NOVEMBER 1961

Practical WIRELESS

2/-

FREE *inside!*

BLUEPRINT *for 4-TRANSISTOR* AUDIO AMPLIFIER

The P.W. Mini-Amp
– four transistors
– 250mW output

USE THE "MINI-AMP" WITH THIS BATTERY RECORD PLAYER

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1. Telephone: PRIMROSE 9090

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6AG5	5/6
6AG7	7/6
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12AT7	6/-
12AU7	6/6
12AX7	7/6
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12J5GT	4/6
12J7GT	9/6
12K5	18/4
12K7GT	5/6
12K8GT	14/-
12Q7GT	5/-
12SA7	8/6
12SC7	8/6
12SG7	7/-
12SH7	8/6
12SJ7	8/6
12SK7	6/-
12SQ7	11/6
12SR7	8/6
12Y4	10/6
19AQ5	10/6
19H1	10/-
20D1	15/8
20F2	27/2
20L1	27/2
20P1	27/2
20P3	23/10
20P4	27/2
20P5	23/10
25A6G	10/6
25L6GT	10/-
25Y5G	10/-
25Z4G	9/6
25Z5	9/6
25Z6G	10/-
27SU	20/5
28D7	7/-
30C1	8/-
30F5	6/-
30FL1	10/-
30L1	8/-
30L15	11/6
30P4	12/-
30P12	7/6
30PL1	10/6
30PL13	13/6
35A5	21/9
35L6GT	9/6
35W4	7/6
35Z3	19/1
35Z4GT	6/-
35Z5GT	9/-
43	10/-
50C5	10/-
50CD6G	37/5
50L6GT	9/6

77	8/-
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807	7/6
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5763	12/6
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AC/PEN 5-pin	23/10
7-pin	15/-
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AC6PEN	7/6
AC/TP	34/-
ATP4	5/-
AZ1	19/1
AZ31	10/-
AZ41	14/3
B36	15/-
BL63	7/6
C1	12/6
C1C	12/6
CBL1	27/2
CBL31	23/10
CCH35	23/10
CK506	6/6
CL33	19/9
CV63	10/6
CY1	19/1
CY31	11/-
D15	10/6
DAC32	10/6
DAF91	6/-
DAF96	8/6
DD41	14/3
DET25	7/6
DF33	10/6
DF66	15/-
DF91	3/6
DF96	8/6
DF97	9/-
DH63	6/6
DH76	5/-
DK32	12/-
DK91	6/6
DK92	9/-
DK96	8/6
DL33	9/6
DL66	17/6

DL68	15/-
DL72	15/-
DL92	7/-
DL94	7/6
DL96	8/6
DM70	7/6
E80F	30/-
E83F	30/-
E180F	34/6
EA50	2/-
EA76	9/6
EABC80	9/-
EAC91	4/6
EAF42	9/-
EB34	2/6
EB41	8/6
EB91	4/-
EBC3	23/10
EBC33	5/-
EBC41	8/6
EBC81	8/-
EBF80	9/-
EBF83	14/3
EBF89	9/6
EBL1	30/6
EBL21	23/10
EBL31	23/10
EC52	5/6
EC54	6/-
EC70	12/6
EC81	27/6
EC92	13/7
ECC32	5/6
ECC33	8/6
ECC34	25/2
ECC35	8/6
ECC40	23/10
ECC81	6/-
ECC82	6/6
ECC83	7/6
ECC84	9/-
ECC85	8/6
ECC88	18/-
ECF80	10/6
ECF82	10/6
ECF86	20/5
ECH3	27/2
ECH21	23/10
ECH35	6/6
ECH42	9/-
ECH81	9/-
ECH83	14/3
ECL80	9/-
ECL82	10/6
ECL83	19/9
ECL86	17/-
EF9	23/10
EF22	14/-
EF36	4/-
EF37A	8/-
EF39	5/6
EF40	15/-
EF41	9/-
EF42	10/6

EF50(A)	7/-
EF50(E)	5/-
EF54	5/-
EF73	10/6
EF80	6/-
EF85	6/-
EF86	10/6
EF89	9/-
EF91	4/6
EF92	4/6
EF97	13/7
EF98	13/7
EF183	19/1
EF184	12/6
EK32	8/6
EL32	5/-
EL33	12/6
EL34	15/-
EL38	27/2
EL41	9/-
EL42	10/6
EL81	17/-
EL83	20/5
EL84	7/6
EL85	14/3
EL86	17/8
EL91	5/-
EL95	10/6
EL820	19/1
EL821	27/2
EL822	25/-
EM34	9/6
EM71	23/10
EM80	9/-
EM81	9/-
EM84	10/6
EM85	17/8
EN31	53/-
EY51	9/-
EY83	17/-
EY84	14/-
EY86	9/-
EZ35	6/-
EZ40	7/-
EZ41	7/-
EZ80	7/-
EZ81	7/-
FC4	15/-
FW4/500	8/6
FW4/800	8/6
GU50	27/6
GZ30	9/-
GZ32	10/-
GZ33	20/5
GZ34	14/-
GZ37	20/5
HABC80	13/6
HL2	7/6
HL23	15/8
HL23DD	7/6
HL42DD	19/9
HN309	25/2

HVR2	20/-
HVR2A	6/-
KF35	8/6
KL35	8/6
KLL32	25/2
KT2	5/-
KT33C	10/-
KT36	30/7
KT41	23/10
KT44	12/6
KT61	12/6
KT63	7/-
KT66	15/-
KT88	24/-
KTW61	6/6
KTW62	7/6
KTW63	6/6
KTZ41	8/-
KTZ63	7/6
L63	6/-
MHL4	7/6
MHLD6	12/6
ML4	8/6
MS4B	23/10
MU12/14	8/-
N37	23/10
N78	20/5
N108	23/10
N308	21/1
N339	15/-
P61	3/6
PABC80	14/3
PCC84	8/-
PCC85	9/6
PCC88	18/-
PCC89	11/6
PCF80	8/-
PCF82	10/6
PCF84	17/-
PCF86	15/-
PCL82	10/-
PCL83	10/6
PCL84	12/6
PCL85	17/-
PCL86	17/-
PENA4	23/10
PEN4DD	27/2
PEN25	4/6
PEN45	19/6
PEN46	7/6
PEN383	23/10
PEN/DD 4020	34/-
PL33	19/9
PL36	12/-
PL38	27/2
PL81	10/6
PL82	7/6
PL83	9/-
PL84	13/-
PL820	19/1
PM84	17/8

PX4	10/6
PY31	17/-
PY32	12/6
PY80	7/6
PY81	8/6
PY82	7/-
PY83	8/6
PY88	13/7
PZ30	20/5
QP21	7/-
QP25	14/6
QS150/15	10/6
R12	9/-
R18	14/-
R19	20/5
RG1/240A	54/-
RK34	7/6
SP4(7)	14/6
SP41	3/6
SP42	12/6
SP61	3/6
SU25	27/2
T41	9/-
TDD4	12/6
TH41	27/2
TP22	15/-
TP25	15/-
TP2620	34/-
TY86F	13/7
U12/14	8/6
U16	10/-
U19	36/-
U22	8/-
U24	30/7
U25	18/4
U26	10/-
U31	9/6
U33	27/2
U35	27/2
U37	27/2
U45	13/6
U50	6/6
U52	6/6
U54	20/5
U76	6/-
U191	17/-
U201	17/-
U251	14/-
U281	20/5
U282	23/2
U301	23/10
U329	14/-
U339	17/-
U403	17/-
U404	8/6
U801	30/7
U4020	19/1
UABC80	9/-
UAF42	9/6
UB41	12/-
UBC41	8/6
UBC81	11/6

UBF80	9/-
UBF89	9/6
UBL21	23/10
UCC84	14/11
UCC85	9/-
UCF80	17/-
UCH21	23/10
UCH42	9/6
UCH81	9/6
UCL82	11/6
UCL83	19/9
UF41	9/-
UF42	12/6
UF80	10/6
UF85	9/-
UF86	18/4
UF89	9/-
UL41	9/-
UL44	27/2
UL46	14/6
UL84	8/6
UM4	17/8
UM34	17/8
UM80	15/8
UR1C	19/1
UU6	20/5
UU8	27/2
UY1N	19/1
UY21	17/-
UY41	7/6
UY85	7/-
VMP4G	15/-
VMS4B	15/-
VP2	12/6
VP4	15/-
VP2B	14/6
VP4B	23/10
VP13C	7/-
VP23	6/6
VP41	6/-
VR105	8/-
VR150	7/6
VT61A	5/-
VT501	5/-
W76	5/6
W81M	6/-
W107	19/1
W729	20/5
X41	15/-
X61(C)	12/6
X63	9/-
X65	12/6
X66	12/6
X76M	14/-
X78	23/10
X79	23/10
X109	17/8
XD(1.5)	6/6
XFG1	18/5
XFY12	9/6
XFY34	18/-
XH(1.5)	6/6
XSG(1.5)	6/6
Y63	7/6

Z66	17/6
Z77	4/6
Transistors and diodes	
CG1C	3/-
CG4E	3/-
CG6E	3/-
CG7E	7/6
CG10E	3/-
CG12E	4/-
GD3, 4, 5, 6, 8	4/-
OA70	3/-
OA73	3/-
OA79	3/-
OA81	3/-
OA86	4/-
OA91	3/6
OA95	3/6
OA210	11/-
OA211	20/-
OC16	48/-
OC19	48/-
OC22	28/-
OC23	87/-
OC26	25/-
OC28	25/-
OC35	25/6
OC44	11/-
OC45	10/-
OC65	22/6
OC66	25/-
OC70	6/6
OC71	6/6
OC72	8/-
OC73	16/-
OC75	8/-
OC77	15/-
OC78	8/-
OC81	8/-
OC139	24/-
OC170	13/6
OC171	14/6
OC200	16/6
OC203	24/-
OCP71	29/6
TJ1	40/-
TJ2	45/-
TJ3	50/-
TP1	40/-
TP2	40/-
TS1	10/-
TS2	12/6
TS3	15/-
TS4	24/-
V30/10P	28/6
XA101	9/-
XA102	10/-
XA103	15/-
XA104	18/-
XB102	6/-
XB103	6/6
XB104	7/-
XC101	6/6

ALL GOODS BRAND NEW AND SUBJECT TO FULL MAKERS' GUARANTEE. PLEASE NOTE THAT WE DO NOT SELL SECONDHAND GOODS OR MANUFACTURERS' REJECTS.

Standard tubular condensers
·001/1000 v.........9d. ·1/500 v.........9d.
·01/500 v.........9d. ·25/500 v...... 1/3
·02/500 v.........9d. ·5/350 v.........1/3
·05/500 v.........9d.

MIDGET TUBULAR CERAMIC CONDENSERS ANY SIZE 9d.

LOW VOLTAGE BIAS CONDENSERS ANY SIZE 1/6

RESISTORS
¼ watt 4d. ½ watt 5d. 1 watt 6d.
Close tolerance types ¼, ½, and 1 watt all 1/- each.

VOLUME CONTROLS
Less switch 3/- each.
With D.P. switch 4/6 each.
10 K 25 K 50 K 100 K
¼ mg. ½ mg. 1 meg. 2 meg.

METAL RECTIFIERS *Full List with ratings free for S.A.E.*

DRM1B 13/-	RM-1 5/3	14A86 17/6	14B130 35/-	14RA 1-2-8-3 (FC31) 21/-	18RA 1-1-16-1 (FC116) 6/6
DRM2B 15/6	RM-2 7/6	14A97 25/-	14B261 11/6	16RD 2-2-8-1 12/-	18RA 1-2-8-1 11/-
DRM3B 15/6	RM-3 7/9	14A100 27/-	14RA 1-2-8-2 (FC101) 17/6	16RE 2-1-8-1 8/6	18RD 2-2-8-1 (FC124) 15/-
LW7 21/-	RM-4 14/-	14A124 28/-	16RC 1-1-16-1 8/6	18RA 1-1-8-1 4/6	
RM-0 7/11	RM-5 19/6	14A163 38/-			

JUST OUT. MIDGET SILICON RECTIFIERS. OUTPUT 120 VOLTS AT ½ AMP. TWO IN SERIES GIVE 240 VOLTS AT ½ AMP. NO LARGER THAN A RESISTOR. 10/6 EACH.

ELECTROLYTIC CONDENSERS

Standard Can
32 x 32 mfd., 450 v. 5/9
50 x 50 mfd., 350 v. 7/-
64 x 120 mfd., 350 v. 8/3

60 x 250 mfd., 275 v. 9/6
100 x 400 mfd., 275 v. 12/6
100 mfd., 275 v. 3/-

200 mfd., 275 v. 4/-
100 x 200 mfd., 275 v. 9/6

Wire-ended tubular
8 mfd., 450 v. 1/9
16 mfd., 450 v. 2/9
32 mfd., 450 v. 3/9

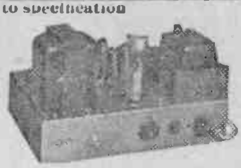
8 x 8 mfd., 450 v. 3/-
16 x 16 mfd., 450 v. 4/-
32 x 32 mfd., 350 v. 4/-
8 x 16 mfd., 450 v. 3/9

Post/packing charge 6d. per item. Orders over £3 post free. C.O.D. 2/6 extra. Full List, with Terms of Business, 6d. Any parcel insured against damage in transit for only 6d. extra. Shop Hours 8.30-5.30. Early Closing Saturday.

STERN'S MULLARD DESIGNS

Designed by MULLARD—presented by STERN's strictly to specification

COMPLETE KIT OF PARTS MULLARD "5-10" MAIN AMPLIFIER



For use with the MULLARD 2-valve pre-amplifier with which undistorted power output of up to 10 watts is obtained. We supply **SPECIFIED COMPONENTS AND NEW MULLARD VALVES**, including **PARMEKO MAINS TRANSFORMER** and choice of the latest Ultra-Linear **PARMEKO** or the **PARTRIDGE** Output Transformer.

COMPLETE KIT OF PARTS (PARMEKO Output Trans.). **£10.0.0**

Alternatively we supply **ASSEMBLED** and **TESTED**. **£11.10.0** **INCORPORATING PARTRIDGE OUTPUT TRANSFORMER, £1.6.0 EXTRA.**

MULLARD'S PRE-AMPLIFIER TONE CONTROL UNIT

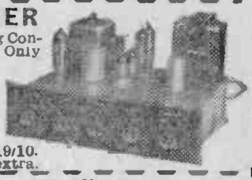
Employing two EF86 valves, and designed to operate with the MULLARD **MAIN AMPLIFIERS**, but also perfectly suitable for other makes.

PRICE COMPLETE KITS OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

Supplied strictly to **MULLARD'S SPECIFICATION** and incorporating:

- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups, and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-amplifier.
- Sensitive Microphone Channel. • Wide range **BASS** and **TREBLE** Controls.

COMPLETE MULLARD "5-10" AMPLIFIER



The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Only Specified Components and new **MULLARD VALVES** are supplied including **PARMEKO MAINS TRANSFORMERS** and choice of the latest **PARMEKO** or **PARTRIDGE** ULTRA-Linear Output Transformers.

KIT OF PARTS **£11.10.0** OR ASSEMBLED and TESTED **£13.10.0**

H.P. (Assembled Amp. only). DEPOSIT £2.14.0 12 months at 19/10. ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6. extra.

PRICE REDUCTIONS

(a) The KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-valve PRE-AMP CONTROL UNIT............ **£15.15.0**

(b) The "5-10" and the 2-stage PRE-AMP both ASSEMBLED and TESTED H.P. Dep. £3.16.0 and 12 months of £1.7.8.......... **£18.18.0**

(c) The KIT OF PARTS to build the DUAL-CHANNEL "3-3" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT.............. **£21.10.0**

(d) The DUAL-CHANNEL "3-3" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT BOTH ASSEMBLED and TESTED............... **£25.0.0** H.P. Terms: Deposit £5 and 12 months of £1.16.8.

(e) THE KIT OF PARTS to build one "5-10" MAIN CHANNEL and the DUAL-CHANNEL PRE-AMP CONTROL UNIT **£21.10.0**

(f) ONE "5-10" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER both ASSEMBLED and TESTED................ **£25.0.0** H.P. Terms: Deposit £5, 12 months of £1.16.8.

(g) KIT OF PARTS to build Two "5-10" MAIN AMPLIFIERS (incorporating Parmeko Output Transformers) and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT **£31.0.0**

(h) TWO "5-10" AMPLIFIERS and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT BOTH ASSEMBLED & TESTED **£36.0.0** H.P. Terms: Deposit £7.4.0, 12 months £2.12.0.

Carriage and Insurance 7/6 extra. Prices quoted are subject to **£1.6.0** extra for Partridge Transformer.

COMPLETE MULLARD "3-3"

THE IDEAL AMPLIFIER FOR A SMALL HIGH QUALITY INSTALLATION PROVIDING EXCELLENT REPRODUCTION OF UP TO 3 WATTS OUTPUT

COMPLETE KIT OF PARTS **£7.10.0** OR ASSEMBLED and TESTED **£8.19.6**

(plus 6/6 carriage and insurance) H.P. Terms: Deposit £2.0.0. and 8 Months at £1.0.0. Complete to MULLARD'S SPECIFICATION including Mullard valves and a **PARMEKO OUTPUT TRANSFORMER.**

DUAL CHANNEL PRE-AMP

Incorporates two Mullard 2-valve Pre-Amplifiers combined into a Single unit enabling it to be used for both **STEREOPHONIC** or **MONAURAL** operation. It is designed primarily to operate with our range of **MULLARD MAIN AMPLIFIERS** but will also operate equally well with any make of Amplifiers requiring an input of 250 m/volts.

COMPLETE KIT OF PARTS **£12.10.0** ASSEMBLED AND TESTED **£15.0.0**

H.P. £3 Dep. and 12 mths. at £1.2.0

SPECIAL CASH OFFER

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

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

The Amplifier consists of a 2-stage design incorporating 3 modern B.V.A. valves and has separate **BASS** and **TREBLE CONTROLS.**

The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Mushroom Grey Rexine.

WE ALSO SUPPLY SEPARATELY—

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

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

(c) 6½in. **P.M. SPEAKER** 18/9 Carriage and Insurance 4/- extra.

MULLARD FOUR CHANNEL MIXER UNIT

Self powered with Cathode follower output. Incorporates Two inputs for MICROPHONES One for CRYSTAL PICK UP and a fourth for RADIO or TAPE

Complete Kit of Parts **£8.8.0**

Assembled and Tested **£10.0.0**

TERMS: Deposit £2 and 12 months at 15/-.

MODEL I.L. one microphone input matched for moving coil or Ribbon Mike. £1.17.0 extra.

STERN'S INTER-COMM or BABY ALARM

A small versatile Unit employing the new MULLARD ECL86 valve and designed to provide two (or three) way conversation up to extreme distances. Operates from A.C. mains 200 to 250 Volts.

PRICES . . . MASTER UNIT and ONE EXTENSION

KIT OF PARTS **£6.17.6** ASSEMBLED AND TESTED **£8.0.0**

Consists of a MASTER UNIT, size only 8½ x 5½ x 6in. and ONE EXTENSION (a second extension may be added to any time). The Master Unit incorporates switching and power supply and with the chassis completely isolated from the mains is operated in absolute safety. Cases covered in quality leatherette.

RECORD PLAYERS

THE LATEST MODELS ARE IN STOCK MANY AT REDUCED PRICES

SEND S.A.E. FOR ILLUSTRATED LEAFLET

B.S.R. MONARCH UA8 4-speed mixer Autochanger with Crystal Pick-up.	**£6.19.6**
The **NEW COLLARO MODEL RP594** 4-speed Single Record Player. Studio Cartridge.	**£9.18.9**
The **NEW COLLARO C60** 4-speed Autochanger unit with Studio "O" Pick-up.	**£7.19.6**
The E.M.I. 4-speed Single Record Player with crystal Pick-up.	**£6.9.6**
B.S.R. MODELS UA12 and UA14. Each a 4-speed mixer autochanger with Crystal Pick-up.	**£7.19.6**
Both available incorporating the **B.S.R. STEREO** Pick-up, plays L.P. and 78 Records.	**£8.13.10**
GARRARD MODEL TA/MkII 4-speed Player fitted high output Crystal Pick-up.	**£8.10.0**
GARRARD MODEL RC/209. Autochanger 4-speeds. High output. Crystal Pick-up.	**£8.19.6**

Carriage and Insurance on each above, 5/- extra.

CASH OFFER

COLLARO "JUNIOR" 4 SPEED SINGLE RECORD PLAYER with separate CRYSTAL PICK-UP **£3.15.0**

Carriage and Insurance 5/-.

Above **PICK-UP** separately for............................£1.6.6

STERN RADIO LTD.

Dept. ... 109 FLEET ST., LONDON E.C.4

Telephone: FLEET STREET 5812/3/4

Stern's "fidelity" TAPE RECORDERS

There are no better value-for-money Tape Recorders on the market—if you can't call and hear them send S.A.E. for fully descriptive leaflet.

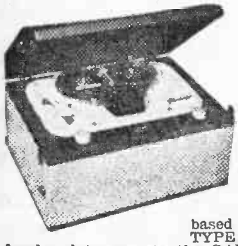
For truly "Hi-Fi" Recordings

EACH MODEL INCORPORATES THE MODEL HFITR3 Mk.II TAPE AMPLIFIER (Described opposite)

MODEL CR3/S Incorporates the COLLARO "STUDIO" TWIN TRACK 3-speed Deck, operating at 1⅞in., 3¾in. and 7½in. speeds **£39.10.0**
H.P. Terms: Deposit £7.18.0 and 12 months of £2.17.11.

MODEL TR3/Mk.VI Incorporates the New TRUVOX Mk. VI TWIN TRACK 2-speed Tape Deck operating at 3¾in. and 7½in. speeds **£44.0.0**
H.P. Terms: Deposit £8.16 and 12 months of £3.4.7

Each price quoted provides for the COMPLETE RECORDER including CRYSTAL MICROPHONE and 1,200ft. Spool of Tape.



The MODEL HFG/2R PORTABLE TAPE RECORDER
(Original Price £33.0.0)
FOR ONLY 22 gns

H.P. Dep. £4.14.0. 12 months £1.13.9. *(Carr. and Ins. 10/- extra).* Incorporates THE LATEST GARRARD "MAGAZINE" TAPE DECK and a HIGH QUALITY AMPLIFIER which is entirely based on the very successful MULLARD TYPE "A" DESIGN and specifically developed to operate the GARRARD DECK. Price INCLUDES SUPPLY OF THE GARRARD TAPE MAGAZINE and 4in. SPOOL of DOUBLE PLAY TAPE. Comprises a Twin Track Recorder operating at 3¾in/sec. speed and providing up to 1 hour 10 mins. playing time. Truly "Portable", weighs only 22 lbs. Outstanding features are excellent performance and simplicity of operation.

THE 'ADD-A-DECK'
Incorporating GARRARD "MAGAZINE" TAPE and the MATCHED MODEL HF/G2P PRE-AMPLIFIER
Supplied on ONE CHASSIS (as illustrated) READY FOR USE **18 Gns.**
(Carr. & Ins. 10/- extra).
Price includes Garrard Magazine and a 4in. Spool Double Play Tape
H.P. Deposit £3.16.0, and 12 months of **£1.7.8.**
Provides complete tape recording facilities and designed to operate through the pick-up sockets of the standard type of RADIO RECEIVER, or an AMPLIFIER, from which really first class reproduction is obtained. It consists of a Twin Track Deck connected to the Pre-amplifier and operates at 3¾in/sec. speed providing up to 1 hr. 10 mins. playing time.

