84	8/3	UCC84	8/-
6AT6	4/-	20P3	10/9	DK92	8/-	EF91	2/9	PCL85	8/-	UCC85	6/6
6BA6	4/6	20P4	13/6	DK96	6/6	EF92	2/-	PCL86	8/6	UCF80	8/3
6BE6	4/3	20P5	11/6	DL33	6/9	EF97	7/6	PENA4	6/6	UCH42	7/6
6BH6	5/-	25L6GT	4/3	DL35	5/-	EF183	6/9	PEN383	9/6	UCH81	6/6
6BJ6	5/6	25U4GT	11/6	DL92	4/9	EL33	6/6	PEN36C	15/-	UCL82	7/3
6BW6	7/9	25Z4G	6/3	DL94	5/6	EL38	11/9	PFL200	17/6	UCL83	9/3
6CH6	6/6	30C18	8/-	DL96	6/-	EL41	7/3	PL36	8/9	UF41	6/9
6F13	3/6	30F5	8/6	DY86	6/9	EL84	4/6	PL81	6/9	UF42	4/6
6F14	9/-	30FL1	9/6	DY87	6/9	EL90	4/9	PL82	5/6	UF80	6/-
6F23	9/-	30L15	10/3	EABC80	6/-	EL95	5/-	PL83	6/-	UF89	5/9
6K7G	1/6	30L17	12/-	EAF42	7/6	EM34	9/6	PL84	6/3	UL41	7/3
6K8G	4/3	30P4	13/6	EB41	4/-	EM80	5/9	PL500	14/-	UL44	15/-
6K8GT	7/6	30P12	7/6	EB91	2/-	EM81	7/3	PL801	7/6	UL46	8/6
6P28	9/6	30P19	13/6	EBC33	6/-	EM84	5/9	PX25	7/9	UL84	5/9
6Q7G	5/9	30PL1	9/6	EBC41	6/6	EM87	6/6	PY32	8/9	UY41	4/9
6SL7GT	4/9	30PL13	10/9	EBF80	6/-	EY51	6/3	PY33	8/9	UY85	4/9
6V6G	3/6	30PL14	11/-	EBF83	7/6	EY86	6/-	PY80	5/3	VP4B	11/-
6V6GT	5/6	35L6GT	6/3	EFB89	5/9	EZ40	6/3	PY81	5/3	W76	3/6
6X4	3/6	35W4	4/6	ECC40	6/9	EZ41	6/6	PY82	5/-	W77	2/-
6X5GT	6/3	35Z4GT	4/6	ECC81	3/9	EZ80	4/-	PY83	5/9	X79	24/6
7B6	10/6	53KU	8/6	ECC82	4/9	EZ81	4/6	PY800	6/6	Z77	2/9

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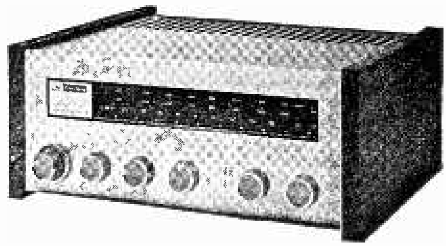

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often assists in clearing noise troubles here.

Noises in the signal stages are often caused by a resistor in one of the electrode feed circuits arriving at the end of its useful life. If the noise is really bad (that is, loud) a rise and fall (flicker) in h.t. voltage at the valve electrode suffering from a worn feed resistor can often be detected on a voltmeter connected between the electrode of the valve concerned and chassis.

For example, if a screen feed resistor is causing the trouble, the pointer of the meter measuring the voltage may be seen flickering about its nominal voltage reading. This is an absolute indication that the feed circuit needs careful examination.

Note, however, that the flicker may be only slight but will be taking place to the pattern of the noise from the speaker.

Similarly, i.f. transformers or the capacitors across their winding, such as L11 and L12 and the capacitors C6 and C7 across them in Fig. 3, may be likewise afflicted. A flicker of voltage at the anode is generally more discernible than that at a screen grid where a feed resistor, as distinct from a winding on a transformer, is concerned.

A fixed tuning capacitor across an i.f. transformer winding can make a lot of noise without showing a flicker in voltage, however. If in doubt, it is best to try a replacement part. Note also that poor insulation in the winding of an i.f. transformer can cause quite a bit of noise without affecting the anode voltage.

A.F. Section Noise

Moving now to the a.f. section we find that potential noise sources are similar to those in the signal stages. Fig. 4 shows the a.f. stages of a typical radio set of the kind that the experimenter may be called upon to service.