FULLY DESCRIPTIVE LEAFLETS ARE AVAILABLE—PLEASE ENCLOSE S.A.E.

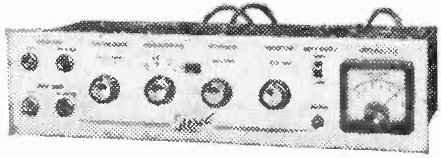
Stereophonic Sound by Stern's

THE "STP-1" STEREO TAPE PREAMPLIFIER
DESIGNED TO OPERATE WITH

- **TRUVOX MkVI TAPE DECK** incorporating the latest 4-TRACK MINI-FLUX TAPE HEADS.
- **BRENELL MkV TAPE DECK** incorporating similar 4-TRACK MINI-FLUX TAPE HEADS.
- **COLLARO "STUDIO" TAPE DECK** incorporating the latest 4-TRACK REUTER TAPE HEADS.

BRIEF SPECIFICATION OF PREAMPLIFIER

- PUSH PULL OSCILLATOR CIRCUIT
- 4-SPEED EQUALISATION
- FERROXCUBE OSCILLATOR TRANSFORMER
- SENSITIVE METER FOR SIGNAL LEVEL
- SEPARATE GAIN CONTROLS IN EACH CHANNEL
- MULLARD VALVES INCORPORATED



OVERALL SIZE CASE 13¼ x 3in. FRONT PANEL (Choice of Black or White) 14 x 3½in.

PRICE
£26 - 0 - 0
Including separate Power Supply Unit.
Deposit £5.4.0, 12 months £1.8.2.

COMBINED PRICE SCHEDULE

THE "STP-1" PREAMPLIFIER IS OFFERED WITH TAPE DECKS AS FOLLOWS:

- TRUVOX MkVI 4-TRACK MODEL.............. **£45.0.0**
  Deposit £9.0.0, 12 months £3.6.0.
- BRENELL MkV 4-TRACK MODEL.............. **£65.0.0**
  Deposit £13.0.0, 12 months £4.15.4.
- COLLARO "STUDIO" 4-TRACK MODEL........ **£41.10.0**
  Deposit £8.6.0, 12 months £3.0.11.

STEREOPHONIC RECORD PLAYER UNITS MICROPHONES & TWIN LOUDSPEAKERS ARE AVAILABLE FROM STOCK

- **THIS EQUIPMENT and the DESCRIPTIVE LEAFLET will be available late OCTOBER**

PLEASE ENCLOSE S.A.E. WITH ALL ENQUIRIES

OUR MULLARD "10+10" STEREO AMPLIFIER

(described opposite) with the "STP-1" PREAMPLIFIER and one of the TAPE DECKS provide a COMPLETE STEREOPHONIC INSTALLATION.

WE OFFER

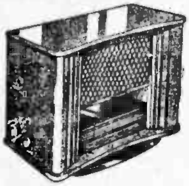
- "10+10" AMPLIFIER, "STP-1" PREAMPLIFIER and the TRUVOX MkVI DECK.................. **£65.0.0**
  Deposit £13.0.0, 12 months £4.15.4.
- As above with BRENNEL MkV DECK............ **£85.0.0**
  Deposit £17.0.0., 12 months £6.4.8.
- As above with COLLARO "STUDIO" DECK........ **£61.10.0**
  Deposit £12.6.0, 12 months £4.10.2.

Please enclose S.A.E. with all enquiries.

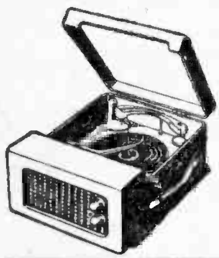
STERN RADIO LTD.

COMPLETE V.H.F./A.M. RADIO FOR £12.10.0

(carr. paid)



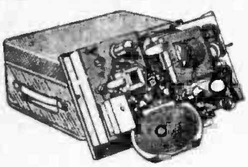
Brand new set, in superb walnut cabinet (size 19 x 8½ x 14½in. high). Covering 80-100 Mc/s. 16-49 M., and 200-500 M. Mains trans. 200-250 v. with 2 tappings. Ferrite rod aerial for A.M. Controls: volume on/off, tone, tuning, w/change. Gram and ext. speaker position provided. Valves 12AT7, 12AH8, 6BJ6, EABC80, 6BW6 and metal rectifier. Fully guaranteed. Today's Value £20.



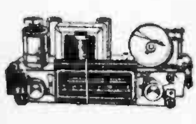
BUILD YOUR OWN RECORD PLAYER FOR £11.10.0

2v. amp. 57/-; B.S.R. 4-sp. autochanger £6.10.0; case 17 x 15 x 8½in. 45/-; carr. 7/6 on any two items or the lot for £11.10.0—carr. paid. Assembled in 15 mins.

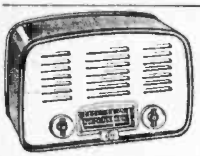
TAPE RECORDER FOR ONLY £17.17.0 (10/- carr.)



A QUALITY ARTICLE. Valves EZ80, ECC83, ECL82, DM70. Acos Crystal "mike", 850ft. Tape and extra spool. 3¾in./sec. Mike and Radio inputs; Vol. on/off tone, Ext. L.S. and Monitor. Fast forward and reverse. Cannot be accidentally erased. Magic Eye Indicator. 6 x 4in. Speaker. Cabinet 14x11½x7in. Supplied completely built and in cabinet.

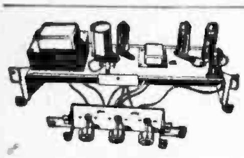


SELF-POWERED VHF TUNER CHASSIS. Covering 88-95 Mc/s. Mullard permeability Tuner, Dims. 10½ x 4½ x 5in. high. ECC85, EF91, EF91 and 2 diodes. Metal Rectifier. Mains transformer. Fully wired and tested. Only £7.14.0 (carr. pd.). Room dipole 10/-. 300 ohm twin feeder, 6d. yd. Tuner without power pack £6.14.0 (carr. paid).



LISTEN WITHOUT INTERFERENCE

Fully built V.H.F./F.M. Set for £8.12.0 (carr. pd.). Covers 88/95Mc/sec. Wired, aligned and tested. Mullard permeability tuner and 4 valves (ECC85, ECL82 and two EF91). 2 diodes. Cheap room dipole, 10/-. 300 ohm twin feeder, or co-axial cable, 6d. yd.

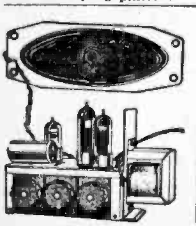


PUSH-PULL AMPLIFIER £4.15.0

(4/- Carr.)

Brand new 200-240 A.C. mains. Bass, treble and vol. controls. With valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 x 3½ x 3½in. With o.p. trans. for 3-2 ohm speaker.

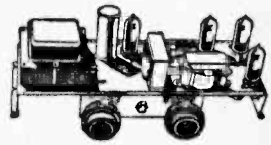
Front panel (normally screwed to chassis) may be removed and used as "flying panel".



3-VALVE AMPLIFIER (INC. RECT.). 4 watts. Valves ECC83, EL84 and EZ80. Controls, volume, bass and treble. On/off switch. (Chassis size 6½ x 3 x 2½in.) 6½in. round or 7 x 4in. elliptical speaker. Not suitable for microphone input. A.C. only. 67/- P. & P. 3/-.

BEREC BATTERY RADIO IN MAKER'S CARTON. Valves DK96, DF96, DAF96, DL96. Two Short Wavebands 2.5 to 7 Mc/s and 6.5 to 17 Mc/s. Cabinet 12 x 7½ x 6in. ONLY £5 (2/6 p. & p.); MW and SW £5.4.0 (plus 2/6 p. & p.).

STEREO AMPLIFIER £4.15.0 (4/- p. & p.)



Brand new. 200-250 A.C. Tone and volume controls each channel. EZ80; ECC83; and 2—EL84; giving 2 x 4W. Size 12 x 3½ x 3½ ins. O.P. Trans. for 2-3Ω speaker. Separate on/off switch to allow balancing to remain set.

GERMAN MADE F.M. FRONT END with ECC85 valve. Capacity tuned with reduction gear. Covers 88-98 Mcs. 4½ x 3 x 3½in. over valve. New. price 22/6 (2/6 post). Circuit 2/6.

"FIDELITY" 6-TRANSISTOR "CORONET" RADIO. Pocket Radio 4½ x 2½ x 1½in. for M.W. and L.W. 12 months' guarantee. 9½ gns. inc. battery, carr. paid.

CONSTRUCTORS' Bargain parcel for 20/- (3/- post)

Electrolytics, tubulars, resistors, ceramics, valveholders, etc. Every parcel worth £4 at current prices.

SAVE 10/-. Swiss made Unic Shaver operating from 1.5 v. battery, usual price 59/8. Our price 50/- with battery. Takes U2 batter. Not a toy, but a shaver (carr. paid).

COLLARO STUDIO TAPE TRANSCRIPTOR. 3 MOTORS, 3 SPEED. 1⅞, 3¾ and 7½ I.P.S. Push buttons. £10.17.6 (10/- carr.) incl. spool.

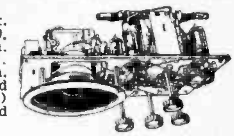
SUPERIOR GRAMOPHONE AMPLIFIER 3 valves, 4 watt

13½ x 7½in. (2½in. front to back). 3 front controls, bass, treble, vol./on-off. 6½in. circ. or 8 x 5in. speaker; UY85, UF86 and UL84. Mains trans. 200-240ac; "gold" fret front. ONLY 70/- (p.p. 3/6).

NEW LOUDSPEAKER BARGAINS. Good Makes.

2-8 ohm. 13 x 8½in. 35/- (4/-); 7 x 4in. 14/6 (2/-); 6½ x 4½in. 12/6 (2/-); 10 x 6in. 25/- (3/-); 5in. 12/- (2/-); 4in. tweeter 7/6 (2/-); 7 x 5in. 17/6 (2/-); 9 x 6in. 22/- (2/6). *Postal charges bracketed.*

MAINS OPERATED RADIO CHASSIS AND AMPLIFIER OF FAMOUS MANUFACTURE



Chassis 10 x 5½ x 4in. front to back. Valves: UBC41, UCH41, UF89, UL84 with metal rectifier. 5in. speaker. Ferrite rod aerial. Tone, vol. and gram. position. Covers L. and M. waves. Limited quantity at only £6 (5/- carr.) complete with small dial. Unused and in working order.

UNREPEATABLE OFFER OF AM-FM CHASSIS AT ONLY £9.9.0 carr. pd.

A small quantity of Printed Circuit chassis by famous manufacturer. Valves UY85, UCH81, UF89, UABC80, UL84 and UCC85, O.p. trans. for 2-3 ohm speaker. Chassis 14 x 7 x 7in. Front controls concentric, left—Vol. and Tone; right—W/c and Tuning. "Gold" centre knobs provided. 2-dial bulbs. Sockets, AE; E; Ext. sp; P.U. Mains isolating provided free. Coverage Long. Med., VHF (87-101 Mc/s). Unused, slightly tarnished, but not dirty; New Mullard Valves; not our manufacture, so no guarantee.

SPECIAL OFFER OF GOODMAN 10 x 6in. SPEAKER high gauss, with doped cone specially suitable for high fidelity work. Price 27/6 (post 2/6).

B.S.R. "MONARDECK" TAPE DECK SINGLE SPEED. Our price only £7.2.6 (5/6 carr.). 850 ft. first grade tape 5¾in. plastic spool, 16/-, post 1/-.

BATTERY ELIMINATOR. For 4 Low Consumption Valves (96 range), 90 v. 15 mA. and 1.4 v. 125 mA, 42/6 (2/6 post). 200-250 v. A.C. Size 5½ x 3¾ x 2in. Also for 250 mA, 1.4 v. and 90 v. 15 mA at same price.

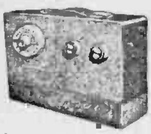
AUTOMATIC RECORD CHANGERS. ALL 4-SPEED WITH TURN-OVER CYRSTAL CARTRIDGE (carr. 5/- extra). Latest UA14. £7.10.0. Collaro C.60 Studio model, plays any records. 7-12in. only £7.15.0. Motor board 3/6. Both UA14 and C.60 fitted mono-aural cartridge but wired for stereo.

BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £14 (Carriage Paid)

Tapped input 200-225 v. and 226-250 v. A.C. ONLY.
Chassis size 15 x 6½ x 5½in. high. New manufacture. 12 mths.' guarantee.
Dial 14½ x 4in. in black and gold.
Pick-up. Extension Speaker. Ae., E., hd Dipole Sockets. Five "piano" push buttons—OFF L.W., M.W., F.M. and Gram. Aligned and tested.
With all valves and O.P. Transformer. Tone Control Fitted.
Covers 1,000—1,900 M.; 200-500 M.; 88-98 Mc/s.
Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85.
Speaker and Cabinet to fit chassis (table model), 47/6 (post 3/6).
10 x 6in. ELLIPTICAL SPEAKER. 20/-, to purchasers of this chassis.
TERMS:—(Chassis) £5 down and 5 Monthly Payments of £2, or with Cabinet and Speaker £5.10.0 down and 6 Monthly Payments of £2.
Cheap Room Dipole 10/-; Feeder 6d. yd.

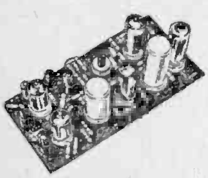
This chassis is an ideal partner for the radiogram cabinet appearing on this page.

THE "CANTATA" 6-TRANSISTOR and DIODE PORTABLE KIT



400mW push-pull output; Ferrite rod aerial; M.W. and L.W.; operates on two 4.5 v. cells; full working instructions; printed circuit, board size 8½ x 2½in. with all holes drilled; booklet of full assembly and alignment instructions; all parts sold separately. Size 9 x 3½ x 7in. Mullard transistors. Car aerial socket provided. Write for list; 8 x 2½in. speaker included tive rexine cabinet 20/- extra. Batteries 5/6 extra.

TAPE RECORDER AMPLIFIER KITS



(a) For COLLARO STUDIO DECK, 11 gns.

(b) For B.S.R. MONARDECK Twin Track, 8 gns.

These kits are complete down to the last screw and length of measured wire. Printed circuit amplifiers are tested and assembled complete with valves. Full instructions. Leaflet available. Carriage paid.

MINIATURISED COMPONENTS FOR TRANSISTOR SET. 3 I.F. trans. 7/16in. sq. x 9/16in.; 2-gang 165pF plus 65pF; ¾ x ¾ x ½in.; input and output trans. each 9/16in. cube; osc. coil. THE LOT for 34/- (post 2/-).

TRANSISTORS. Top Grade. Two matched OC78; 1—OC78D; 1—OC44 (yellow); 2—OC45 (orange and blue). THE LOT of 6 for 37/6 (registered 1/- extra).

MAINS TRANSFORMERS—New, of course

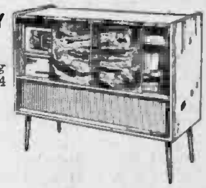
(A) Primary tapped 200-250 v. Output 275-0-275 v. at 200 mA; 6.3 v. 6 A and 5 v. 3 A; 4½ x 4½ x 4in. Drop thru' top shrouded type. Weight 10 lbs. 35/- (post 4/-).
(B) Tapped primary 110 v., 125 v., 150 v., 210 v. and 240 v. 250-0-250 out at 100 mA; 6.3 v. 3 A; 6.3 v. 1 A. 3½ x 3½ x 3in. high overall. Drop thru' type top shrouded. Weight 4½ lbs. Price 22/6 (post 3/-).

AERIALS

Combined B.B.C. (Single Dipole) **and Band 3 I.T.A.** (5-Element) **Aerial**, with chimney lashings and Stand-off Arm £3.15.0.
I.T.A. (Band 3) Aerials, for clipping to existing mast of diameter 1in. to 2in. Alternatively with wall-fixing plate at same price: 3 element £1.2.0, 5 element £1.10.0, 8 element £2.10.0, 11 element £3.2.6. Chimney lashings and Stand-off Arm 20/- extra for each of above.
Loft Mounting I.T.A. Aerials. 3 element 20/-, 5 element 26/-. Larger aerials for I.T.A. and B.B.C. can be supplied to special order.
Double 6 Element I.T.A. Plus B.B.C. "H" Aerial with 10ft. pole and double chimney lashings. £8.10.0.
All the above aerials are carriage paid.
An I.T.A. Table Top Aerial with amazing performance. The Wolsey Hi-Q at 19/6 (2/6 post). Good reception up to 20 miles. Cross-over unit in base with socket for B.B.C. aerial. Slightly tarnished at 12/6 (2/6 postage).

PERSPEX. 15 x 12 x ⅛in., tinted blue/grey. 6/6; 12½ x 9½ x ⅛in.. Clear. 5/-; 16 x 14 x 3/16ins., Clear. 7/6. Postage 2/- on 1; 3/- on 2 or more; 6 post paid.

SUPERB CONTEMPORARY CABINET

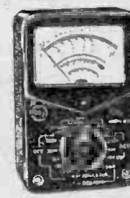


Fitted with 3 sliding doors providing room for Radio, Autochanger, 4 speakers, and record storage.

PRICE **15 Gns.**

Free delivery in London area.
35/- carriage elsewhere.

THE "CABY" TEST METERS



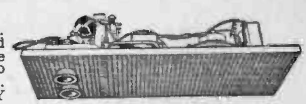
Prices include **Test Prods, Batteries, Instruction Book.** Also measure dB. Accuracy: A.C., 3 per cent, D.C., 2 per cent.

A-10 **£4.17.6** B-20 **£6.10.0**

A.10—2K ohms/v. on A.C. and D.C. volts (10, 50, 250, 500 and 1000 v.); 10K and 1M ohms; ½ mA, 25 mA and 250 mA. D.C. Size, 5½ x 3½ x 1½in. Weight 17 oz.

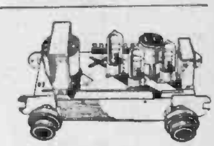
B.20—10K ohms/v. on 0.5 v. and 2.5 v.; 4K ohms/v. on 10, 50, 250, 500 and 1000 v.. A.C. and D.C. Resistance, 2K, 200K, 2M and 20M ohms; D.C. current, 100 microA, 2.5 mA, 25 mA, 250 mA. Size 5½ x 3½ x 2½in. Weight 24 oz.

GRAMOPHONE AMPLIFIER



With 5in. SPEAKER. Baffle 12½ x 6in. EZ40 and EL41. Tone and Volume On/Off switch. Two Knobs. Ready to play. Useful for Stereo. ONLY 57/-, post 3/-.

3-VALVE AMPLIFIER (INC. RECT.). 4 watts. ECC83, EL84 and EZ80. Controls, volume bass and treble. On/off switch. Overall size 10½ x 4½ x 5in. over valves. Mains and O.P. trans. and 6½ x 4½in. Celestion speaker. Suitable for for microphone input. A.C. only.



70/- P. & P. 4/-.

"READY TO USE" ITA CONVERTER Direct switching ITA to BBC, metal rectifier, co-axial plug. Can be fitted in 5-10 mins., and needs no alteration to your set. ALL AREAS. ALL SETS. ALL CHANNELS. 12 months' guarantee (3 months on valves).
Separate gain controls. Valves PCF80 and PCC84. Switch positions OFF—ITA—BBC. Bakelite moulded cabinet. 8½ x 4 x 6in. 70/- (3/- P. & P.).

PANEL OF 7 POTS. 10 x 1½in.—4 x 1M & 3 x 2M. 4/- (post 1/-).

6 DIFFERENT PRE-SET POTS. 2K to 500K. 3/- (post 1/3).

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ALL ITEMS GUARANTEED 12 MONTHS—B.V.A. VALVES 3 MONTHS.

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MITCHAM · SURREY
Tel: Mitcham 6201

★ VALVE

ALL VALVES ETC. BRAND
EXPRESS 24 HOUR

NEW
RECORDING TAPES!!

E.M.I. B.A.S.F. SCOTCHBOY Etc.
ALL IN STOCK

TAPE RECORDERS

Any make supplied—FREE TRIALS!

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RM1	5/3	RM4	14/-	14A97	25/-
RM2	7/6	RM5	19/6	14A100	27/-
RM3	7/9	14A86	17/6		

14RA	1-2-8-2	17/6	(FC31)
16RC	1-1-16-1	8/6	
14RA	1-2-8-3	19/-	(FC31)
16RD	2-2-8-1	12/-	
16RE	2-1-8-1	8/6	
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Open to Callers: 9 *a.m.* to 6.30 *p.m.*
Phone: Mit 6201.

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AC2PEN DD	21/-
AC4PEN	25/-
AC4PEN DD	25/-
AC5PEN	22/6
AC5PEN DD	22/6
AC6PEN	21/-
AC6PEN DD	21/-
ACHL	12/6
ACHLDD	15/-
ACP	12/6
ACP4	12/6
ACPEN	17/6
ACTH1	34/-
ACSG	15/-
ACSGVM	15/-
ACTP	32/-
ACVP1	17/6
ACVP2	17/6
AL60	12/6
ATP4	4/-
AZ1	15/-
AZ31	10/-
AZ41	13/6
B36	10/-
B65	8/6
B152	5/9
B309	9/6
B329	9/6
B339	9/6
B719	8/-
BL63	10/-
C1	12/6
C1C	12/6
CBL1	17/6
CBL31	21/-
CCH35	21/-
CL4	10/-
CL33	18/6
CY1	15/-
CY31	15/9
C36A	12/6
D1	10/-
D15	10/-
D41	10/-
D42	10/-
D43	10/-
D63	2/6
D77	4/-
D152	4/-
DA30	17/6
DAC32	9/6
DAF91	7/6
DAF96	8/9
DCC90	14/6
DD41	10/-
DD620	10/-
DF33	10/-
DF91	4/-
DF92	7/-
DF96	8/6
DF97	9/6
DH63	6/-
DH76	5/-
DH77	7/-
DH101	15/-
DH107	13/6
DH142	10/-
DH150	10/-
DH719	6/-
DK32	11/6
DK40	21/-
DK91	8/-
DK92	8/6
DK96	8/6
DL33	8/6
DL35	10/6
DL66	15/-
DL68	15/-
DL72	15/-
DL82	17/6
DL92	7/6
DL93	7/-
DL94	8/-
DL96	8/6
DL145	17/6
DM70	7/6
DN41	17/6
E80F	20/-
EA50	2/-
EA76	8/-
EABC80	6/-
EAC91	4/-
EAF42	9/6
EB34	2/6
EB41	7/6
EB91	4/-
EBC3	21/-
EBC33	4/6
EBC41	9/-
EBC81	10/-
EBF80	8/6
EBF83	8/6
EBF89	8/6
EBL21	22/-
EBL31	21/6
EC31	10/-
EC52	10/-
EC54	10/-
EC90	9/6
EC91	9/6
EC92	9/6
ECC31	10/-
ECC32	8/6
ECC33	5/-
ECC34	15/-
ECC35	8/-
ECC40	21/-
ECC81	5/9
ECC82	8/6
ECC83	7/6
ECC84	8/6
ECC85	8/-
ECC88	17/6
ECC91	4/-
ECF80	8/6
ECF82	8/6
ECH3	21/-
ECH21	22/-
ECH42	9/6
ECH35	10/-
ECH81	8/-
ECH83	8/6
ECL80	9/-
ECL81	10/-
ECL82	9/6
ECL83	12/-
EF6	21/-
EF9	21/-
EF22	14/-
EF36	4/-
EF37	8/-
EF37A	8/-
EF39	4/-
EF40	15/-
EF41	8/-
EF42	10/-
EF50A	4/-
EF50E	3/6
EF54	5/-
EF55	5/-
EF80	5/-
EF85	5/-
EF86	10/6
EF89	9/-
EF91	4/-
EF92	4/-
EF93	7/6
EF94	8/6
EF95	7/6
EF97	12/6
EF98	10/-
EF183	18/-
EF184	14/-
EK32	8/6
EL2	21/-
EL3	21/-
EL6	21/-
EL31	12/6
EL32	4/6
EL33	10/-
EL34	15/-
EL35	10/-
EL37	17/6
EL38	21/-
EL41	10/-
EL42	10/-
EL81	12/6
EL83	10/6
EL84	6/9
EL85	10/-
EL86	16/-
EL90	8/6
EL91	4/-
EL95	10/6
EL820	17/6
EL822	22/6
EM1	17/6
EM4	17/6
EM34	9/6
EM71	21/0
EM80	8/6
EM81	8/6
EM84	9/6
EM85	10/-
EN31	30/-
EN32	25/-
EY51	8/6
EY81	8/6
EY83	15/-
EY84	10/-
EY86	8/6
EY91	4/-
EZ35	6/-
EZ40	7/-
EZ41	7/-
EZ80	7/-
EZ81	7/-
EZ90	7/-
E1148	2/-
FC2	21/-
FC2A	21/-
FC4	15/-
FC13	21/-
FC13C	21/-
FW4/500	9/-
FW4/800	9/-
GT1C	20/-
GU50	20/-
GZ30	10/6
GZ32	10/6
GZ33	19/3
GZ34	13/6
GZ37	19/3
H30	5/-
H63	9/-
HABC80	10/-
HBC90	9/6
HL2	7/6
HL23	8/6
HL23DD	8/6
HL41	8/6
HL41DD	8/6
HL42	8/6
HL42DD	8/6
HL92	8/6
HL133DD	10/-
HN309	20/-
HVR2	20/-
HY90	8/-
IW4/350	10/-
IW4/500	10/-
K40N	10/6
KBC32	9/6
KF35	8/6
KL32	10/-
KL35	8/-
KL232	10/-
KK32	10/6
KT2	5/-
KT8	7/6
KT32	8/6
KT33C	8/-
KT35	12/6
KT36	17/6
KT41	17/6
KT44	10/-
KT45	12/6
KT55	17/6
KT61	9/6
KT63	7/-
KT66	15/-
KT71	9/-
KT74	12/6
KT76	10/-
KT81	15/-
KT88	21/-
KT101	21/-
KTW61	7/6
KTW62	7/6
KTW63	7/6
KTZ41	8/6
KTZ63	8/6
L63	5/-
LN152	9/-
LN309	12/6
LZ319	12/6
MH4	8/6
MH41	10/-
MHD4	17/6
MHL4	10/6
MKT4	17/6
ML4	8/6
MS4B	17/6
MSPEN	10/6
MSPENB	12/6
MSP4	17/6
MSP41	14/-
MVSPEN	17/6
MVSPENB	17/6
MU14	9/-
MX40	15/-
N17	4/-
N18	8/-
N19	8/-
N37	14/-
N78	17/6
N108	18/-
N142	9/6
N147	15/-
N150	10/-
N152	12/-
N153	10/-
N308	20/-
N309	10/-
N329	8/-
N339	15/-
N369	10/6
N727	7/6
N729	8/-
OD3	5/-
OZ4	5/6
P2	10/-
P41	5/-
P61	5/-
PABC80	13/-
PCC84	9/-
PCC85	9/6
PCC88	15/-
PCC89	9/6
PCF80	9/6
PCF82	7/-
PCF84	16/-
PCF86	15/-
PCL82	9/6
PCL83	12/6
PCL84	10/6
PCL85	16/-
PENA4	17/6
PENB4	17/6
PEN4DD	22/6
PEN4VA	17/6
PEN25	4/-
PEN36C	21/-
PEN40DD	21/-
PEN44	21/-
PEN45	10/-
PEN45DD	22/6
PEN46	5/-
PEN220	3/6
PEN383	21/-
PEN453DD	27/6
PEN1320	21/-
PEN3520	21/-
PENDD1320	21/-
PENDD4020	25/-
PL33	15/-
PL36	15/-
PL38	21/-
PL81	12/-
PL82	8/-
PL83	10/6
PL84	9/-
PL820	18/-
PM2A	12/6
PM2B	12/6
PM2DX	12/6
PM2HL	12/6
PM12	6/6
PM12M	6/6
PM22A	13/6
PM24M	13/6
PM84	21/-
PM202	8/6
PX4	15/-
PX25	25/-
PY31	15/-
PY32	12/6
PY80	7/6
PY81	7/6
PY82	7/6
PY83	8/6
PZ30	18/6
QP21	10/-
QP22B	12/6
QP25	12/-
QP230	17/6
Q59510	10/-
QS15015	10/-
R2	10/-
R3	10/-
R10	10/-
R12	8/6
R16	17/6
R17	12/6
R18	12/6
R19	19/-
R20	19/-
S130	7/6
SD6	8/6
SP2	12/6
SP4	12/6
SP4B	12/6
SP13	12/6
SP13C	12/6
SP41	3/6
SP42	10/-
SP61	3/6
SU25	25/-
SU61	8/6
SU2150	25/-
SU2150A	25/-
T41	15/-
TDD2A	12/6
TDD4	12/6
TDD13C	17/6
TH21	17/6
TH30C	17/6
TH41	24/-
TH233	15/-
TH2321	19/-
TP22	15/-
TP23	17/6
TP25	15/-
TP2620	27/6
TT11	5/-
TY86F	12/6
U10	9/-
U12	9/-
U14	9/-
U16	9/-
U17	7/6
U1820	8/6
U22	8/-
U24	21/-
U25	12/6
U26	10/-
U27	8/-
U31	9/-
U33	17/6
U35	17/6
U37	17/6
U43	8/6
U45	10/-
U47	12/6
U50	7/6
U52	4/-
U54	17/6
U76	7/6
U78	4/6
U107	15/-
U142	7/6
U145	10/6
U147	7/-

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Tel : Mitcham 6201

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EAC91	4/-	PL84	9/-	6K8	5/-
EB91	4/-	UABC80	7/-	6L6	7/6
EBF89	8/6	UBF89	7/6	6Q7	6/6
ECC81	5/9	UF41	7/6	6SL7	6/6
ECC85	8/-	UL41	8/6	6SN7	5/6
ECC91	4/-	UF89	6/6	6V6	4/6
ECH81	8/-	UL84	7/-	6X5	5/-
EBC33	4/6	UY85	7/-	8D3	4/-
EF39	4/-	W81	6/-	12AT7	5/-
EF50	3/6	OZ4	5/-	12AH8	9/-
EF80	5/-	5U4	4/-	12BA6	7/6
EF85	5/-	6AQ5	6/6	12BE6	7/6
EF91	4/-	6BA6	6/-	12K7	5/-
DF91	4/-	6BE6	6/-	12Q7	6/6
EL84	6/9	6D2	4/-	807	5/-

Obsolete Valves a Speciality
Quotations by Return

U153	8/6	VP2	12/6	Z66	10/-	5T4	9/-	6C31	32/-	6P1	10/6	7Y4	7/6	12SN7	10/-	38	12/6
U191	15/-	VP2A	12/6	Z77	4/-	5R4	9/-	6CD6G	32/-	6P25	10/6	7Z4	10/-	12SR7	10/-	40SUA	15/-
U201	15/-	VP2B	12/6	Z152	5/-	5U4	4/-	6CH6	10/-	6P26	15/-	8D2	3/6	12Y4	10/-	41STH	21/-
U251	12/6	VP4	15/-	Z309	12/6	5V4	7/9	6D1	5/-	6P28	17/6	8D3	4/-	12Z3	15/-	42	12/6
U281	18/-	VP4A	17/6	Z359	12/6	5Y3	8/6	6D2	4/-	6Q7	6/6	9BW6	12/6	12Z5	10/-	43	10/-
U292	19/6	VP4B	17/6	Z719	5/-	5Y3GT	8/6	6D3	11/6	6Q7GT	8/6	9D2	4/-	13D3	12/6	50C5	10/-
U301	22/6	VP13	15/-	ZD17	8/-	5Z3	8/6	6D6	5/6	6R7	7/6	10C1	12/6	14H7	10/-	50L6	8/6
U329	12/6	VP13C	17/6	ZD152	8/6	5Z4	9/6	6E5	10/-	6R7GT	8/-	10C2	17/6	14R7	10/-	50CD6G	
U339	15/-	VP23	7/6	OZ4	5/-	5Z4GT	12/6	6F1	10/6	6SA7	7/-	10D2	12/-	14S7	15/-		36/6
U403	10/-	VP41	7/6	1A3	3/-	6A7	9/-	6F5	12/6	6SC7	7/-	10F1	15/-	15A2	17/6	52KU	12/6
U404	10/-	VP133	10/-	1A5	4/9	6A8G	8/6	6F6	6/9	6SF5	8/-	10F3	15/-	15D2	17/6	53KU	12/6
U801	29/-	VR10530	7/-	1A7	11/6	6A8GT	13/6	6F7	15/-	6SG7	7/-	10F9	12/6	19AQ5	8/-	54KU	12/6
U4020	15/-	VR15030	7/-	1C1	8/6	6AB7	7/-	6F8	6/6	6SH7	6/-	10LD3	10/-	19B6G	21/-	58	13/6
UABC80	7/-	VU39	9/-	1C2	9/-	6AB8	9/-	6F11	10/-	6SJ7	6/6	10LD11	15/-	19H1	11/-	59	13/6
UAF42	8/6	VU111	2/6	1C3	9/6	6AC7	4/-	6F12	4/-	6SK7	5/6	10LD12	10/-	20A2	8/6	61BT	17/6
UB41	7/6	VU120	2/6	1C5	10/6	6AG5	5/-	6F13	10/-	6SL7GT	6/-	10P13	15/-	20D1	10/-	61SPT	17/6
UBC41	8/6	W17	4/-	1D5	8/6	6AG7	6/-	6F14	10/-	6SN7GT	5/6	10P14	19/-	20D2	23/-	62BT	17/6
UBC81	10/-	W21	10/-	1D6	10/-	6AJ7	15/-	6F15	12/6	6SQ7	8/6	10P18	15/-	20F2	17/6	72	13/6
UBF80	8/6	W31	15/-	1D8GT	8/6	6AJ8	9/6	6F16	9/6	6SR7	6/6	11D3	17/6	20L1	17/6	75	8/-
UBF89	7/6	W61	11/-	1G6	12/-	6AK5	5/-	6F17	12/-	6SS7	7/6	11D5	17/6	20P1	25/-	76	13/6
UBL21	21/-	W76	5/-	1E7GT	7/6	6AK6	6/6	6F19	12/6	6T7	15/-	12A6	6/6	20P3	25/-	77	8/-
UCC84	10/6	W77	4/-	1H5	9/6	6AK7	8/-	6F23	10/6	6U4GT	10/-	12AC6	15/-	20P4	22/-	78	7/6
UCC85	7/6	W81	6/-	1L4	5/-	6AK8	7/6	6F32	10/-	6U5G	7/6	12AD6	17/6	20P5	25/-	80	9/-
UCF80	13/6	W81M	6/-	1LD5	5/-	6AL5	6/-	6F33	5/6	6U7G	7/6	12AE6	13/-	21B6	12/-	82	8/6
UCH21	21/-	W107	15/6	1LN5	4/6	6AM5	5/-	6G6	8/6	6V6	4/6	12AH7	8/6	25A6	8/-	83V	12/6
UCH42	9/6	W109	15/6	1F1	8/-	6AM6	4/-	6H6	2/-	6V6GT	8/-	12AH8	9/-	25L6	8/-	83	12/6
UCH81	8/-	W142	8/6	1F3	7/6	6AN5	7/6	6J5	4/6	6X2	9/-	12AT6	7/6	25Y5	8/-	84	12/6
UCL82	10/-	W719	7/6	1N5	9/6	6AQ5	6/6	6J5GT	4/6	6X4	4/6	12AT7	5/-	25Z4	7/6	85	17/6
UCL83	13/6	W727	7/6	1R5	7/6	6AQ8	9/3	6J6	3/6	6X5	4/6	12AU7	8/6	25Z5	8/-	85AZ	12/6
UF41	7/6	W729	15/-	1S4	8/-	6AT6	6/-	6J7	5/-	6X5GT	5/-	12AX7	7/6	25Z6	8/-	89	15/-
UF42	7/6	X17	8/6	1S5	7/6	6AU6	9/-	6J7GT	7/6	6X6	15/-	12AU6	17/6	27SU	17/6	90Av	12/6
UF80	7/-	X18	9/-	1T4	4/-	6AV6	12/-	6J8	10/-	6Z4	15/-	12AV6	12/-	28D7	8/-	117Z6GT	5/-
UF85	7/6	X24	21/-	1U5	5/9	6B7	10/-	6K6GT	5/-	630L2	10/-	12BA6	7/6	30	12/6	142BT	5/-
UF86	12/6	X41	15/-	2A3	8/-	6B8G	3/-	6K7	2/-	7A7	10/-	12BE6	7/6	30C1	9/6	150B2	12/6
UF89	6/6	X61	12/6	2A5	8/-	6BA6	6/-	6K7GT	8/6	7B5	12/6	12BH7	10/-	30F5	10/-	161	10/6
UL41	8/6	X61M	22/6	2A6	10/-	6BE6	6/-	6K8	5/-	7B6	10/-	12C8	8/6	30FL1	10/6	185BT	30/-
UL44	21/-	X63	12/6	2D4A	8/6	6BG6G	17/6	6K8GT	9/6	7B7	8/6	12E1	15/-	30L1	9/6	210DDT	
UL46	14/6	X65	12/6	2D21	8/6	6BH6	8/-	6K25	18/-	7B8	8/-	12H6	2/6	30L15	11/6		12/6
UL84	7/-	X66	12/6	2P	24/9	6BJ6	6/-	6L1	13/-	7C5	8/-	12J5GT	4/-	30P4	21/-	210Lf	12/6
UL85	7/6	X76	12/6	2X2	5/-	6BQ7A	12/6	6L5	10/6	7C6	8/-	12J7GT	8/6	30P12	10/-	210VPT	12/6
UM4	15/-	X76M	12/6	3A4	5/-	6BR7	12/6	6L6	7/6	7C7	8/-	12K7GT	5/-	30P16	9/-	303	9/6
UM80	10/6	X78	21/-	3A5	10/6	6BS7	12/6	6L7	7/-	7D3	15/-	12K8GT	10/-	30PL1	15/-	304	9/6
UR1C	15/-	X79	21/-	3A8GT	10/-	6BW6	7/-	6L18	10/-	7D5	15/-	12Q7GT	6/6	30PL13	12/6	305	9/6
UU6	19/-	X101	15/-	3B7	15/-	6BW7	5/-	6L19	17/6	7D6	15/-	12SA7	8/6	32	13/6	307	9/6
UU7	15/-	X109	15/-	3B24	7/6	6BX6	5/-	6L34	10/-	7D8	15/-	12SC7	5/-	35A5	17/6	328	9/6
UU8	21/-	X142	9/-	3D6	14/6	6C4	3/6	6LD3	9/6	7H7	7/6	12SG7	7/6	35L6GT	8/6	329	9/6
UU9	7/6	X150	8/6	3Q4	8/-	6C5GT	8/-	6LD12	8/6	7K7	8/6	12SH7	4/-	35W4	7/6	807BR	5/-
UY1N	12/6	Y61	10/-														
UY21	15/6	Y63	9/-	3Q5	9/-	6C6	6/6	6LD20	14/-	7Q7	10/-	12SJ7	4/-	35Z3	10/6	807A	5/6
UY41	7/6	Y66	9/6	3S4	7/-	6C8	10/-	6M1	10/6	7R7	12/-	12SK7	6/-	35Z4	7/6	954	4/-
UY85	7/-	Z21	12/6	3V4	8/-	6C9	12/6	6M2	10/6	7S7	10/-	12SQ7	8/6	35Z5	8/6	955	4/-
VMS4B	12/6	Z63	7/6	4D1	8/6	6C10	12/6	6N7GT	6/6	7V7	10/-	12SL7	8/-	37	12/6	5763	12/6

83 HIGH ST., MERTON, S.W.19

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EBC33	5/-
EBC41	8/6
EBC81	8/-
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EBF83	13/11
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EBL21	23/3
EBL31	23/3
EC52	5/6
EC54	6/-
EC70	12/6
EC92	13/3
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ECC81	6/-
ECC82	6/6
ECC83	7/6
ECC84	9/-
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ECC88	18/-
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ECF80	10/6
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ECH3	26/6
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ECH42	9/-
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ECH83	13/11
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EF40	15/-
EF41	9/-
EF42	10/6
EF50(A)	7/-
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EF73	10/6
EF80	6/-
EF85	6/-
EF86	10/6
EF89	9/-
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EL81	16/7
EL83	19/11
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EL86	17/3
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EM80	9/-
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EM84	10/6
EM85	17/3
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EY83	16/7
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EZ40	7/-
EZ41	7/-
EZ80	7/-
EZ81	7/-
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FW4/800	8/6
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GZ30	9/-
GZ32	10/-
GZ33	19/11
GZ34	14/-
GZ37	19/11
H63	12/6
HABC80	13/6
HL2	7/6
HL23	15/3
HL23DD	7/6
HL41DD	19/3
HL42DD	19/3
HN309	24/7
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KF35	8/6
KL35	8/6
KLL32	24/7
KT2	5/-
KT33C	10/-
KT36	29/10
KT41	23/3
KT44	12/6
KT61	12/6
KT63	7/-
KT66	15/-
KT88	24/-
KTW61	6/6
KTW62	7/6
KTW63	6/6
KTZ41	8/-
KTZ63	7/6
L63	6/-
MHL4	7/6
MHLD6	12/6
ML4	8/6
MS4B	23/3
MU12/14	8/-
N37	23/3
N78	19/11
N108	23/3
308	20/7
339	15/-
P61	3/6
PABC80	13/11
PCC84	8/-
PCC85	9/6
PCC88	18/-
PCC89	11/6
PCF80	8/-
PCF82	10/6
PCF84	16/7
PCF86	15/-
PCL82	10/-
PCL83	10/6
PCL84	12/6
PCL85	16/7
PENA4	23/3
PENB4	26/6
PEN4DD	26/6
PEN25	4/6
PEN40DD	25/-
PEN44	26/6
PEN45	19/6
PEN45DD	26/6
PEN46	7/6
PEN383	23/3
PEN453DD	33/2
PEN/DD 4020	33/2
PL33	19/3
PL36	12/-
PL38	26/6
PL81	10/6
PL82	7/6
PL83	9/-
PL84	12/8
PL820	18/7
PM2B	12/6
PM84	17/3
PX4	10/6
PY31	16/7
PY32	12/6
PY80	7/6
PY81	8/6
PY82	7/-
PY83	8/6
PY88	13/3
PZ30	19/11
QP21	7/-
QP25	14/6
QS150/15	10/6
R12	9/-
R18	14/-
R19	19/11
RG1/240A	45/-
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S130	22/6
SP4(7)	14/6
SP41	3/6
SP42	12/6
SP61	3/6
SU25	26/6
SU61	9/-
T41	9/-
TDD4	12/6
TH41	26/6
TH233	33/2
TH2321	20/-
TP22	15/-
TP25	15/-
TP2620	33/2
TY86F	13/3
U12/14	8/6
U16	10/-
U18/20	8/6
U19	36/-
U22	8/-
U24	29/10
U25	17/11
U26	10/-
U31	9/6
U33	26/6
U35	26/6
U37	26/6
U43	9/-
U45	9/-
U50	6/6
U52	6/6
U54	19/11
U76	6/-
U78	5/-
U107	16/7
U191	16/7
U201	16/7
U251	14/-
U281	19/11
U282	22/7
U301	23/3
U329	14/-
U339	16/7
U403	16/7
U404	8/6
U801	29/10
U4020	16/7
UABC80	9/-
UAF42	9/6
UB41	12/-
UBC41	8/6
UBC81	11/4
UBF80	9/-
UBF89	9/6
UBL21	23/3
UCC84	14/7
UCC85	9/-
UCF80	16/7
UCH21	23/3
UCH42	9/6
UCH81	9/6
UCL82	11/6
UCL83	19/3
UF41	9/-
UF42	12/6
UF80	10/6
UF85	9/-
UF86	17/11
UF89	9/-
UL41	9/-
UL44	26/6
UL46	14/6
UL84	8/6
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UM34	17/3
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UU6	19/11
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UU8	26/6
UU9	7/6
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UY41	7/6
UY85	7/-
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VP4	15/-
VP2B	14/6
VP4B	23/3
VP13C	7/-
VP23	6/6
VP41	6/-
VR105	8/-
VR150	7/6
VT61A	5/-
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W76	5/6
W81M	6/-
W107	18/7
W729	19/11
X24M	24/7
X41	15/-
X61(C)	12/6
X63	9/-
X65	12/6
X66	12/6
X76M	14/-
X78	23/3
X79	23/3
X109	17/3
XD(1.5)	6/6
XFG1	18/-
XFY12	9/6
XFY34	17/6
XH(1.5)	6/6
XSG(1.5)	6/6
Y63	7/6
Z63	7/6
Z66	17/6
Z77	4/6
Z719	6/-
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OB2	17/6
OZ4	5/-
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1A7GT	12/-
1C5	12/6
1D6	10/6
1G6	17/6
1H5GT	10/6
1L4	3/6
1LD5	5/-
1LN5	5/-
1N5GT	10/6
1R5	6/6
1S4	9/-
1S5	6/-
1T4	3/6
1U5	6/-
2P	26/6
2X2	4/6
3A4	6/-
3A5	10/6
3B7	12/6
3D6	5/-
3Q4	7/6
3Q5GT	9/6
3S4	7/-
3V4	7/6
5R4GY	17/6
5U4G	6/6
5V4G	10/-
5Y3	6/6
5Z3	12/6
5Z4G	9/-
6A7	10/6
6A8	9/-
6AC7	4/-
6AG5	5/6
6AG7	7/6
6AK5	8/-
6AL5	4/-
6AM6	4/6
6AQ5	7/6
6AT6	7/-
6AU6	10/-
6AV6	12/8
6B8	5/-
6BA6	7/6
6BE6	6/-
6BG6G	23/3
6BH6	8/-
6BJ6	6/-
6BQ7A	15/-
6BR7	23/3
6BS7	25/-
6BW6	8/6
6BW7	6/-
6BX6	6/-
6C4	5/-
6C5	6/6
6C6	6/6
6C9	13/6
6C10	9/-
6CD6G	36/6
6CH6	9/-
6D6	6/6
6E5	12/6
6F1	26/6
6F6G	7/-
6F11	17/3
6F12	4/6
6F13	11/6
6F15	15/3
6F23	10/6
6F32	10/6
6F33	7/6
6G6	6/6
6H6	3/-
6J5	5/-
6J6	5/6
6J7G	6/-
6J7GT	10/6
6K7G	5/-
6K7GT	6/-
6K8GT	10/6
6K8G	6/6
6K25	19/11
6L1	23/3
6L6G	8/-
6L6M	9/6
6L7GT	7/6
6L18	13/-
6L19	23/3
6LD3	8/6
6LD20	15/11
6N7	8/-
6P25	12/6
6P26	19/11
6P28	26/6
6Q7G	6/6
6Q7GT	11/-
6R7G	10/-
6SA7GT	8/6
6SC7	7/6
6SG7GT	8/-
6SH7GT	8/-
6SJ7GT	8/-
6SK7GT	6/-
6SL7GT	6/6
6SN7GT	5/6
6SQ7GT	9/-
6SS7GT	8/-
6U4GT	12/6
6U5G	7/6
6U7G	8/6
6V6G	7/-
6V6GTG	8/-
6X4	5/-
6X5GT	6/-
6/30L2	10/-
7A7	12/6
7B6	21/3
7B7	8/6
7C5	8/-
7C6	8/-
7H7	8/-
7R7	12/6
7S7	9/6
7V7	8/6
7Y4	7/6
8D2	3/6
8D3	4/6
9BW6	15/3
9D2	4/-
10C1	13/-
10C2	26/6
10D2	12/-
10F1	26/6
10F9	11/6
10LD3	8/6
10LD11	15/11
10P13	15/-
10P14	19/3
12A6	5/-
12AC6	15/3
12AD6	17/3
12AE6	13/11
12AH7	8/-
12AH8	12/6
12AT6	7/6
12AT7	6/-
12AU6	23/3
12AU7	6/6
12AV6	12/8
12AX7	7/6
12BA6	8/-
12BE6	9/-
12BH7	21/3
12E1	30/-
12J5GT	4/6
12J7GT	9/6
12K5	17/11
12K7GT	5/6
12K8GT	14/-
12Q7GT	5/-
12SA7	8/6
12SC7	8/6
12SG7	7/-
12SH7	8/6
12SJ7	8/6
12SK7	6/-
12SQ7	11/6
12SR7	8/6
12Y4	10/6
14S7	27/10
19AQ5	10/6
19H1	10/-
20D1	15/3
20F2	26/6
20L1	26/6
20P1	26/6
20P3	23/3
20P4	26/6
20P5	23/3
25A6G	10/6
25L6GT	10/-
25Y5G	10/-
25Z4G	9/6
25Z5	9/6
25Z6G	10/-
27SU	19/11
28D7	7/-
30C1	8/-
30F5	6/-
30FL1	10/-
30L1	8/-
30L15	11/6
30P4	12/-
30P12	7/6
30PL1	10/6
30PL13	16/6
35A5	21/3
35L6GT	9/6
35W4	7/6
35Z3	10/6
35Z4GT	6/-
35Z5GT	9/-
43	10/-
50C5	10/-
50CD6G	36/6
50L6GT	9/6
53KU	19/11
77	8/-
78	6/6
80	9/-
83	15/-
85A2	25/-
150B2	15/-
161	10/6
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304	10/6
305	10/6
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OA95	5/-
OA210	25/-
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OC16	54/-
OC19	54/-
OC23	87/-
OC26	44/-
OC28	25/-
OC35	48/-
OC44	26/-
OC45	23/-
OC65	22/6
OC66	25/-
OC70	14/-
OC71	14/-
OC72	17/-
OC73	20/-
OC75	15/-
OC77	21/-
OC78	17/-
OC81	18/-
OC170	35/-
OC200	54/-
OC203	58/-
TJ1	40/-
TJ2	45/-
TJ3	50/-
TP1	40/-
TP2	40/-
TS1	10/-
TS2	12/6
TS3	15/-
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XB103	14/-
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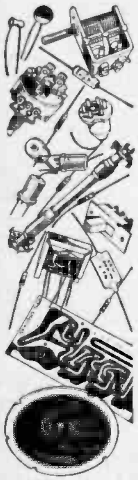