Here the signal from the detector is fed across the volume control while the audio is tapped off from the slider to the grid of the triode in V3. The strapped diodes act as the detector and these work in conjunction with the secondary of the second i.f. transformer IFT2.

A noise source is the anode load resistor R7. C16 the coupler can also produce noise if leaky, but this generally adds distortion due to the control grid of the pentode V4 going a little positive owing to the leak in the capacitor.

Noise is very bad if the primary of the speaker transformer OP1 (L15) goes intermittent or poor insulation. In most cases the cause can be proved by connecting a voltmeter between V4 anode and chassis and observing the flicker in reading in sympathy with the noise from the speaker.

Whether the noise originates from the triode a.f. amplifier or from the output stage can be proven by shorting the control grid of the output valve to chassis when the noise is occurring. If the noise ceases with the grid shorted it is developing in V3 stage, but if it continues the output stage of V4 is responsible.

The power supply section (V5 and associated circuits in Fig. 4) rarely goes noisy, but if it does it usually shows by a bad flicker of the voltage when measured on the h.t. line. The choke L18 in the circuit could go bad, but if this leaks to chassis, things could start getting hot and a firework display takes place inside the rectifier V5.

Printed-circuit Noise

Noise can be injected via the a.g.c. line, but this can be eliminated early in the noise tracing exercises simply by shorting it to chassis. Modern receivers are somewhat more noise prone than earlier models due to the new techniques in construction. Printed circuits can cause noise should the insulation between printed conductors go low due to excessive heat and/or dust accumulations.

Heat is sometimes transferred to the printed circuit board from a hot output valve, for example, via the special type of printed circuit valve holder.

The plastic board suffers from local scorching which with some base materials tends to reduce the insulation resistance. Under certain conditions a very high resistance path, of varying value, may develop between, say, the h.t. line and a control grid circuit and this sets up conditions for very elusive noise troubles.

Transistor circuits suffer less from the type of noises detailed in this article, but if they lack input signal in the early stages, due to misalignment, broken ferrite rod aerial and so forth, there can be trouble with a disconcerting hiss on a tuned station, especially if the station is not a very local one. ■

MODIFYING MAINS TRANSFORMERS

—continued from page 878

In general we have:

$$\text{No. of turns on existing winding} \times \frac{\text{(Voltage of existing winding)}}{\text{(Voltage of replacement winding)}}$$

this holds if the new voltage is greater than the old. If the new voltage is less than the old, then we invert the term in brackets, placing the voltage of the replacement winding in top of the voltage of the existing winding.

Make sure that there is room for the winding you propose to use see Fig. 2, and that you take the wire ends and tappings out at a suitable point. Each layer of turns must be covered with stiff paper before the next layer is wound on. The beginning and end of the coil should have a short length of plastic covered flex soldered to it and should then be anchored as shown in Fig. 2. In the case of tappings, when the required number of turns is reached scrape the enamel covering from the wire and solder on the length of plastic covered flex, then proceed with the winding after ensuring that the bare parts are insulated from the other wires with paper.

If you require the new windings to have the same wattage rating as the old you should use the same diameter wire. If you use a smaller diameter wire in order to gain more space the heat generation varies as the square of the diameter of the wire in order to gain more space the heat generathe wire it must carry only a quarter of the current carried by the thicker wire if the heat generation is to remain the same. ■

No. 4 UNIVERSITY OF SHEFFIELD AMATEUR RADIO SOCIETY

THE Society, which is affiliated to the R.S.G.B. was formed in November 1964. Since then the main activity has been to attempt to get the Society established, with some measure of success obtained.

Members are drawn from all sections of the University, academic and technical staff playing their part as well as the students. There are also a limited number of associate members who are not connected with the University in any other respect.

Members' interests range through the whole field of radio from amateur transmitting through short wave listening to high fidelity and tape recording. Attempts are made to cater for all these interests.

Lack of QTH

Activities have been limited during the life of the Society so far due to a lack of a permanent QTH. There have been offers but usually high authority has not been as co-operative as hoped.

There have been a few lectures arranged at fairly short notice but most activities have been undertaken by members acting as groups of individuals. However, as reported previously in P.W. the Society arranged a December sitting of the R.A.E., at which six members passed.

Morse practices are held regularly, but so far only one member has taken the G.P.O. test—and failed.

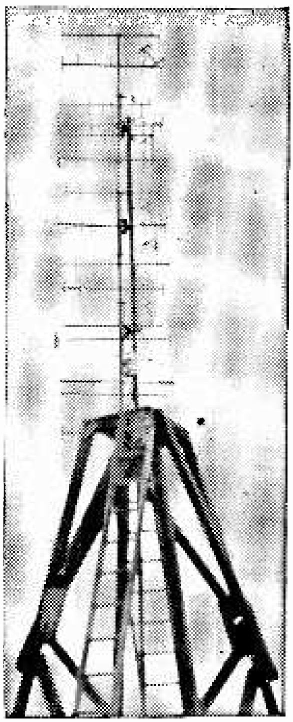
Undoubtedly the most successful meeting to date was a demonstration of "High Quality Sound Reproduction" given by Messrs. W.B., makers of the Stentorian loudspeakers.

An attempt was made to participate in the Oscar III project, but this met with failure due to the hastily assembled equipment being inadequate. However, from the lessons learned from this attempt, it is hoped that future projects will be more successful.

10 Licensed Members

There are ten licensed amateurs in the Society,

Left: Members erecting the aerial array at the R.S.G.B. v.h.f. National Field Day.



Right: Photograph of the fully completed 128-element array on which five stations were worked.

and, not surprisingly, where technical qualifications prevail, sound "B" licences predominate. The following are the members' calls:—

G3MZY, G3RKL, G3TGN, G8AAC, G8AAZ (also G6RAX/T), G8ADZ, G8AET, G8AGH, G8AGN and G8AGQ.

Because of this predominance of "G8's" the emphasis is on v.h.f. and u.h.f. activities, and, in fact, it was two of these "G8's" who started off the Sheffield area v.h.f./u.h.f. activity nights on Wednesdays.

R.S.G.B. v.h.f. Field Day

The Society took part in the R.S.G.B. v.h.f. National Field Day on September 4th and 5th last year. Elaborate preparations were made for the 70cms band including a 10W transmitter and a 128 element array. Five stations were worked (one less than in May last year—when the aerial was a 12-element array).

However, h.f. activity is not ignored. G3TGN has his station in the Physics department, using a Heathkit DX-40U as his Tx and a CR-100 for his Rx. Unfortunately, access is limited so this cannot be used as a Club transmitter. Most QSO's are on 80m.

Several members are engaged on individual construction projects to promote group activities. The emphasis, at the moment, is on equipment for the "G8's" "Top Band". A 432Mc/s Tx using nine transistors has been built and operated. A valve Tx with less than 1W to the final has been heard 30 miles away. A number of surplus klystron units became available in Sheffield recently and some members are preparing these for use on the 3400—3475Mc/s band. There is also some work going on with a 3cms transceiver.

Future Development

Being a recently formed Society, the emphasis is on future development rather than past glories. The acquisition of a QTH is the major objective, and many plans must be shelved until one is obtained. Once a QTH is obtained, priority will be given to setting up a station. For this, the Society hopes to use the call sign G3UOS when it becomes available.

The aim of the Society is to provide the enthusiast with help in obtaining his licence. It is possible for the beginner, joining at the start of the Society's year, to be on the air using his own call sign a few months later.

The Society maintains cordial relations with other Societies and Clubs in the area, and a number of joint meetings and visits have been arranged for this year.

To sum up, this is a new Society, it has little past history the emphasis must be on the future, and although ambitious projects are on the cards, we must first establish ourselves as a meeting point for people with an interest in, and a love for all aspects of Amateur Radio. ■

METROPOLITAN TAPE RECORDER

—*continued from page 871*

position. Clamp the magnet down firmly when the best position is found. This position will not necessarily be optimum for other brands of tape.

Next set the standing current on the output transistors. Remove the (black) supply lead from the output transformer and connect in a milliameter or a multimeter reading on a 0-100mA scale. If the recorder is to be used mainly on batteries, the standing current with no signal in should be as low as the potentiometer VR3 allows, but for mains use a useful figure is 50m/A.

Bias and drive must now be set. The bias potentiometer VR4 should initially be set at mid-range, as should also the drive indicator potentiometer VR5. Make a trial recording, preferably of the 400 cycle note which often accompanies TV test cards, or precedes radio broadcasts, or of a 400 c/s note from a signal generator. Noting the positions of the recordings on the counter, make several recordings at various positions of the drive potentiometer VR5 noting the "o'clock" position of the slot each time. Make sure that the volume control for each recording is set so that the indicator column just touches the dot. Determine the best recording from the point of view of distortion and volume and return the potentiometer to that setting. Now repeat this procedure with the bias potentiometer VR4 to find its optimum position.