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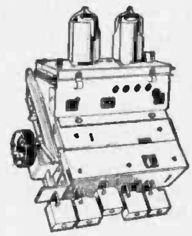
CYLDON PUSH BUTTON T.V. TUNER



A compact T.V. tuner of superb design adjustable to any channel. 5 push buttons (on/off and 4 channels). Brand new. Complete with valves (30C15 & 30L15).

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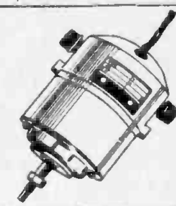

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HARVERSONS TRANSISTOR TUNER

At last a compact transistor tuner! Although primarily designed as the partner to our transistor amplifier, this tuner will give excellent results with any good amplifier. We are confident that you will agree that the T.R.F. circuit employed gives a comparable performance to a superhet. Complete Kit including ferrite rod aerial, midget volume control, 2 diodes and 1 transistor, printed circuit board ($2\frac{1}{4}$ x $2\frac{1}{4}$in.) and instructions.

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T.S.L. Stick Mike............22/6
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8 x 5 inch 3Ω Speaker.
Large Pot..........12/6, P.P. 1/6

HI/FI STEREO MONAURAL AMPLIFIER

A 5 valve HI/FI amplifier with switched stereo/monaural operation. Output 3 watts per channel, provision for bass and treble speakers on each. Volume and tone controls fitted both channels. All housed in stylish blue/grey metal case, with gold finished knobs and trimmings. **£9.19.6** Plus 4/6 P. & P.

WHARFEDALE 12in. HI-FI FULL FREQUENCY SPEAKER

Mdl. SUPER 12/FS/AL. Aluminium voice coil, 15 ohms, 17,000 lines, foam plastic suspension, 15-30 watts peak. Brand new in maker's cartons. List £17.10.0.

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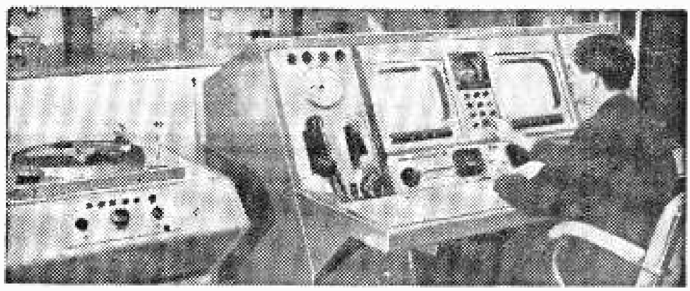

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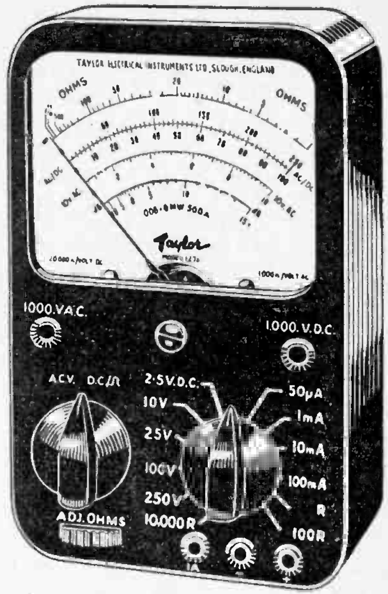
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250V
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1mA
10mA
100mA
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R.S.C. (Manchester) Ltd. LIVERPOOL, LEEDS, BRADFORD, MANCHESTER

R.S.C. A12 STEREOPHONIC AMPLIFIER KIT

A complete set of parts to construct a good quality Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Outputs for matched 2-3 ohm speakers. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and point-to-point wiring diagrams supplied.

4 Gns. Carr. and pkg. 5/-

Jason FMT1. VHF/FM Radio Tuner design. Total cost of parts including valves. Tuning dial, Escutcheon, etc. £6.19.6.

STEREO EQUIPMENT OFFER—Comprising A12 Kit, 2 matched 8in. L/Speakers, and Acos T/O Stereo head suitable most pickups. **£6.19.6** Carr. 7/6.

PICK-UP ARMS complete with Hi-Fi turnover crystal head. Acos GP54. Limited number brand new, perfect at approx. half price. Only 29/11.

ACOS CRYSTAL MICROPHONES. Mic40 stand or desk. Listed 45/-. Only 27/9. 39-1 Stick type. Listed 5 gns. Only 39/6.

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

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response ±3 db. 30-30,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used EF86, EF86, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE.** The unit is designed for **CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS**, etc. For use with Electronic **ORGAN, GUITAR, STRING BASS** etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for a **RADIO FEEDER UNIT.** An extra input with associated vol. control is provided so that two separate inputs such as Gram. and 'Mike' can be mixed. Amplifier operates on 200-250 v. 50 c/cs. A.C. Mains and has output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required perforated cover with carrying handles can be supplied for 19/9. The amplifier can be supplied, factory built with EL34 output valves and 12 months guarantee, for 14 Gns.

11 Gns. Carr. 10/-

TERMS: DEPOSIT 33/9 and 9 monthly payments of 33/9.

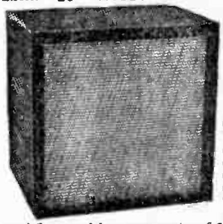
FULL RANGE OF LINEAR AMPLIFIERS ALWAYS IN STOCK.

COLLARO JUNIOR 4-speed single player units and Hi-Fi crystal pick-up with turn-over head. £3.19.6.

B.S.R. UA8 4-SPEED AUTO-CHANGERS with Hi-fi turnover pick-up head. £6.19.6. Carr. 5/-.

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

12in. 10 WATT HIGH QUALITY LOUD-SPEAKER IN POLISHED WALNUT FINISHED CABINET



Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4.19.6 Carr. 5/-. Terms: Deposit 11/3 and 8 monthly payments of 11/3.

12in. 20 WATT HI-FI LOUDSPEAKERS IN CABINETS. Size 18 x 18 x 10in. Finish as above. Terms: Deposit 17/9 and 9 monthly payments of 17/9. Only £7.19.6. Carr. 8/6.

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

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

R.S.C. PORTABLE GUITAR AMPLIFIERS (For 200-250v. A.C. Mains)

Junior 5 watts High Quality output. Separate Bass and Treble "Cut" and "Boost" controls. Sensitivity 15 m.v., Twin inputs. High Flux 8in. Loudspeaker "built-in". Handsome, strongly made Cabinet (size approx. 14 x 14 x 7in.) finished in attractive and durable policrome, and fitted carrying handle. Terms: Deposit £1 and 9 monthly payments of £1. **£8.19.6** Carr. 7/6

Senior 10 watts High Fidelity output Separate Bass and Treble "Cut" and "Boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two loudspeakers are incorporated, a high Flux 12in. for Bass notes and a 7 x 4 m. elliptical for Treble. Cabinet is well made and finished as Junior model. Size approx. 18 x 18 x 9in. H.P. Terms. Deposit 34/9 and 9 monthly payments of 34/9. **15 Gns.** Carr. 10/-.

Super Hi-Fi 15 Watt. All facilities as 10 watt. Cabinet size 20 x 15 x 13ins. Terms: Deposit £2.11.6 and nine monthly payments of 51/6. 22 gns. Carr. 12/6.

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

STANDARD MODEL. As above but for 12in. speakers. Size 20 x 15 x 13in. Especially recommended for Plessey Dual Concentric Speaker. £5.19.6. Suitable legs with brass ferrules, 25/- per set of 4.

PLESSEY DUAL CONCENTRIC 12in. 15 ohms HIGH FIDELITY SPEAKER (12,000 lines) with built-in tweeter (completely separate elliptical speaker with choke, condensers, etc.) providing extraordinarily realistic reproduction when used with our A11 or similar amplifier. Rated 10 watts. Price only £5.19.6.

P.M. SPEAKERS. 2-3 ohm. 2½in. Perdio 21/9. 5in., 17/9. 6½in., 16/9. 8in., 19/9. 8 x 5in. 25/9. 10in. 26/9. 10 x 6in. 29/9. 12in. 29/11. 10in. W.B. "Stentorian" 3 or 15 ohms type HF1012 10 watts, hi-fidelity type. Recommended for use with our A11 Amplifier. £4.10.9. 12in. R.A. 3 ohms 10 watts (12,000 lines), 59/6.

TWEETERS. Plessey 3Ω 19/9, 15Ω 25/9.

HI-FI CRYSTAL PICK-UP HEADS. (Turnover type with sapphire stylus.) Acos. Standard replacement for Garrard and B.S.R. B.S.R. Ful-fi. Garrard GC2, 19/9. Acos. Stereo-Monaural 49/9.

R.S.C. EQUIPMENT CABINET. Dimensions and outer appearance identical with Standard Bass Reflex Cabinet. Top hinged. Bass board adjustable. Will take Tape Deck or Player Unit, and Amplifier plus F.M. or A.M./F.M. Unit. Only 6 gns.

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

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces battery supplying 1.4 v. and 90 v. where A.C. mains 200-250v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types.

Complete kit with diagrams, 39/9, or ready to use, 46/9.

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

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched Negative feedback equalisation. Positions for Record 1⅞in. 3¾in., 7½in. and Playback, EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9 gns. S.A.E. for leaflet.

TERMS: C.W.O. or C.O.D. No C.O.D. under £1. Post 1/9 extra under £2. 3/3 extra under £5. Open 9 to 6. Weds. until 1 p.m., except Manchester open all week. Trade supplied. S.A.E. with all enquiries.

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This 272-page book is the perfect companion to your servicing set. Covers basic circuitry fault-finding, interference, alignment, valves, etc. Presented with every set of Newnes RADIO & TV SERVICING.

Please send me Newnes RADIO AND TELEVISION SERVICING (in 7 Volumes) and TV ENG. POCKET BOOK without obligation to purchase. I will return them in 8 days or send 16/- deposit 8 days after delivery, then twenty monthly subscriptions of 16/-, paying £16. 16s. in all. Cash in 8 days is £16.

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Transistorised Stethoscope

Trace signal right through: Radio, T.V., Tape amplifier, Hi-Fi, etc.—simplest way to fault-find—carry it like a fountain pen—all parts including transistor barrel crystal, everything except battery, 12/6 plus 1/6, data included or separately 1/6. Or complete with deaf aid type earphone, 20/-.

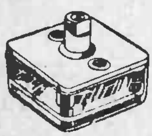
Speaker Bargain

12in. Hi-fidelity loudspeaker. High flux, permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price 32/6, plus 3/6 post and insurance.

Hi-Fi Snip Infinite Wall Baffle

Nicely Veneered and polished. Corner fitting (attaches to picture rail). Takes up no floorspace. Gives really fantastic results with only low-priced 8in. speaker fitted for tweeter. Only 45/- each, carriage and insurance 3/6.

Smallest Possible 2-gang

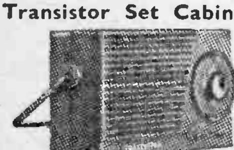


With built in trimmers, polystyrene cased, size only 1 x 1 x 7/16in., price 17/6. Smallest IF and oscillator to match, 21/-. P.P. input and P.P. output transformers, 12/6. Circuit diagram free with any of above.

Building A Scope?

3in. oscilloscope tube. American made type No. 3FP7, 6.3 v. 0.6 amp. heater, electrostatic deflection, brand new and guaranteed with circuit diagram of scope, 15/- each, plus 1/6 post and insurance.

Transistor Set Cabinet



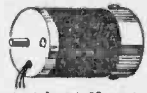
Very modern cream cabinet, size 5½ x 3 x 1½in. with chrome handle, tuning knob and scale. Price 7/6, plus 1/6 postage and packing.

BATTERY CHARGER BARGAIN

Components Would Cost More

Carr Battery Charger—ready-made high output battery charger in stove enamelled sheet steel louvred case. New, complete and ready to work. Rated at 12 v. 5 amps. and variable rate selector for trickle charging, also a meter to show charging rate. Suitable for 230/250 A.C. mains. Special snip price of 65/-, plus 3/6 post and ins.

MOTOR SNIP

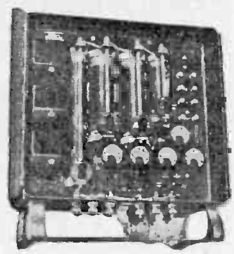


Miniature motor 2½in. long x 1½in. diameter, laminated poles and armature, separate winding for reversing. Operates off 20-30 v. D.C. or off A.C. mains through stepdown transformer. Original cost at least £3 each. Snip price for one month only 8/6, plus 1/6 postage and insurance.

PRACTICAL WIRELESS "TUTOR"

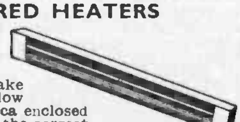
Stage 1 all components except headphones..	20/-
Stage 2 all components	15/-
Stage 3 all components	19/-
Stage 4 all components	9/-
Headphones, high resistance	15/-

CHARGING SWITCHBOARDS



Type A. 550 w. 18 v.—contains three reverse current relays, one voltmeter rated 25 v. f.s.d., one main ammeter rated 40 amps. f.s.d., one secondary ammeter rated 15 amps. f.s.d. and two secondary meters rated 20 amps. f.s.d., one 2 ohm variable resistor, one 11 ohm variable resistor and two 1.2 ohm variable resistors. Complete in metal case 2ft. 6in. x 2ft. 8in. approx. Price £2.15.0, carriage and ins. 15/-.
Type B. 1260 w. 50 v., 0.12 amps.—contains one 14 ohm variable resistor and four 1 ohm variable resistors, one main ammeter rated at 40 amps. f.s.d., four secondary meters rated at 20 amps. f.s.d. and one voltmeter rated at 50 volts, and two reverse current relays. Complete in metal case—size approximately 2ft. 6 in. x 2ft. 8in. Price £4.15.0, carriage 15/-.
Connecting Leads for these switchboards with Nifam plugs 30/- each.

INFRA-RED HEATERS



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—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and instructions 15/6, plus 2/6 post and insurance.

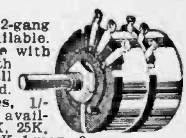
THIS MONTH'S SNIP

A fully-built, tested and ready to work pocket radio using six semi-conductors and tuning over the long and medium wave bands. An excellent performer and a real bargain at £5.15.0, post free.
Seven days approval. Send for one today. If you are not 100% pleased then return it within seven days and your money will be refunded.

Miniature Earphones

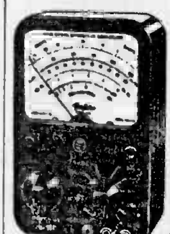
For Transistor Circuits or Deaf Aid Very lightweight and easy to wear, cord almost invisible, good quality production of music and voice, complete with miniature plug and socket, ready to use—correct impedance OK for red spot and similar transistors. Crystal and Magnetic, 9/-. Post and Insurance 1/-.

Morganite Potentiometers



Single and 2-gang types available, standard size with good length spindle, all new and boxed. **Single types,** 1/- each, values available: 5K, 10K, 25K, 50K, 100K, 250K, 1 meg., 2 meg. **Gang type** 3/- each—values available: 5K±5K, 100K±100K ½ meg. ± ½ meg. 2 meg. ±2 meg.

The Taylor Meter Model 127A



A pocket size meter but with a big scale and a sensitivity of 20,000 ohms per volt D.C., therefore an ideal unit for television servicing—robustly made and complete with leads and prods—20 ranges as follows: D.C. current 50 microamps. to 1 amp. D.C. voltages—0-1,000 volt in seven ranges (25 kV) with external probe, optional extra. Volts A.C.—0-2,500 in six ranges. Ohms—0.20 meg. ohm in three ranges (self-controlled). Self-contained, 3½in. movement. Price £10 or 10/- deposit and 23 fortnightly payments of 10/-. Non-callers add 5/- carriage and insurance.

"Dim and Full" Switch

Particularly useful for controlling photoflood lamps which have only a short life at full brilliance. This switch has three positions; the first position puts two lamps in series at half brilliance for setting up, the second position is off and the third position full brilliance for the operation shots. Also useful for controlling night lights, heaters, etc., etc. Price 3/9 each, post 9d. Circuit diagram included.
Ditto but without the off position, i.e. d.p.d.t., 10 amp. 2/9.

Miniature Microphone

American made. Dynamic type, real bargain at 2/6, plus 6d. postage.

Transistor Amplifiers

2 x CX71's direct coupled cascade drive to 2 precision matched OC74's in Class B push-pull provide up to 1 W undistorted output from 5 mV. in at 1.5 K-ohm Frequency response, 60-16,000 c/s ± dB. Overall size 3 x 2.2 x 1.2in. 92/6. Post and ins. 2/6.
750 M/WATT AMPLIFIER. Similar specification, £2.2.6.

SUB-MINIATURE COMPONENTS

1. **Ferrite aerial** with Long and Medium Wave Coils, 4½in. long, for pocket superhet, complete with circuit showing component values, etc., 7/6.
2. **Ferrite aerial,** as above, but ⅜in. diameter, 8in. long, for table model receiver or portable. 10/6.
3. **Three I.F. Transformers** with oscillator coil and circuit details to work with item 1. 19/6.
4. **Three I.F. Coils and oscillator** to work with item 2. 23/6.
5. **Smallest possible electrolytics.** 1MFD, 2MFD, 4MFD, 6MFD, 8MFD, 10MFD, 20MFD, 30MFD, 50MFD, 100MFD, 200MFD, all 1/9 each.
6. **Smallest ¼ watt resistors,** all 10 per cent values. 5d. each.
7. **Miniature condensers,** .1, 1/-; .05, .04, .02, .01, all 8d. values below this 7d.
8. **Miniature slide switch** double pole change over, 2/6.
9. **Edgewise volume controls,** 2K, 5K, 10K and 20K, 2/6 each.
10. **Small edgewise controls** with switch, 2K, 5K, 10K and 20K, 4/9 each.
11. **Red Spot Transistors,** tested and suitable all A.F. applications. 2/6.
12. **White Spot Transistors** tested and suitable as I.F. or mixer, 3/6.
13. **Set of 6 Mullard transistors** for superhet in original packets, fully guaranteed, comprising OC44, OC45, OC81D and matched pair OC81. £2 the set.
14. **Special 500 sub-miniature diodes,** 1/- each.
15. **Surface Barrier transistors,** 5-10 Mc/s, 6/6 each; 10-15 Mc/s, 8/- each; 20-30 Mc/s, 9/- each; 40-50 Mc/s, 15/- each.
16. **Push-Pull Driver and Push-Pull output transformers** for pocket superhets, 150 mW, 10/- pair; 400 mW, 15/- pair; 750 mW (driver only, no output needed), 8/6, all complete with circuit details.
17. **Smallest Tuning Condenser,** size approx. ⅜in. sq., 165pF and 65pF, with trimmers, 17/6 each.
18. **Oscillator coil** to suit the above, 6/-.
19. **Three I.F.s,** 455 k/c sub-miniature to suit items 17 and 18, 18/- the set.
20. **Jackson 00 2-gang tuning condensers,** 208pF plus 176pM, spindle tapped 6BA with trimmers, 10/6, less trimmers 9/6.
21. **Tuning condensers** for items 1 and 3, 9/6.
22. **Tuning condensers** for items 2 and 4, 10/6.
23. **Printed circuit** for items 1 and 3, 6/6.
24. **Printed circuit** for items 2 and 4, 7/6.
25. **2½in. speaker,** 3 ohm, 19/6; 80 ohm, 19/6.
26. **3in. speaker,** 3 ohm, 18/6; 80 ohm, 18/6.
27. **5in. speaker,** 3 ohm, 18/6; 35 ohm Hi flux, 19/6; 35 ohm Super Hi flux, 22/6.
28. **Elliptical speaker,** 7 x 4, 3 ohm, 19/6; 35 ohm, 19/6.
29. **Battery connectors,** large, 1/- pair; miniature, 1/- pair.

NOW THE MARK IV

Pocket '5' Transistor Radio

Read these Testimonials

D. A. Hilton, Leigh, Lancs.
"I received Pocket 4 on Christmas Day. I made it up on Boxing Day and I am very pleased with the results. It brings in local stations and many foreign stations including Luxembourg at good strength. I am 13 years old".

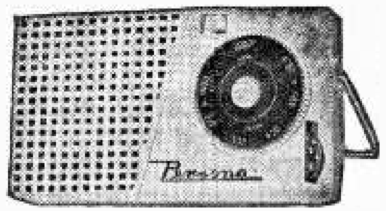
Mr. J. Bell, Wolverhampton.
"I am writing to express my satisfaction at the standard of your kit for your Pocket 4 Transistor set and also to state that it has come up to my expectations in regard to performance.

Mr. R. Belt, Newcastle-on-Tyne.
"I have built your Pocket 5 Transistor set. I am very pleased with it."

Mr. F. Jackson, Ickenham, Middx.
"I have built the Pocket 4 and am more than pleased with the results."

Mr. G. Bamford, Ramsgate.
"I find this set even better than you claim it to be and most certainly up to your usual standard of quality. I feel that nobody could fail to build it and get results. Even the first-time-ever novice, as your circuit diagrams and instructions are so clear and precise.

Mr. A. J. Simmonds, Welling, Kent.
"I purchased from you a week ago the Pocket 4 Transistor Kit. I put it together last night in 1½ hours, on switching on the set I was right on Radio Luxembourg. I must say thank you because not only has the set a very attractive appearance, it also behaves fantastically."



Our famous Pocket "4" which is doing yeoman service all over the country has been modified and improved to make it an even better receiver. The new features include:—

- **New elegant dial graduated for Long and Medium Waves.**
- **Switched Long and Medium Waves.**
- Slide switch on/off control.
- Printed circuit.
- Ferrite Rod Aerial.
- Improved reaction circuit.
- Positive spindle coupling to tuner.
- Battery containers.

The Pocket "5" of course retains its original r.f. circuit which means still no aerial or earth needed.

The Pocket "5" Mark IV uses 3 transistors, crystal diode, miniature loud speaker and has all the above refinements, complete in case as illustrated (less motif) 52/6, battery 10d., post and insurance 2/6. Motif 2/-.

Pocket "6" as Pocket "5", but **with Moving Coil** Speaker and Q.P.P. output **stage 95/-.**

Seven days approval.
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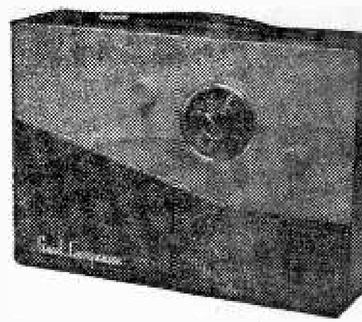

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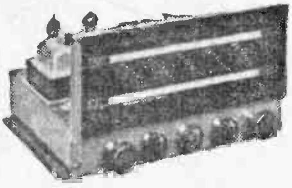

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6J5	5/6	35L6	9/6	EL32	5/6	UBC41	9/6
6J6	5/6	35Z4	7/6	EL41	9/6	UCH42	9/6
6J7G	6/6	80	9/6	EL84	8/6	UF41	9/6
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For Cathode Ray Tubes having heater cathode short circuit and for C.R. Tubes with falling emission. full instructions supplied.

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HEATER TRANS. 6.3 v, 1½ amp. ..	7/6
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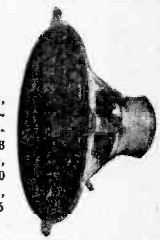

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Practical Wireless

VOL. XXXVII No. 657 NOVEMBER, 1961

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Contents

Our Free Blueprint

AS promised last month, we present free with every copy of this month's issue yet another of our new series of blueprints. As may be seen from the illustration on our cover, this amplifier is built on one of the standard 1½in. group boards and it is therefore neat, compact, and very easy to build. Many readers who saw details of this form of construction for the first time in our October issue have written to say how they like this method of building apparatus, and prefer it to the customary assembly using a metal chassis. Naturally, with certain larger types of equipment, metal chassis will still have to be employed, but there are very many instances in which the group board may be used as a basis, and, apart from the ease of handling during construction, the open type of assembly greatly facilitates construction—as a matter of interest, an experienced constructor was given the parts for the "Mini-Amp" and the blueprint and the time he took to make up this amplifier was a little over half an hour.

Next month, there will be another of these free gift blueprints, which will deal with a superhet receiver, and the amplifier described in this issue will constitute the output stages. This superhet will be constructed in two units on two 18-way group boards of the same type as those used for the "Tutor" and the "Mini-Amp". One group board will form the frequency-changer stage (using one transistor) and the other the I.F. amplifier (using two transistors). The two units (together with the "Mini-Amp") will form a sensitive, 7-transistor superhet, with its own internal aerial, equal in performance to many commercial designs. Order your copy of the December issue now; the demand will be great.

Multimeter Blueprint

With every copy of the October issue of our companion journal *Practical Television* is a free gift blueprint for a comprehensive multimeter—the latest *Practical Television* design. This blueprint is the result of several months' work, and, although this design has been described in *Practical Television* it should not be thought that it is only suitable for the television enthusiast; in fact, the multimeter is equal in performance to many commercial instruments and will be found worthwhile on any experimenter's work bench, whether his main interest lies in television, radio, or electronics.

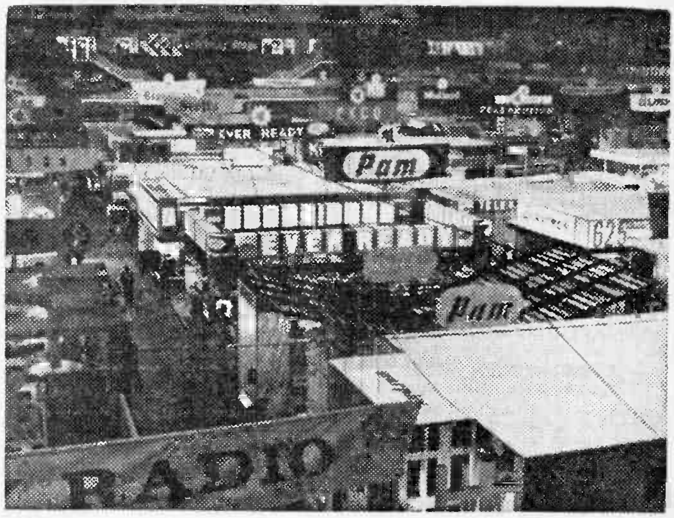
A Film Show

ANOTHER film show has been arranged in collaboration with Mullard Ltd. It will be held at Caxton Hall, Westminster, and readers are invited to send for their free tickets which are now available from these offices. The films will be shown on Friday, February 2nd, 1962, and the programme will begin at 7.30 p.m. When applying for tickets, enclose a stamped addressed envelope (at least 3½in. x 6in.). Mark your envelope "Caxton Hall" in the top left-hand corner.

Our next issue, dated December, will be published on November 7th,

Round the World of Wireless

POTENTIAL AND CURRENT NEWS



A general view of this year's Radio Show, at Earls Court, London.

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of July, 1961, in respect of wireless receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region	*Total*
London	687,209
Home Counties	647,133
Midland	471,460
North Eastern	507,129
North Western	437,197
South Western	385,019
Wales and Border Counties	224,110
Total England and Wales	3,359,265
Scotland	374,562
Northern Ireland	116,560
Grand Total	3,850,387

Record Radio Show

THE 1961 Radio Show, which ended on September 2nd, had attendances averaging nearly 40,000 a day; the highest since it moved to Earls Court from Olympia in 1951. Most manufacturers were well pleased with the amount of business transacted, and several claim it to be the best show for five years.

The next Radio Show will be held at Earls Court, London, from August 22nd to September 1st, 1962.

Radio Bournemouth

DURING September, the BBC held an exercise in local broadcasting, when Radio Bournemouth went "on the air". This exercise was spread over seven days—September 5th to 11th inclusive.

Each day there were four or five hours of local programmes. The many aspects of local interest which were covered, were given as bulletins, talks, interviews and discussions. Among others, items on local government, sport, voluntary organisations and well-known local personalities were of particular interest to the people of Bournemouth, Poole, and Christchurch.

Although the station was in operation continuously throughout each day from 6.30 a.m. until late evening, not every minute of the day was filled with local material. In between local items, the station manager linked his station with one of the BBC's networks, to draw programmes from the Light Programme or Home Service.

New Communication System

A NEW communication system has been installed in the 24 bungalows and the flat of the resident warden on the Church View Estate, Eastwood, Nottinghamshire. Each has been equipped with a Portaphone—a unit which when plugged into an electric mains socket forms a communications system with any other similar unit plugged into the same circuit.

The Portaphone is made by Labgear Ltd., a member of the Pye Group, and its use in this system will ensure that the occupants of Church View Estate — mostly elderly people living alone—are able to contact the warden immediately in any emergency.

The system operates free of any interconnecting cables as the speech travels along the electricity mains wiring.

Iraqi Contract

A CONTRACT to the value of approximately £100,000 has been signed by the Iraqi Port Authority and Pye-Telecommunications Limited of Cambridge for the supply and installation of several VHF and UHF radiotelephone networks.

VHF telephone services are to be installed at Margil for Basrah airport; the Ports' ambulance, fire-fighting units, electricity distribution department and the maritime services. Four other VHF communication systems are to be supplied for the maritime services at Al-Wasillah, Fao, the Deep Water Berth and Um Qasir. A UHF telephone link between Fao and the Deep Water Berth and a VHF telephone service aboard the Ports' maritime vessels is also included in the contract.

It is anticipated that the entire scheme will be fully operational early in 1962.

German Radio and TV Show

BETWEEN August 25th and September 3rd this year the German Radio, Television and Phono Exhibition was held in Berlin.

One hundred and fifty-eight exhibitors had on show equipment appertaining to all branches of the radio, television and record industry.

Telephone Exchange for Infirmary

A NEW telephone exchange for the Radcliffe Infirmary, Oxford, one of Britain's leading teaching hospitals, is to be supplied by Associated Electrical Industries Ltd. It is to be installed by early 1962 by the Private Telephone Department of AEI Telecommunications Division.

As a result of the installation of this up-to-date exchange, a considerable economy in the number of telephone instruments needed will be achieved.

The exchange will cater for 550 telephones in the Infirmary, and their users will be able to call each other by dialling, and call outside telephone subscribers through the local GPO exchange from which there will be 35 public exchange lines. Oxford now has Subscriber Trunk Dialling and direct dialling of trunk calls will be possible from certain extensions.

Three operators will staff a manual switchboard suite to handle incoming calls and provide service where a personal agency is necessary. The switchboard will be of the new AEI cordless type where, instead of the familiar plugs and cords, keyswitches are used to set up the call; and where the normal dial is superseded by press buttons which operate an automatic dialling unit known as a keysender.

New Export Company

A NEW subsidiary company of E. K. Cole Ltd., has recently been formed—Ekco Export Ltd. The new company will handle the export of radio, television and car radio receivers, electric heating and plastics products produced by the Ekco Group and will be responsible for maintaining and expanding overseas manufacturing arrangements.

Mr. T. C. Cleveland, formerly Export Manager of E. K. Cole Ltd. is Director and General Manager of Ekco Export Ltd. Other directors are: Mr. W. M. York (chairman), Mr. J. Corbishley and Mr. D. J. Cole.

The new company will operate from the main Ekco works at Southend-on-Sea and a Personal Exports Department and showroom for radio and television receivers will be opened in London at 41-47 Old Street, E.C.1.

New Factory in Crawley

THE commercial divisions and most of the productions staff of Mullard Equipment Ltd. moved to their new factory at Crawley New Town, Sussex, on September 4th.

About 600 staff moved to the new plant. In addition, staff recruitment has been going on at Crawley for some time, and it is hoped that up to 200 will be engaged by the end of this year.

The new 134,000sq.ft plant is on a site of 17 acres on which expansions are planned to be made in the future. The new buildings are constructed so that they can conveniently form part of a larger unit.

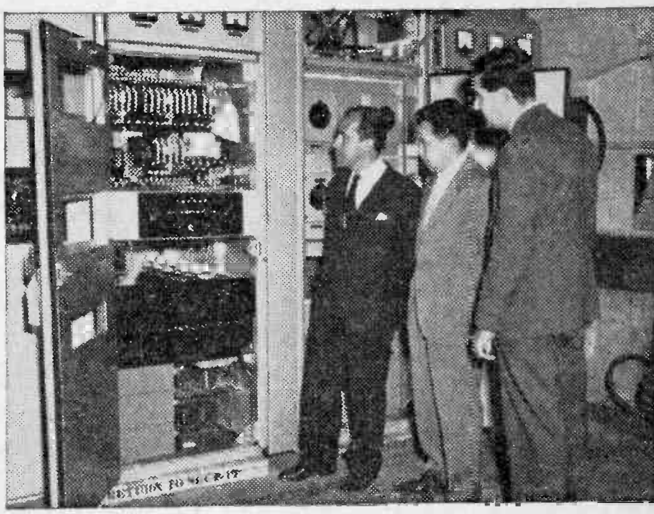
Research Scholarships

EACH year the BBC awards research scholarships (valued at £500 per annum) to university graduates in electrical engineering or physics, giving them the opportunity to work for a higher degree at any university in the United Kingdom, not necessarily the one from which they graduated. The scholarships are normally for two years in the first instance, with the possibility of extension in suitable cases where this is required. The scholarships are limited to male subjects of the United Kingdom, and the only condition applying to the subject for research is that it must be in those fields of telecommunications or physics which have an application to sound or television broadcasting.

This year three scholarships have been awarded—one for one year and two for two years. The scholarship for one year has been awarded to Mr. J. Elliott who graduated at Imperial College, University of London, with first-class honours in electrical engineering in 1957.

One scholarship for two years has been awarded to Mr. K. L. Hughes who graduated from Birmingham University with first-class honours in electrical engineering.

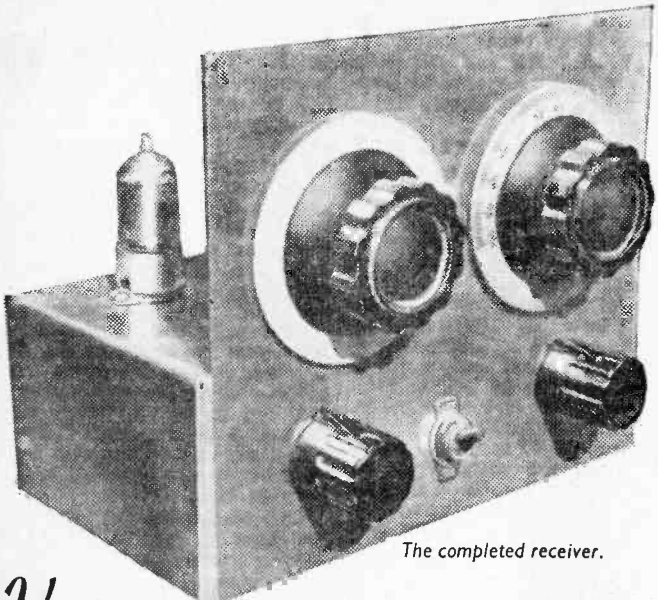
The second two-year scholarship has been awarded to Mr. B. J. Tilley who has graduated with second-class honours in electrical engineering from University College of Swansea.



Spending a few days at Marconi's, Chelmsford, recently, in discussion with Communications Division, were two senior engineers from Empresa Nacional de Telecomunicaciones, Bogota, Colombia—Senor Dn. I. Ancines (left) and Senor Dn. J. A. Velex (centre). They are pictured here inspecting a 10kW H.F. ISB Transmitter type HS 71 in the test department at the company's Chelmsford works with B. W. Bardwell of Communications Division.

THE P.W.

A SENSITIVE SHORT-WAVE RECEIVER COVERING 10m TO 60m IN TWO RANGES



The completed receiver.

VERY long range reception is possible with a short wave 1-valver, and the addition of an amplifying stage provides a useful increase in volume. The circuit described here uses two 1T4 valves, but any equivalents, such as the CV785, W17, or DF91 are equally suitable. The two wavebands permit tuning from approximately 10m to 60m, and thus cover the most popular S.W. bands.

Bandspread Tuning

Bandspread tuning is fitted, and allows accurate logging of transmissions. This method of tuning does not make construction difficult, as no reduction drives are needed. The circuit is shown in Fig. 1, and the 150pF condenser is adjusted to the required band, which is then covered by means of the 15pF condenser. The small capacity of the latter makes tuning easy, and dial readings can be noted down so that they can be returned to when necessary. Two coils are fitted, the required coil being selected by means of the 2-way switch.

For high tension, 45V or more will be needed. A 45V supply can if necessary be obtained by wiring two 22½V batteries in series. Less than 45V is not recommended, as insufficient reaction is available. A standard 67½V battery may also be used, and would do very well.

The valve filaments require 1·4V and this can be obtained from a 1½V battery, as used in portables. Alternatively, dry cells such as found in torch and lamp batteries may be used, provided they are wired in parallel. With such batteries, the zinc case is negative. Cells must not be wired in series, nor must more than 1½V be used. The filament consumption is only 0·1A.

Components

There is reasonable latitude in the selection of components, so items to hand may possibly be used. For bandspreading, a condenser of about 10pF to 20pF is satisfactory. Some S.W. condensers can easily have plates removed, to reduce the capacity. For bandsetting, 100pF or 200pF could be fitted, if to hand, with some modification in the band coverage.

The H.F. choke must be capable of working over the frequencies tuned, so a reliable S.W. or all-wave component is needed. As the insulation of the 0·01μF coupling condenser must be very good,

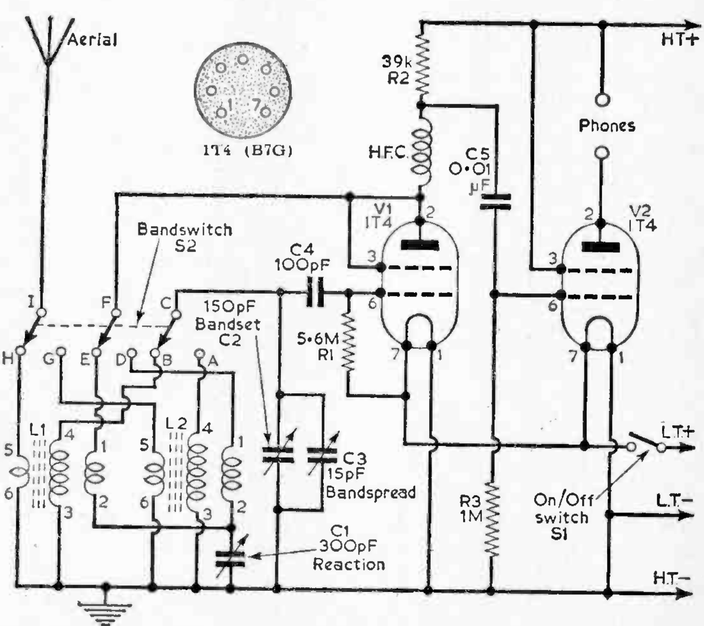


Fig. 1.—The circuit diagram of the receiver.

Beginners' S.W. Two

By F. G. Rayer

a mica condenser, preferably new, is best here. Leakage would cause a positive voltage to reach the amplifier valve grid.

It is worth noting that the receiver can be constructed as a 1-valver, merely by omitting the 39k resistor, 0·01μF condenser, 1M resistor, and second 1T4 valve. Phones are then connected from the H.F. choke to H.T. positive. Quite good results may be obtained with the single valve.

Chassis Preparation

Chassis and panel should be drilled before mounting any parts. A chassis about 7in. x 4in. x 2½in. deep will be convenient, but some change in

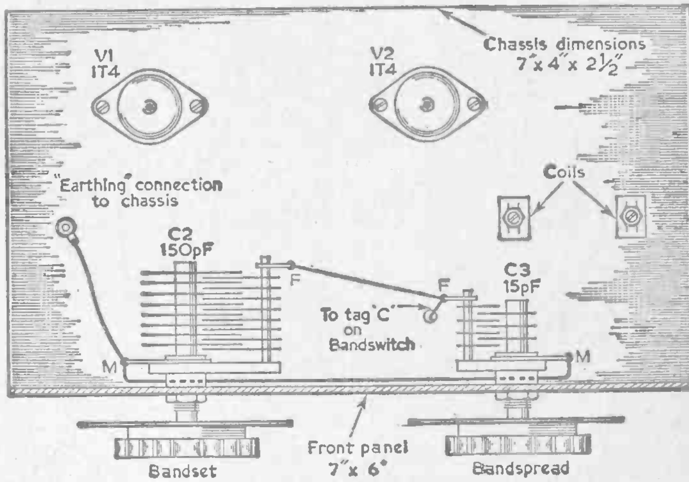


Fig. 2.—The above-chassis wiring of the set.

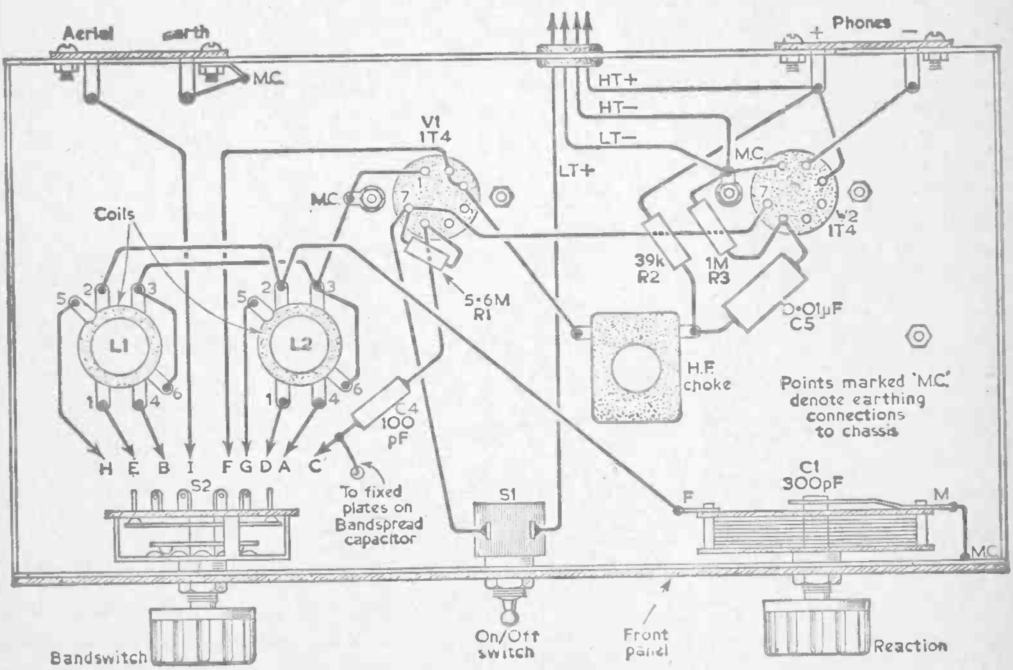


Fig. 3.—The underchassis wiring.

size will not affect performance. The panel can be about 7in. x 6in.

Fig. 2 shows the top of the chassis. Holes for the B7G holders can most readily be made with a chassis cutter or valveholder punch. If these are not available, a ring of small holes may be drilled, the piece broken away, and the hole smoothed with a round or half round file.

Holes for the 150pF and 15pF variable condensers should also be drilled. The three holes near the bottom of the panel are then marked and drilled. The panel is then positioned against the front runner of the chassis, and the location of the holes is marked. The chassis is then drilled, so that the two switches and reaction condenser will hold the panel and chassis together.

At the rear of the chassis, drill or punch clearance holes for the two socket strips. Ensure that aerial and phone sockets will be well clear of the metal. Holes are also made to take the coils, but these are best left off until later.

Wiring

Fig. 3 shows the wiring and component layout under the chassis. The three points marked "M.C." consist of tags bolted to the chassis, so that leads may be soldered to them. Place the valveholders so that the sockets come approximately as in Fig. 3.