Now check the setting of the bias rejector. Using a germanium diode in series with a 1mA meter at the "live" end of the head drive transformer, set the core of L1 for minimum reading. (Resistance in series with the meter may be needed if the setting is badly out.) Incidentally, an open circuit bias coil on this recorder causes heavy treble boosting and should be suspected if all recording sounds too shrill. If there is considerable noise on replay with no tape and the volume control full up, the first transistor is noisy, and should be replaced by a low-noise type such as the AC107. Frequently in these recorders, the second transistor is the culprit for noise; it pays in this case to put the first transistor in place of the second and use a low-noise type in the first position.

With the modifications described, the Metropolitan makes a transistorised tape recorder of outstanding versatility. The output is quite adequate for use in a small hall, and the separate amplifier facility is very useful, especially for public address work. Spares, however, are in short supply, and the following references may be useful.

All parts (Trade only—order through a dealer).
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323 Kennington Road,
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Motors, Idlers, Pinch Wheels, Heads.
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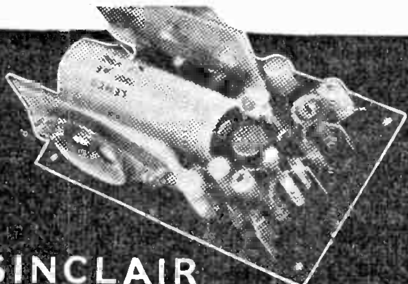

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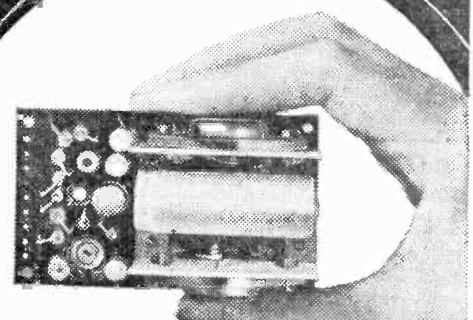

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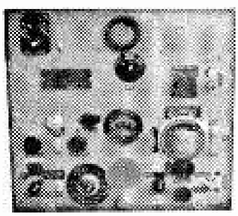

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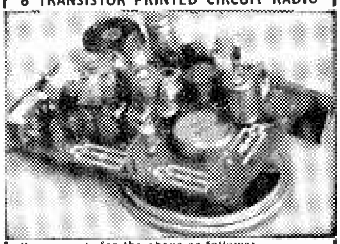

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FOR SALE

FOR SALE
(continued)

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5in., 12/6; 6½in., 15/-; 8in., 21/-; 10in. 25/-; 12in., 27/6; (12in. 15 ohm 30/-) 10in. x 6in., 26/-. E.M.I. 13½ x 8in. with high flux ceramic magnet 42/-; 15 ohm, 45/-, P. & P. 5in., 2/-; 6½ and 8in., 2/6; 10 and 12 in., 3/6 per speaker.

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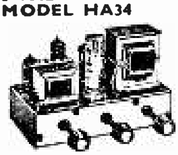
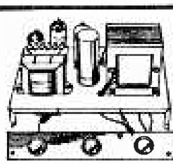
3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records A.C. Mains operation. Ready built on plated heavy gauge metal chassis size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83 EL84 EZ80 valves. Heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc. wired and tested for only **£4.5.0** P. & P. 6/-

TYPE HSL 'FOUR' AMPLIFIER KIT 3 VALVE 4 WATT USING ECC83 EL84, EZ80 VALVES for AC mains 200/240v.



Special features include:
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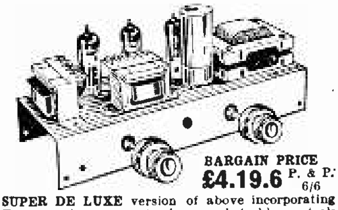
Comprehensive circuit diagram, practical layout and parts list 2/6. (Free with Kits).

This kit although similar in appearance to HA34 it employs entirely different and advanced circuitry

STEREO AMPLIFIERS

Incorporating 2 ECL82's and 1 EZ80 heavy duty double-wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



BARGAIN PRICE **£4.19.6** P. & P. 6/6

SUPER DE LUXE version of above incorporating ECL86 valves separate bass and treble controls and full negative feedback. 8 gns. P. & P. 6/6.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. Size 7in. w. x 2¼in. d. x 5½in. h. This amplifier (was used in a 29 gn. record player) employs heavy duty double-wound mains transformer. ECC83, EL84 EZ80 valves Separate bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Ready built and tested.
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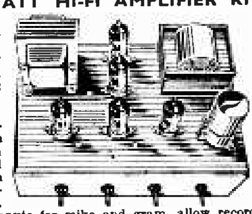

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