Soldering will cause no difficulty if the iron is really hot, and tags and leads are perfectly clean. Use a cored solder, as sold for radio work. Do not carry solder to the joint on the iron. Instead, apply iron and solder to the joint, so that the flux can take effect where required.

The moving plates tags of both 150pF and 15pF condensers are wired together, as in Fig. 2, and the lead soldered to a soldering tag which is bolted to the top of the chassis. The fixed plates of these variable condensers are similarly joined, and a lead goes through the chassis to the 100pF fixed condenser, and switch (tag C in the switch diagram).

Use flex for battery connections, and fit suitable plugs, or identify the leads so that the filament circuit will not be taken to the H.T. battery in error.

Most of the wiring in Fig. 3 can be done first, the coils being left until last. All leads in the coil, switch, and tuned circuit section should be reasonably short and direct. With the reaction condenser, the moving plates tag goes to chassis, and the fixed plates tag to tags 2 of the coils.

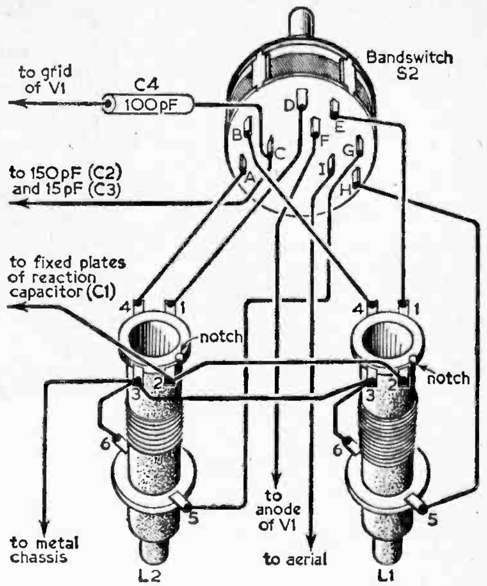


Fig. 4.—The wiring of the coils and the switch S1.

Coil Connections

When the receiver is viewed from underneath and behind, the coil and switch connections will appear as in Fig. 4. Note that each coil has a notch, for tag identification.

Wire tags 6 to tags 3 before mounting the coils, and also solder leads a few inches long to tags 5. The higher wavelength coil (which has most turns) is placed at the right, in Fig. 4. The coils can then be inserted, and secured with their clips. Ensure that tags 5 and 6 cannot touch the chassis.

The remainder of the wiring, as shown in Fig. 4, can then be completed. Connections should be short and direct, but clear of each other. The same identification letters are used in Figs. 1, 3 and 4, and no difficulty is likely to arise in wiring up the switch correctly.

Dials and Knobs

Fairly large knobs are best for 150pF and 15pF condensers, but they need not necessarily be of the type illustrated. Scales (0-100 or 0-180) should be fitted to knobs or panel, so that readings can be noted.

For reaction, a very small knob makes operation a little difficult, as the reaction setting is critical, with weak signals. The band selection switch can be of the same type, to match.

Phones should be of the usual medium or high impedance type, and low impedance surplus phones are likely to be unsatisfactory.

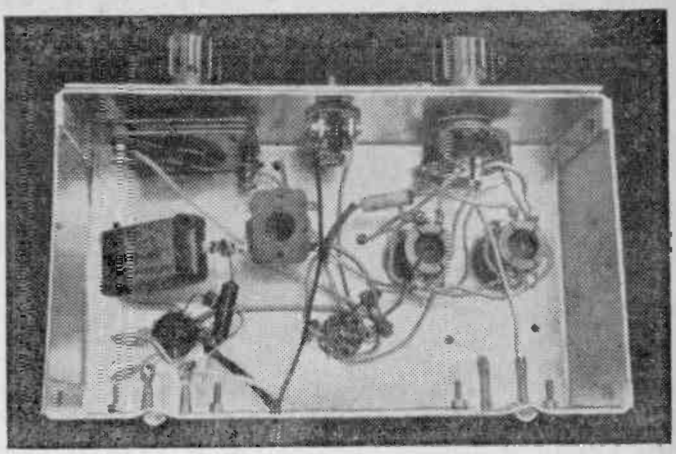
If an earth is available, it is taken to a plug which is inserted in the socket marked in Fig. 3. An earth lead may be connected to an

COMPONENTS LIST

Two 1T4 valves
Two B7G valveholders
Fixed condensers: 100pF and 0·01 μF (mica)
Resistors: 39k, 1M, 5·6M
3-pole, 2-way switch
300pF reaction condenser
SWQ1 and SWQ2 coils (Osmor)
H.F. choke (Osmor)
150pF and 15pF or similar short wave tuning condensers
Two 2¾in. diameter or similar dials and knobs
Two 1 in. knobs
On/off switch
Two double socket strips
Chassis approximately 7in. x 4in. x 2½in. deep
Aluminium panel approximately 7in x 6in.

earth spike, or water pipe, or any similar metal object in contact with the ground. The lead should not be connected to gas pipes, hot water pipes, or mains earth circuits.

For general purposes the aerial can be a single uncut length of insulated wire, forming both aerial and lead-in. The actual length which can be erected will depend on circumstances, and may be anything from about 20ft to 45ft or so. The wire and downlead should be as far from walls and other earthed objects as possible. One or two aerial insulators are used at each suspension point. Reception of distant stations is, of course, possible with an indoor aerial, but volume will be reduced. It is thus worthwhile trying to fit up a reasonably effective aerial.

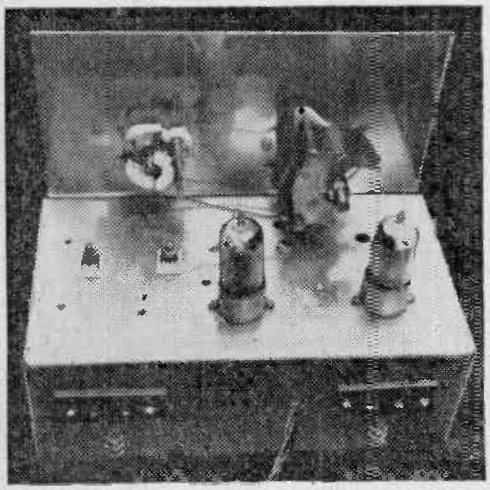


The underchassis wiring.

If a really long aerial is available, it can be used. If it is found that reaction is difficult to obtain on some frequencies, a small fixed or pre-set condenser should be included in series with the lead-in, at the aerial socket. A capacity of about 50pF is generally satisfactory. If a pre-set is used, adjust it for best results.

Using the Receiver

If the constructor is not familiar with S.W. reception, it should be remembered that the results obtained on the various bands depend on the time



Rear view of the set.

of day, and other conditions. Most broadcast stations use wavelengths near each other, and are thus found congregated into bands, such as the 49, 41, 31, 25 and 19m bands. Morse and various other transmissions will be heard between these bands.

The actual tuning range of each coil, and also reaction, will be modified to some extent by the core position. The cores should be adjusted until reaction is easily obtained. If necessary, some modification of this position is possible, to change band coverage. The cores should then be locked with nuts, as moving them will change dial readings.

The reaction condenser should be closed slowly until a sudden increase in sensitivity, and oscillation on tuning through a station, shows that the optimum position has been passed. While tuning, the reaction control is adjusted to keep the receiver just below the oscillation point. In this condition it is extremely sensitive. If the reaction control is insufficiently advanced, only powerful stations will be heard. On the other hand, if the control is turned too far, results will be very poor. However, the way in which the reaction control operates will soon become apparent.

For reception of ordinary stations, or telephony (voice and music) the receiver is kept just below the oscillating point, as described. The setting is not critical with powerful stations, but is quite exact with weak stations. To receive C.W. Morse (unmodulated carrier) the reaction control has to be advanced to the oscillation point.

The 150pF condenser is only used to locate the various bands. The dial reading of this condenser should then be noted down as accurately as possible. Tuning is then carried out on the 15pF condenser, in conjuction with reaction, as described.

If there is any variation in the efficiency of the 1T4 valves, the best valve should be placed in the detector position.

It is not very likely that any fault should arise in the receiver, but if no results are obtained, a few simple tests should localise the trouble. First, the phones may be connected across the 39k resistor. If normal 1-valve reception is then obtained, the amplifier stage is faulty. The valve can be tested by placing it in the detector position.

If results are absent with the 1-valve circuit, check the detector stage wiring. If reception is obtained with one coil, but not the other, suspect the switch connections, or the wiring to the inoperative coil. ■

A Simple Condenser Bridge

AN INEXPENSIVE INSTRUMENT WITH THREE RANGES

By G. A. W. Partridge

IT is obvious that the efficiency of electronic equipment depends largely upon the components. Resistors are quickly checked with an ohmmeter, but unfortunately condensers are far too often taken for granted. These are the very components that can mar the efficiency of a circuit. Old condensers should be tested before they are used again, and it is an idea to check up on new ones as well.

Range

This simple capacity tester can be made up in a few hours. It is easy to use and costs only a few shillings. There are three ranges: 100pF—1000pF; 1000pF—0·01μF; 0·01μF—0·1μF. which are adequate for most purposes. However, provision has been made for an extra range if necessary. The circuit is shown in Fig. 1.

The various components are mounted in a box (Fig. 3). The dimensions and constructional details are clearly seen in Fig. 2. The condensers used as standards must be of a high grade as the accuracy of the instrument is largely dependent upon them. The variable resistance is a 1M volume control potentiometer. Both resistors must be non-inductive. An old radio wave change switch will be suitable as a range switch. Tests are carried out in the following manner:—

The A.C. supply is drawn from an audio frequency oscillator which is set to give a good clear note of about 1000c/s; a pair of headphones or an amplifier and loudspeaker is connected to the detector terminals; the condenser under test is then connected to the test terminals. A suitable range is selected and the isolating switch turned on. The variable resistance is then turned until the A.F. note is no longer heard or is at its minimum value. Great care must be taken in finding the "null point".

The isolating switch is now turned off, and the resistance in circuit of the variable resistance measured by connecting an ohmmeter to the terminals marked Resistance.

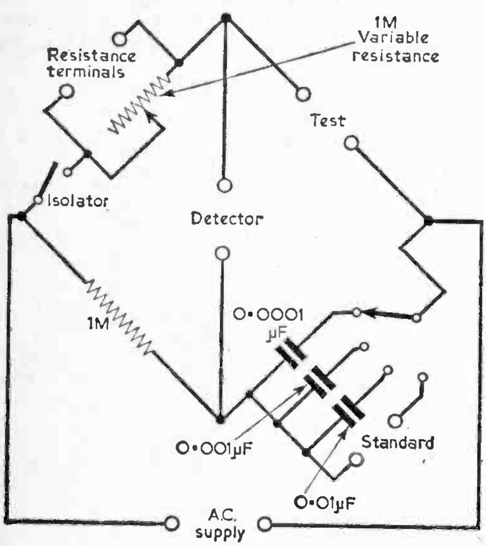


Fig. 1.—The circuit of the bridge.

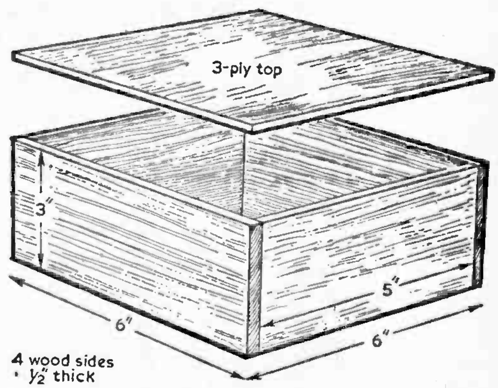
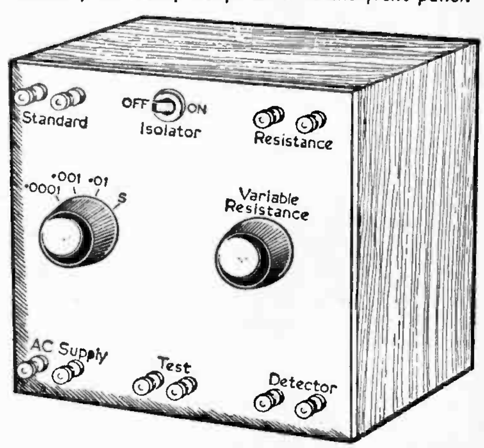


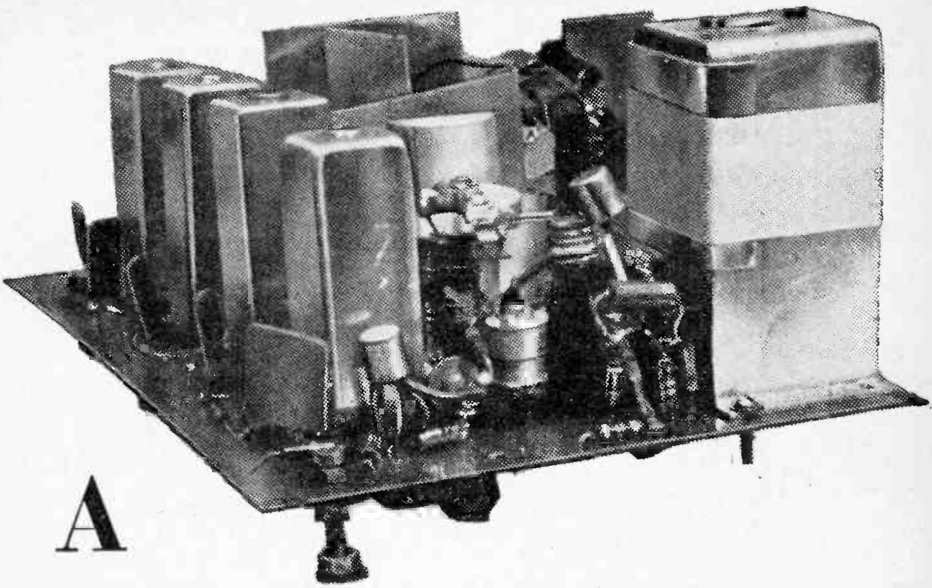
Fig. 2 (above).—The construction of a suitable case for the unit.

Fig. 3 (below).—The completed unit showing the various positions of components on the front panel.



From the formula: $C = \dfrac{\text{Range} \times 1{,}000{,}000}{\text{Circuit variable resistance}}$, the capacity of the condenser is determined in microfarads.

(Continued on page 607)



A Transistorised VHF Superhet

THE "PRINTED" CIRCUIT AND HOW TO MAKE IT

By D. R. Bowman

(Continued from page 494 of the October issue)

THE receiver is based on a piece of laminated copperclad plastic measuring approximately 10$\frac{1}{2}$in. x 6in. The copper layer serves not only as a source of conductors but also as a metal chassis. The prototype receiver was constructed on a sheet of very ordinary laminated board, but for reliability and good electrical properties the board specified is "Bakelite" grade DH74. This grade is an epoxy glass fibre laminate and is rather expensive; if cost is a major item, "Bakelite" grade E60 will be found very efficient, and the cost is about a quarter that of the DH74. It is important that the sheet is mechanically stable—the thickness of the board should be not less than $\frac{1}{16}$in.

The first step is to mark out the position of the components, beginning with the large items such as transformers, heat sinks, tuning capacitor and volume control, and following with the I.F. transformers which are contained in four cans. Marking out can be done with a ball-pen, very soft pencil or fine brush and white watercolour or drawing ink. Figs. 9 and 11 show the layout suggested, which includes the necessary conductors marked out. Conductors are shown white, while conducting tags, surrounded by an insulating space, are marked by a full spot surrounded by a ring. These latter are used for anchoring component wires which need to be insulated from the copperclad board.

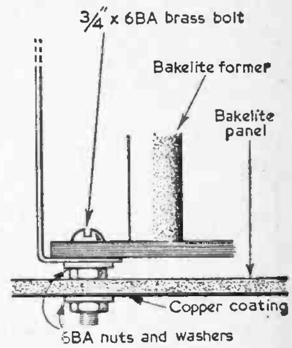


Fig. 8.—The method of spacing the I.F. coils from the chassis—see also Fig. 5, on page 494 of the October issue.

Layout

The I.F. transformers separate the I.F. transistors, and the R.F. and frequency changer stages are mounted to the right of the tuning capacitor; there is plenty of room in the layout given. The audio stages begin directly below the ratio detector, and continue across the bottom part of the board.

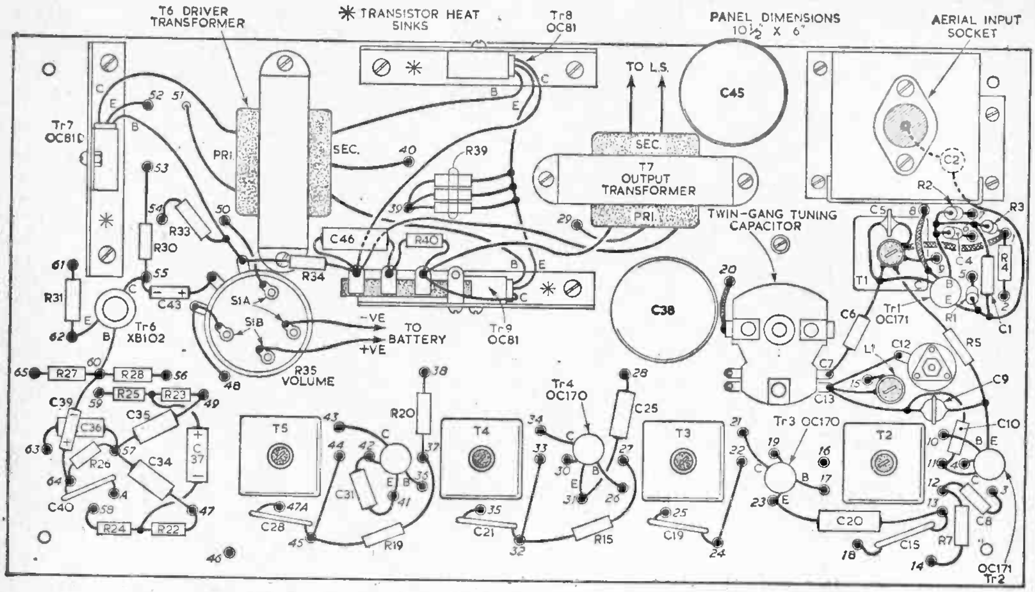


Fig. 9.—The above-chassis layout and wiring of the receiver.

The marking out of all components, down to the last resistor and capacitor, must be carried out before etching is put in hand. When, by comparison between the marked laminate and the theoretical diagram, it is quite certain that full provision has been made, the preparation of the board can begin. First it must be kept in mind that as little copper as possible is removed, and

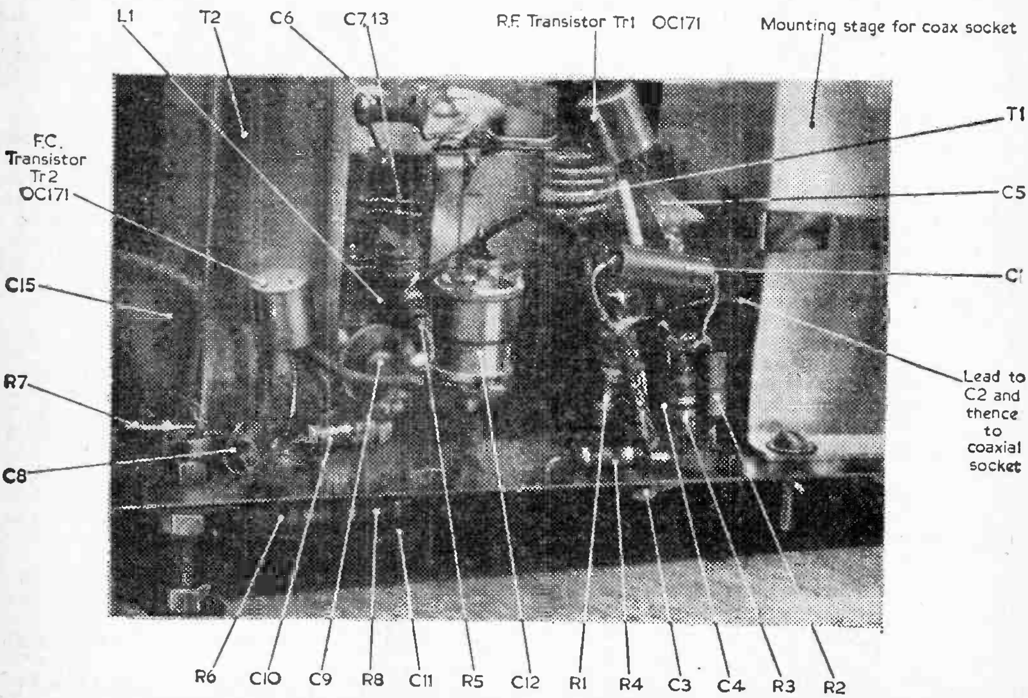
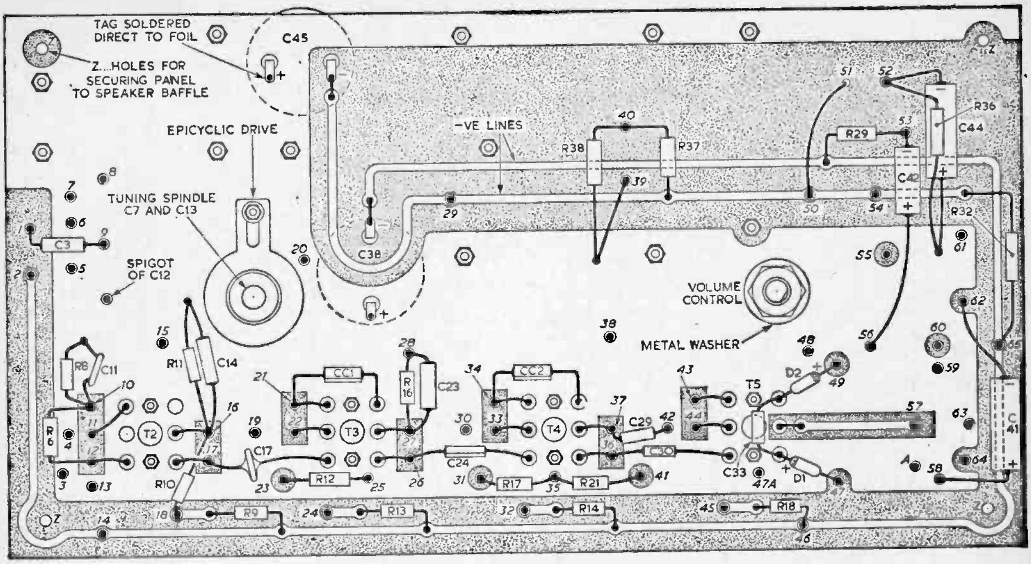


Fig. 10.—The layout of the R.F. stage of the receiver—this constitutes the only critical part of the set.



KEY TO CONNECTIONS

CONNECTIONS THROUGH PANEL ◉ CONNECTIONS DIRECT TO FOIL ●

CONNECTIONS SHOWN ◎ ARE ANCHORING POINTS FORMED BY ETCHING AWAY A RING OF COPPER CONNECTIONS TO I.F. TRANSFORMERS ◉

Fig. 11.—The below-chassis wiring—this diagram should also be used to mark out the printed wiring before etching; the copper which remains after etching is shown unshaded.

that the "earth" part of the copper is electrically continuous. Sufficient space must of course be left for insulation where needed; the width of conductors should be not less than ⅛in. and the anchor tags should be of $\frac{3}{16}$in. diameter, surrounded by an ⅛in. width of insulation where the copper is etched away.

"Resist" Solution

A "resist" material is now made up by dissolving ½oz of shellac in about 4oz of methylated spirit. This will take some while to dissolve, and is conveniently left overnight to complete the process. If some sealing-wax is added at the same time, or a little mahogany spirit dye, the resist solution will be found more visible when applied.

A water-colour brush is used to apply the solution which should be reasonably "thick" or else it may run where not desired. A steady hand is needed, and some practice is essential; this may well be carried out on a sheet of glass or paxolin. All parts which are to be conducting must be covered, not only the "conductors" but the "chassis" part of the board as well—shown *unshaded* in Fig. 11. The only parts not covered are those which are to be etched away.

Mistakes can be corrected by a plug of cotton wool damped (not saturated) with methylated spirit; the plug should be turned frequently so that all traces of the resist are removed from the area concerned. Thorough cleaning is essential and is not easy, so mistakes are best avoided. When it is decided that all is in order, the resist coating is gone over again to thicken it. Finally, the prepared board is left overnight to dry.

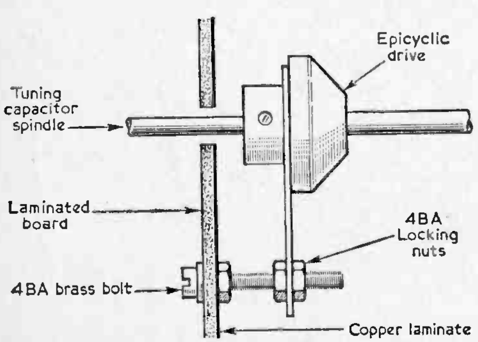


Fig. 12—The mounting of the epicyclic drive for the tuning capacitor.

Etching Solution

A solution of ferric chloride, $FeCl_3$, is made up by dissolving 4oz ferric chloride in 6oz water, adding 1oz concentrated hydrochloric acid—HCl. (Commercial "spirit of salts" is suitable.) This will form a very deep orange clear solution *which is corrosive and must be kept in a well-corked, labelled bottle well out of the way of food and out of the reach of children.* For use, the solution is poured into a flat container such as a photographic dish, and the laminated board immersed in it.

Etching will take a little while to accomplish; about an hour should be allowed but it may take longer, depending on the temperature. When the copper is completely removed, where required, the board should be removed from the solution, washed for a few minutes in running water, and dried with a soft cloth.

The removal of the resist is best effected by soaking the board in methylated spirit for 10-15 minutes, and then rubbing briskly with a plug of cotton wool damped with methylated spirit. Finally, hot water is used with some kitchen scouring powder on a rag; this will give a bright surface ready for silver-plating if it is now desired to carry out the process. If an electrolytic method is used, only the "chassis" can be plated, but this is relatively quite effective.

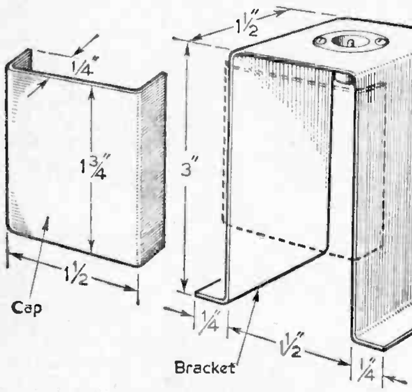


Fig. 13.—The mounting bracket for the coaxial socket in the R.F. stage.

All necessary holes should now be pierced. For holes which carry one wire, a $\frac{1}{32}$in. drill is enough, but where several wires will be anchored at one point, a hole of $\frac{1}{16}$in. diameter will be needed. It is not strictly necessary to drill at all points where "earth" connections have to be made; if a connection is carried through the board a hole will of course be needed.

All the components are now mounted in position, and this is best done direct from the theoretical diagram following the logical layout. When fixing the I.F. transistors, all wires but the "earth" wire are covered with thin insulating sleeving. The wires are not cut down at all, and this will be found not only convenient for mounting but safe for soldering. Nevertheless a really hot iron should be used, to minimise the time of the soldering operation.

R.F. Stage Layout

In the R.F. stage, it is most important to avoid capacitive coupling between collector and emitter. For this reason, the R.F. stage is a three-dimensional assembly and layout is somewhat critical. Fig. 10 which shows the arrangement of components should be used as a guide.

The coaxial socket for the aerial is carried on a bracket of bent-up aluminium sheet. Dimensions are given in Fig. 13.

The "cap" is clipped over the vertical sides of the stage to shield the aerial connection from the rest of the R.F. assembly, as shown in Fig. 14 and the illustration of the R.F. stage.

The bakelite formers for R.F. and F.C. stages may readily be affixed to the laminated board with the impact adhesive used according to the manufacturers' instructions and remembering that once contact has been made very little further drying can take place. It is therefore essential to ensure that complete drying has taken place before putting the former in contact with the laminated board. After preparing the surface, at least ten minutes should be allowed for drying in a room at 68°F.

The Tuning Capacitor

The specified capacitor is mounted, by two screws, at right angles to the printed circuit board, and is operated by means of an epicyclic drive. The lug of the epicyclic is clamped to the board by means of a 4B.A. brass bolt passed through the board (see Fig. 12).

In the prototype receiver, a circle of Perspex was cut, and a hole drilled in the centre to make a good force fit over a standard knob, to fashion a tuning knob of attractive appearance. A pointer fixed to the epicyclic was arranged to move in front of a scale cut out of paper and stuck to the front of the cabinet.

Mounting of the Loudspeaker

If the loudspeaker is mounted on the same panel of the cabinet as the printed circuit, microphony may be experienced at moderate volume levels. To minimise this difficulty, the speaker may be mounted on an ellipse of rubber surrounding the hole in the cabinet. Adhesion between speaker and rubber, and rubber and cabinet, can be secured by one of the contact adhesives.

A cut-out will be needed in one of the folds used for fixing the mounting bracket to clear a bolt used for mounting the printed circuit to the loudspeaker baffle (see Fig. 9).

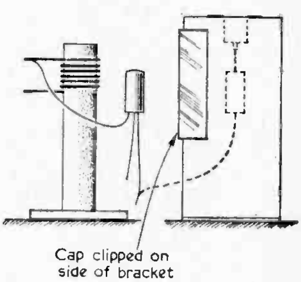


Fig. 14.—The position of C2 inside the mounting bracket.

Alignment

Alignment is carried out as follows, and a signal generator capable of covering the frequencies of 10·7Mc/s and about 100Mc/s is required. (Amplitude modulation will be needed.)

1—Set the generator to 10·7Mc/s and switch on. Allow ten minutes for warming up. Switch on the internal modulation (A.M.)

2—Switch to "high" output and bring an insulated wire from the signal generator close to the base wire of Tr5. Rotate the core of T5 (collector winding) for maximum sound in the loudspeaker. Align the slug of Tr5 base winding in T4 for maximum output.

3—Transfer the wire from the signal generator to near the base wire of Tr 4. Align cores of T4 for maximum output. Align the slug of Tr4 base winding in T3 for maximum output.

The alignment of the I.F. stages is now almost complete; next month the alignment of the discriminator and oscillator circuits will complete the receiver.

(To be continued)

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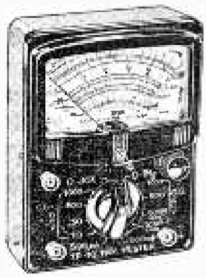

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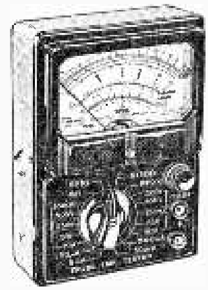

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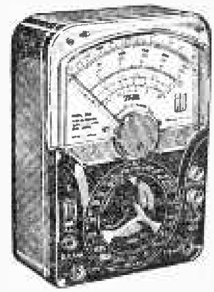

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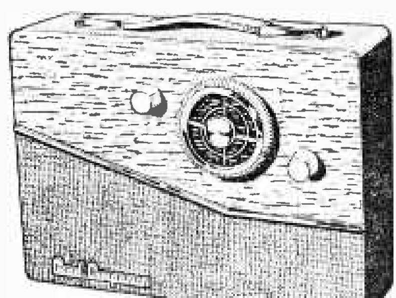

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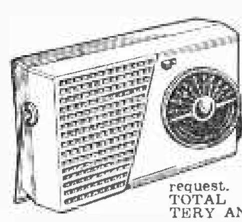

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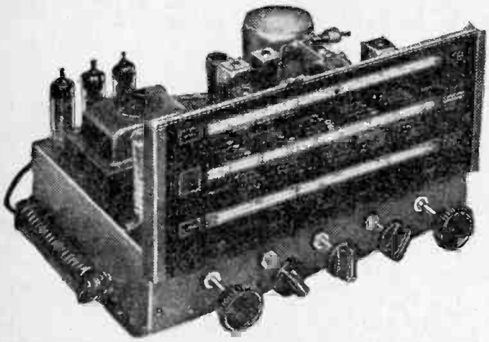

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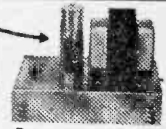

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Electrolytic Capacitors

SOME OF THE USES AND FAULTS OF THESE COMPONENTS

By G. J. King

THE primary applications of electrolytic capacitors as reservoir and smoothing components in H.T. filter circuits are probably amongst the most well known. When a radio produces a loud hum from the speaker which is unaffected by the setting of the volume control, one can be reasonably sure that the reservoir or smoothing electrolytic condenser is open-circuit or low in value.

Short Circuit

When the set is dead, and the rectifier starts sparking accompanied by overheating of the surge limiter resistor, again, the reservoir condenser should be suspected, but this time for a short-circuit. If the smoothing or filter resistor also heats up badly, a short-ciruit in the smoothing electrolytic is most likely responsible. These components, anyway, should be the first to be checked.

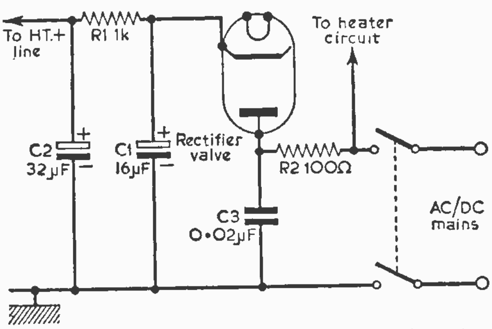


Fig. 1.—The H.T. circuit of a receiver; C1 is the reservoir capacitor and C2 the smoothing capacitor.

In Fig. 1 is shown the H.T. circuit of a typical receiver. The electrolytic capacitors are C1 and C2, from which it will be seen that the symbol for electrolytics differs slightly from the ordinary capacitor symbol, such as C3. Electrolytic capacitors are polarised. That is to say one terminal is marked positive (usually with a blob of red paint), while the negative terminal is sometimes the metal can in which the capacitor is housed. The positive side is signified by the narrow, open rectangle of the symbol.

The reservoir capacitor is the one connected between the output of the rectifier and negative H.T. or chassis (C1), while the smoothing capacitor is the one connected between the H.T. line side of the filter resistor or choke and chassis (C2). The filter resistor in Fig. 1 is R1: R2 is the surge limiter and C3 is a mains filter capacitor.

Voltage

Electrolytic capacitors are given two voltage ratings: the maximum working voltage and the maximum surge voltage. The working voltage is the direct voltage applied to the capacitor (as would be measured on a D.C. voltmeter) together with the peak ripple voltage. The ripple voltage is governed by the type of rectifier circuit used and by the H.T. current.

The surge voltage is the voltage which develops across the capacitor before the equipment starts taking current, or the voltage across the capacitor when the H.T. line is open-circuited.

Ripple Current

The ripple current is another very important factor in the rating of a capacitor and one which is not always fully appreciated by the experimenter. An H.T. reservoir capacitor, for example, is required to pass a considerable alternating current

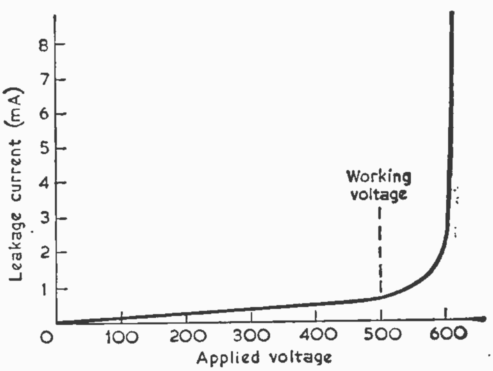


Fig. 2.—This graph shows how the leakage current increases rapidly when the working voltage is exceeded.

by the very nature of its application. This A.C. is termed ripple current, and it is essential that this does not exceed the ripple current rating of the capacitor.

Ripple current is directly related to such factors as the amount of D.C. drawn by the set, the source impedance of the H.T. circuits, the value of the capacitors, etc., and is rather difficult to assess directly in these terms. However, a fairly reasonable idea of the ripple current can be obtained by multiplying the total direct current drawn by the set by 1·5 for full-wave rectifier circuits and by 3 for half-wave rectifier circuits.

Thus, if the half-wave circuit in Fig. 1 were supplying, say, 50mA of H.T. current, the ripple current in C1 would be approximately 150mA. On the other hand, if the circuit were supplying 200mA for an audio amplifier or television set, then the capacitor would have to be rated for a safe ripple current of at least 600mA.

It should be noted that there is a world of difference between capacitors with a ripple current rating of 150mA and 600mA, even though the working and surge voltages may be identical.

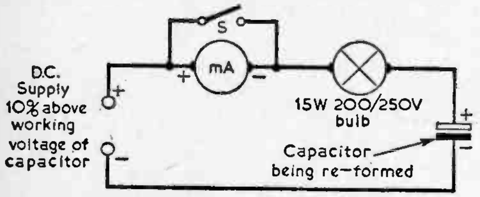


Fig. 3.—A suitable circuit for re-forming electrolytic capacitors.

Ambient Temperature

The ripple current rating is related to ambient temperature, since the power factor tends to increase with increase in temperature. If a capacitor which is unable adequately to handle the ripple current is employed as reservoir, its temperature will rise, and as a result its inadequate ripple current rating will be further reduced. Eventually, the capacitor will become so hot and pass so much ripple current that it will explode.

A test of this nature was carried out on a television receiver. The original reservoir capacitor was disconnected and in its place was wired a capacitor of the same value and voltage working but with a 150mA ripple current rating. The set worked perfectly when first switched on, but the capacitor quickly became hot. The temperature progressively increased, and without warning the component exploded with considerable violence. Fortunately, the set was set up with this in mind and was lightly fused, thereby saving the rectifier.

Multiple Capacitors

Electrolytic capacitors are made in units of two or more elements. In most cases there is a common negative terminal, or the can itself may be negative. The positive terminals are then colour-coded to correspond to the various capacitances as indicated on the outside of the case. The ripple current rating of most multiple capacitors is common to all elements, but where this is not the case, the section with the highest ripple current rating, which should be used as the reservoir, is generally indicated.

Some metal canned capacitors also have a negative terminal which may or may not be connected to the metal case. Where there is no connection between case and negative terminal, it is usually indicated that the can is isolated, and it is as well to ensure that the can remains isolated from H.T. negative or chassis in actual service. On the other hand, where the can is definitely connected to the negative terminal, then it is perfectly in order to clamp the can directly to chassis.

Power Factor and Insulation Resistance

The power factor of a capacitor is a measure of the loss of energy which results when A.C. is passed through it and is given by the ratio of watts (actually measured) to volt amperes. Power factors of the order of 15% are permitted with electrolytic capacitors; a figure which could never be tolerated with paper and mica capacitors of the kind used in R.F. circuits.

A capacitor with a poor power factor will be found to have a relatively large leakage current. This can be dangerous since it results in overheating (owing to the poor insulation resistance) and may cause damage to the rectifier and associated components.

It should be noted that it is normal for the leakage current to rise rapidly above the working voltage, as shown in Fig. 2, and it is this factor which endows an electrolytic with a surge rating.

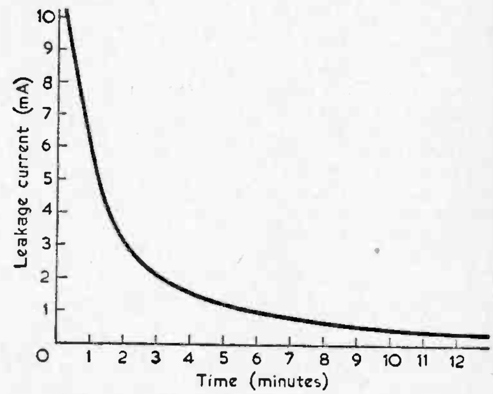
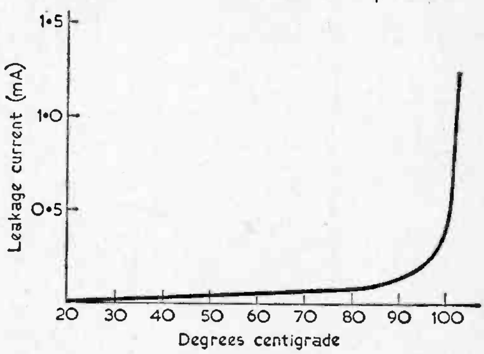


Fig. 4 (above).—The leakage current reduces with time in a capacitor which responds to re-forming.

Fig. 5 (below).—This graph shows how the leakage current increases with increase in temperature.



For example, when first switching on a receiver the voltage across the electrolytics is above the normal working value, but since the leakage current is then higher than normal, the capacitors effectively absorb the direct current and thereby prevent the H.T. voltage rising to a level which may otherwise damage associated components. The surge rating in this respect is usually about 100V above the working voltage.

(Continued on page 611)

TRF UNITS AND INSTABILITY

By A. Sydenham

CURING FEEDBACK AND OSCILLATION

SIMPLE radio receivers and tuners employing TRF (tuned radio frequency) principles are favoured by many constructors as they are not so expensive to construct as A.M. superhets, F.M. or transistorised receivers. TRF front ends are used too by quality enthusiasts, for excellent results can be obtained from comparatively simple apparatus when the output is fed into a good quality amplifier. The really serious listener usually invests eventually in a VHF tuner, but owing to the cash outlay required for such a set, he must sometimes be content meanwhile with less complicated apparatus.

Circuit

A TRF tuner for use with an amplifier or as an integral part of a receiver often comprises a single R.F. amplifying stage coupled to a detector, no reaction (positive feedback) being applied in the interests of quality. The intervalve tuned circuit is not much damped if a detector of the infinite impedance type is employed and selectivity is fairly good provided high grade coils are used. The overall sensitivity is of a low order, but is usually adequate for local station reception —which is all one obtains from VHF apparatus anyway!

A Typical TRF Circuit

A basic circuit for a tuner is shown in Fig. 1 and it looks remarkably simple. Unfortunately, such tuners may prove very unstable and fierce oscillation that makes any form of listening impossible frequently results.

Such instability is usually most serious at the high frequency end of the band being tuned, i.e. where the tuning condenser vanes are least enmeshed—at the other end of the scale the gain tends to be less. Such oscillation is due to unwanted feedback from the anode of V1 to its grid (Fig. 1) and can arise in several ways, usually due to capacitative or electromagnetic coupling.

Tracing Instability

The cure is to find and remove each unwanted coupling and is not easy unless great care has

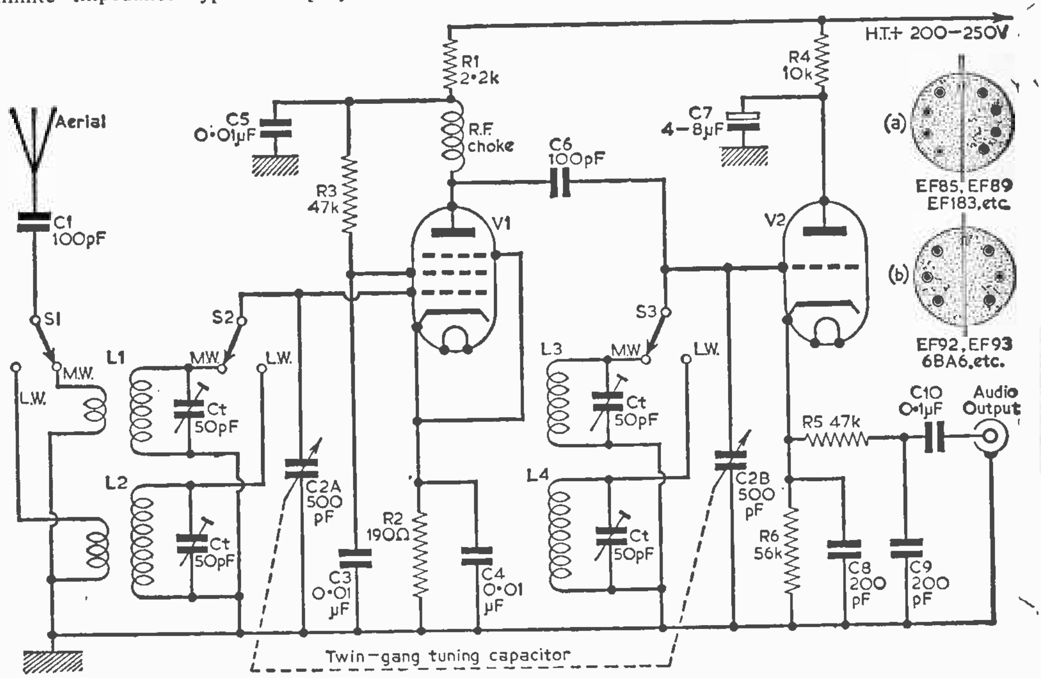


Fig. 1.—The circuit of a typical TRF tuner.

been paid to the initial layout and construction. Sometimes no feedback is evident until alignment is attempted, and only when the tuned circuits are brought to resonance by means of the trimmers provided for this purpose does howling commence.

There are several methods by which the R.F. valve may be coupled to the detector circuit, and in the circuit of Fig. 1, choke capacity coupling is depicted since this method simplifies switching and also ensures reasonably high gain together with a fair amount of protection against instability.

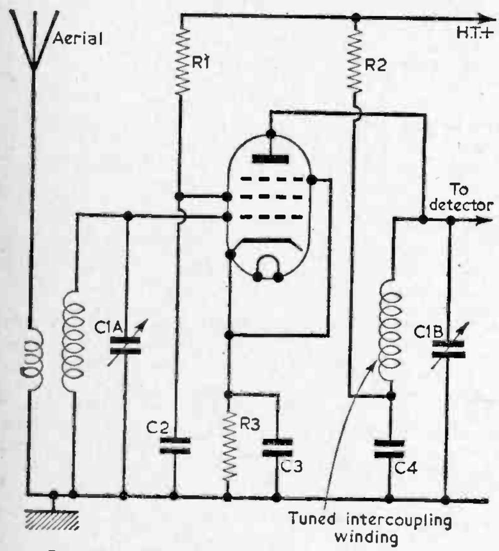


Fig. 2(a).—'Tuned anode' intervalve coupling.

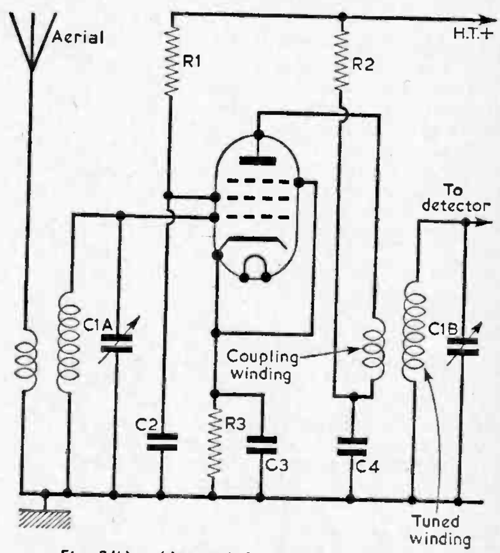


Fig. 2(b).—'Aperiodic' intervalve coupling.

Tuned anode coupling gives greater gain but increases the risk of instability whilst aperiodic coupling, although ensuring excellent stability, tends to make switching complicated when several wavebands are to be incorporated in the tuner, as both the primary and secondary windings of the intervalve coils must be switched. The primary windings also carry H.T. supplies to the anode of the R.F. valve. The two forms of coupling may be seen in Figs. 2(a) and 2(b).

Essentials

If any wiring associated with the anode circuit of V1 or the grid circuit of V2 is allowed to run in close proximity to that of the input wiring to V1, positive feedback will occur. It is essential, therefore, to keep these circuits and their wiring as far apart as possible and to use earthed screening where necessary. It is very tempting to use a miniature, single wafer rotary switch for band changing, but a little thought will show that this is most undesirable as the interstage wiring must necessarily be in proximity at the contacts. A two-wafer type is essential, and each wafer should be separated from the other by spacers. If the aerial and intervalve coils are to be mounted in the same plane as the switch, screens should be incorporated as shown in Fig. 3. Usually, however, one set of coils can be mounted above the chassis and one below, so that the chassis provides its own screen. Designers usually pay considerable attention to these points when developing a prototype model for construction purposes, and the beginner is well advised to use the specified components and to follow the layout given as closely as possible.

It is sometimes beneficial to fit a screen to the base of the R.F. valve as the pin layout usually permits the input and output circuits to be separated. Some bases are shown on the right-hand side of Fig. 1, the double line indicating the screen position. Such screens may easily be made from tinplate and should be approximately $\frac{5}{8}$in. high. Careful orientation of the base in a

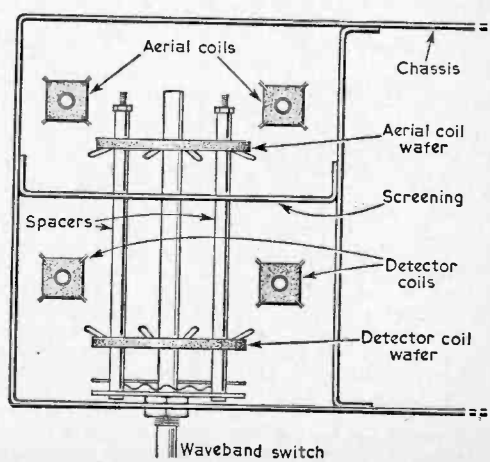


Fig. 3.—Avoiding instability by the judicious use of screening.

newly constructed tuner can also affect the length of the connecting leads considerably.

Curing Instability

In a receiver or tuner that has previously worked satisfactorily and then suddenly developed instability, the trouble is more than likely due to a component failure, and the usual tests should be made to isolate it. In newly constructed apparatus, however, capacitive or electromagnetic coupling

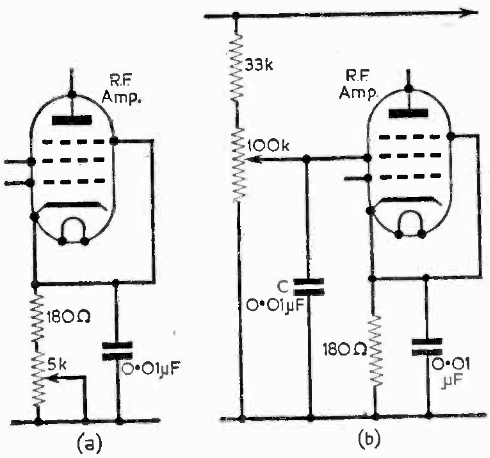


Fig. 4.—Temporary cures for instability—in (a), a 5k potentiometer is added in the cathode lead, and in (b), a 100k potentiometer is used to vary the screen grid potential.

should be suspected if oscillation and general instability is present, particularly if the trouble is worst at the high frequency end of the band being tuned. A temporary cure can usually be effected by connecting a 5000Ω potentiometer in series with the earthy end of the existing bias resistor as shown in Fig. 4(a). Alternatively a 100k potentiometer may be fitted in series with the screen feed resistor as shown in Fig. 4(b), but in this case care must be taken to see that the screen bypass condenser, C, is in direct connection with the screen grid pin tag rather than the slider of the potentiometer.

Adjustment of the control will lower the gain of the valve, and it should be set so that any unwanted oscillations just cease. The next step is to align the tuned circuits, and this will inevitably mean readjusting the newly fitted potentiometer to obtain stability. With the unit adjusted to the very edge of oscillation it should be possible to tune in a transmission, but good results cannot be expected as the R.F. valve is unlikely to be performing at its best owing to the incorrect voltages being applied. With the receiver or tuner in this state, it is usually possible to find the offending lead or leads by prodding the wiring with an insulated tool such as a discarded knitting needle, when the faulty lead will be evident as oscillation suddenly occurs. Several leads may be involved and these should then be screened, the screening being earthed at *both* ends. Although the work will prove tedious it is well worthwhile. The potentiometer will need adjustment from time to time as improvement results and, finally, may be removed from the circuit entirely, when full gain conditions have been realised.

Another source of instability may be the twin gang tuning condenser, and this should be checked to ensure that good contact is made with the chassis at several points. The detector circuit also can be responsible for feedback difficulties and, referring to Fig. 1, it will be observed that the demodulated signal is taken from the cathode of V2 and then passed through a filter comprising R5, C8 and C9, which is intended to remove any residual unwanted R.F. accompanying the audio signal. Since no filter is perfect, it is possible for a small amount of this R.F. to pass via the output circuit back to V1 and give trouble. A good "in-line" layout will usually avoid this, however, but in difficult cases a suitable choke should be fitted in place of R5. The decoupling capacitor C8 is also critical; if it is low in value, uncontrollable oscillation may result. It may easily be checked by wiring another condenser in parallel.

Creating Instability

In conclusion, it should be noted that benefit is sometimes derived by making a hitherto stable TRF tuner slightly unstable deliberately to increase gain.

As mentioned earlier, reaction is undesirable in modern equipment, but the use of a judicious amount of feedback can improve sensitivity. This may be obtained by soldering a short, insulated length of connecting wire to each of the fixed plate sections of the twin gang tuning condenser. The receiver or tuner should now be switched on and tuned to the high frequency end of the scale, when the wires, not bared, are twisted together until oscillation commences. They should then be shortened and untwisted carefully until oscillation just ceases. The extra gain is, unfortunately, not constant, over the whole range of tuning but, as no extra control is needed, the inclusion of the device is sometimes worthwhile. ■

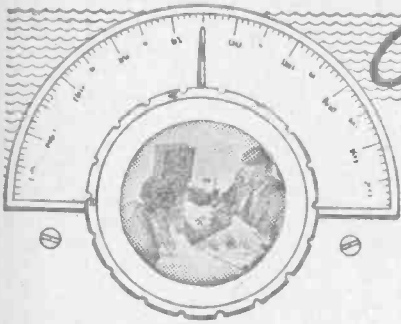
BRITISH STANDARD LETTER SYMBOLS FOR LIGHT-CURRENT SEMICONDUCTOR DEVICES (B.S.3363:1961)

So extensive have been the developments in the manufacture and use of semiconductor devices that there is now an urgent need for letter symbols for these devices—hence the publication of B.S.3363.

International work on the standardisation of letter symbols for semiconductors, sponsored by the International Electrotechnical Commission, is well advanced but has not reached the publication stage; the international agreements to date have been taken into account and largely incorporated in this new British Standard.

The Standard is primarily intended as an aid to manufacturers and users of semiconductor devices: It should simplify, speed up and cut down the costs of cataloguing and ordering. It should also, however, be found useful for most technical literature concerned with the characteristics or behaviour of light-current semiconductor devices.

Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1., price 5s. each. (Postage will be charged extra to non-subscribers.) ■



On Your Wavelength

BY THERMION

Those Transistor Sets!

IN the October issue I made some further comments on the abuse which is being made of these small portables, and gave some details of an idea which had been sent to me by a reader. This hinted that an interfering set could be made with a very limited range to "jam" the annoying receiver. As I mentioned, and as I expected, the authorities do not look with any favour on this idea and the following remarks have been received from the G.P.O. ". . . under the Wireless Telegraphy Act, 1949, it is an offence deliberately to interfere with any form of wireless telegraphy (which includes broadcast receiving apparatus), either by wireless telegraphy or electrical apparatus". The relevant part of the Act is section 13 which states:—"Any person who uses any apparatus for the purpose of interfering with any wireless telegraphy shall be guilty of an offence under this Act. The penalty on conviction for such an offence is imprisonment for a period not exceeding three months or a fine not exceeding one hundred pounds, or both.". The Postmaster General could not, therefore, sanction the use of any equipment designed for the purpose suggested. So if any reader is thinking of making up a unit on the lines suggested, my advice is "don't". The letter from the G.P.O. goes on to say, however, that "Undue noise caused by the excessive use of a loudspeaker is in a similar category to that caused by the inconsiderate use of a musical instrument, for example, and Local Authorities already have power to make bye-laws for the prevention and suppression of such nuisances". I note that it was recently reported that the Eastbourne council desired to make such an additional bye-law and, as this has to be approved by the Government, application was made but the council was informed that permission could not be given as the position of these portable receivers was being considered at Government level and an announcement would be made in due course.

Old-time Equipment

A number of readers have written recently extolling the virtues of old equipment which they remember owning, and in many instances have said that they are quite certain that the results were better than present-day equipment. I wonder if this is really so, or whether their memories have not been dulled by the passage of time?

I do remember a well-known reverend gentleman who used to write for us, who was also an authority on the organ, and who was a very keen experimenter, but many of the circuits he tried and extolled had no technical measurements or other data which we could now refer to, in order to see whether their performance was good or not. One of his circuits had many very good claims which were upheld by a host of readers judging by the letters we received. This utilised two high-class L.F. transformers (Ferranti products) coupled in a series-parallel arrangement, and his claims for bass reproduction as shown by organ reproduction were remarkable. Perhaps there are still some readers who are using this coupling, although L.F. transformers are not now available.

Remote Control

I was intrigued by the remote control devices shown at this year's Radio Show. I think I liked best the beam of light idea used to switch on and off a TV receiver, and also to change stations. I think I have remarked before, that one of our early contributors suggested, many years ago, that eventually the radio and TV would be consigned to the cellar together with the normal electric and gas meters, all listening or viewing being carried out by remote controls. There was at one time on the market a neat relay switch, operated by a dry-cell, which was fitted next to the radio, and push-buttons suitably sited in every room permitted a receiver, even of the mains type, to be switched on or off from any room in the house. A simple modification of this would permit station changing, and I wonder this has not come into more general use. It would enable a really good speaker cabinet to be designed to suit the room furnishings.

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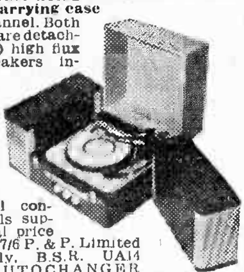

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THE "WAVEMASTER" 7-TRANSISTOR LUXURY PORTABLE

400 Milliwatt Output

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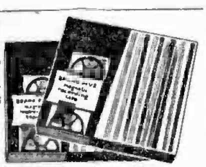

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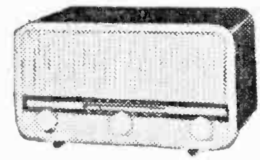

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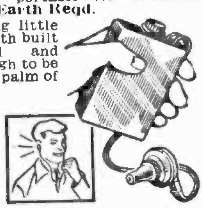

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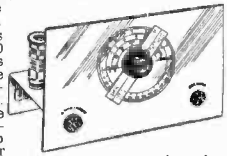

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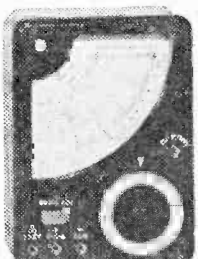

Ranges: A.C. Voltage: 10, 50, 100, 500, and 1000 volts (10,000 ohms per volt). D.C. Voltage: 5-25, 50, 250, 500, and 2.5k. (20,000 ohms per volt). D.C. Current: 0-50 microamps. 0-2.5 m/a. 0-250 m/a. Resistance: 0-6k, 0-6 meg. (300 ohm and 30k at centre scale). Capacitance: 10 pF to .001 mfd. .001 mfd to 1 mfd Decibels: —20 to +22 dB.

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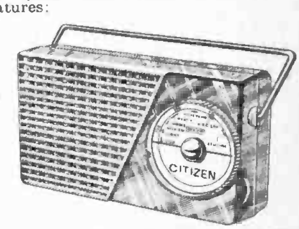

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RS12/DD

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The moving assembly is supported by a roll surround, formed from resin impregnated cloth permanently moulded under heat and pressure. Together with the high grade synthetic centring device this roll surround permits very large cone and coil excursions with minimum distortion.

The magnet system is a highly efficient Feroba II assembly, giving outstanding performance with reduced depth and weight. Furthermore, these new magnets are very stable and almost impossible to demagnetise.

This loudspeaker covers a very wide frequency range and the roll surround permits the use of enclosures down to 1½ cu. ft. with good LF performance, provided the acoustic requirements are met. Constructional details of several specially designed cabinets are supplied with each unit.

Some important features of the RS12/DD:

Very low bass resonance — Synthetic Centring device — Ceramic magnet — Die-cast chassis — Foam edge damping — One-piece HF flare and dome — Soft, heavy main cone with wool fibres — Airtight impregnated roll surround.

RS12/DD Specification:

Fundamental Resonance	25–32 c/s
Frequency Range	30 c/s–15 Kc/s
Flux Density	14,000 gauss
Total Flux	156,000 maxwells
1¾in. dia. Centre Pole	
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Short-wave Listeners' Log

WHEN an ordinary domestic or similar receiver is the only one available, it is usually impossible to cover the 160m and 80m amateur bands, which are often very interesting. Many popular receivers tune approximately 1000-2000m (3001150kc/s) on the long wave range, 200-550m (1500-550kc/s) on the medium wave range, and may have a single short wave range of about 19-45m (16-6·5Mc/s). There is thus a wide gap from about 45-200m (6·5-1·5Mc/s).

Some receivers can be made to cover the 160m band, with no modification other than unscrewing the M.W. band trimmers. This band extends from 1·8-2Mc/s (roughly 170-150m) and should be reached with the gang condenser almost fully open. It may be necessary to remove the trimmers entirely, or replace them with low-capacity trimmers. The receiver should be realigned, and will give similar M.W. results as before, though dial readings will no longer apply.

Quite often the L.W. band is little used. With home constructed receivers, it is then relatively easy to fit coils for about 70-170m (4·25-1·8Mc/s). this will allow both 80m and 160m bands to be covered. If the L.W. range is to be retained, it will be necessary to replace the existing wave-change switch with one having an additional position. The new coils should be of the correct type. Most receivers have an intermediate frequency of around 465kc/s, and aerial and oscillator coils for this can easily be obtained. The only other additional components required will be a 50pF or similar trimmer for each coil, and the oscillator coil padder.

Many ordinary receivers will give good results on these bands. A new tuning scale should be drawn up to suit.

M and A Calls

New listeners on the amateur bands may be puzzled by the use of the letters M and A, which may be added to ordinary call signs. The letter M denotes a Mobile station, for example, one fitted in a car. Quite a number of such stations are in operation, especially at week-ends and holiday periods. The letter is added at the end of the usual call. For example, G3ZZZ/M.

The letter A shows that the station is being operated from an alternative address. That is, the operator has some kind of transportable equipment, which he has taken away from the usual station. When working in this way, the call would be G3ZZZ/A. Any station may operate in this way, whenever wished, but the locality must be announced at intervals. It is thus easy to log the place from which a /A station is transmitting.

Station Logging

When logging stations received, it is useful to employ the readability and signal strength code, which will give a good indication of the results obtained.

Readability is from 1 to 5, as follows:

1 Unreadable.
2 Barely readable, occasional words distinguished.
3 Readable with considerable difficulty.
4 Readable with practically no difficulty.
5 Perfectly readable.

Signal strength is from 1 to 9, as follows:

1 Barely perceptible signals.
2 Very weak signals.
3 Weak signals.
4 Fair signals.
5 Fairly good signals.
6 Good signals.
7 Moderately strong signals.
8 Strong signals.
9 Extremely strong signals.

A signal that is 5/9 is thus perfectly readable, and very strong. A 4/3 signal would be weak, but readable. A 2-3/5 signal would be fairly strong, but only readable at its best with difficulty, due to interference or other causes.

Times are best logged in G.M.T. This simply begins at 1a.m. and goes right through to 24, or midnight. For example, 8 : 10a.m. would be 08 : 10 G.M.T., or 0810 G.M.T. Similarly, 2p.m. would be 14 : 00 or 1400 G.M.T., while 11 : 40 p.m. would be 2340 G.M.T., and so on. When British Summer Time is in use, one hour has to be deducted, to obtain normal time. So 11 : 00a.m. B.S.T. would be 1000 G.M.T. ■

FAULTS IN VHF/F.M.

1—The aerial and tuner unit

By G. J. King

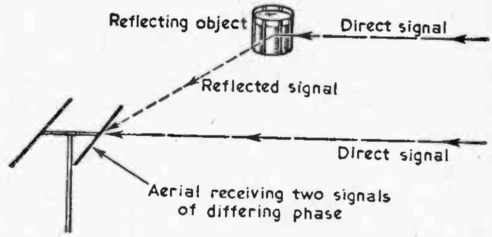

Fig. 1.—The cause of multipath distortion: the aerial picks up two signals of differing phase since the reflected signal arrives later than the direct signal.

ALMOST the whole of the British Isles is within range of the VHF/F.M. service, and the majority of radio receivers now produced cater for such reception—including certain transistorised portables and television receivers.

The circuitry and characteristics of these receivers differ from A.M.-only sets, and one of the most obvious differences is in the aerial required. Unlike the ordinary "long-wire" or untuned aerial which works admirably with ordinary A.M. receivers, F.M. receivers require something a little more elaborate in the way of a tuned aerial if the best reception is to be obtained. The modern F.M. receiver or tuner is highly sensitive, and for this reason will give a useful A.F. output in all but extreme fringe areas on a short length of wire. Unfortunately, many sets are, in fact, operating under such conditions, and the reception as a consequence is no better, and sometimes worse, than that obtained by the A.M. services. Listeners have rightly been led to believe that F.M. reception is better than A.M. reception, and they are justly disappointed when they find in practice that this is not always true. The trouble, of course, is usually the aerial system.

Effects

A sensitive receiver often encourages the experimenter to make do with an aerial of dubious characteristics and performance, simply because the aerial provides a signal sufficient to give an audible output signal. This is not enough unless one lives very close to a transmitter, and even then, a poor aerial may cause an interference effect. The very quiet background which F.M. can provide, and which can be so impressive in comparison with A.M. reception, cannot be obtained with a weak aerial signal.

The noise suppression inherent in F.M. only works properly when the signal strength is above a certain level, and it usually follows that the stronger the signal the better the noise suppression and the quieter the background. This applies particularly to electrical and car interference, for even though the set may be tuned accurately, such interference disturbances may break into the programme if the aerial signal is of insufficient strength.

Multipath Interference

Multipath interference can also be extremely troublesome and disconcerting, especially if insufficient attention has been given to the aerial. This interference is the result of the receiving aerial picking up two signals from the same transmitter. One is the direct signal from the transmitting aerial and the other is an indirect signal which has been reflected by an object such as a gas-holder, large buildings, hills, or even trees. The effect is shown in Fig. 1, and the indirect signal arrives a fraction of a second later at the receiving aerial than the direct signal. This means that the indirect signal will arrive out of phase with the direct signal and a modulation owing to the phase difference will be produced.

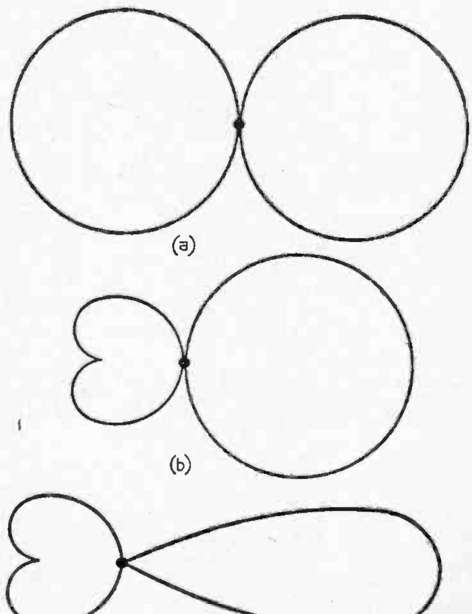

Fig. 2 (a).—The polar response of (a) a simple horizontal dipole; (b) a horizontal dipole with reflector and (c), a dipole with reflector and director.

RECEIVERS

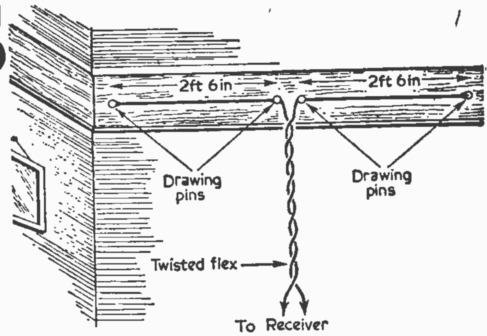

Fig. 4.—A simple indoor F.M. aerial, shown mounted on the picture rail.

Although an F.M. receiver is insensitive to amplitude modulation, it is, in fact, sensitive to phase modulation, since this is very much like frequency modulation. Thus, owing to the phase modulation produced by the reflected signal, a form of distortion is produced, which is sometimes called "multipath distortion".

Distortion

The resulting deformation of the programme material is difficult to assess and varies depending on the strength and phase difference of the reflected signal or signals in relation to the direct signal. In most cases a buzz or rattle distinctly spoils the reception, which in certain instances may be mistaken for audio distortion or an out-of-centre loudspeaker. This can usually be proved, however, by tuning to another programme as the trouble is rarely consistent on all programmes.

Passing aircraft may give similar symptoms during the time that the aircraft is close enough to act as a reflector. A beat effect accompanied by distortion occurs as the direct, and reflected signals are received in and out of phase owing to the rapid movement of the reflecting surface. It will be realised that multipath interference is caused by the effect which causes "ghosting" on television pictures.

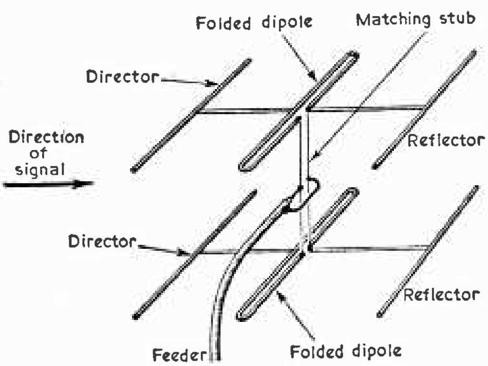

Fig. 3.—Two arrays stacked as shown increase the vertical directivity and reduce the distortion caused by reflections from aircraft.

The Cure

Where the distortion is severe, a cure can be effected by the use of a directional array orientated for maximum discrimination between the direct and reflected signals. In practice, this means a multi-element aerial, for a simple dipole cannot discriminate between the required signals and signals reaching the aerial from other directions. The addition of further elements to a simple dipole results in an increase of forward gain at the expense of gain in other directions. This effect is shown by the polar diagrams in Fig. 2. The diagram (a) is representative of the response of a dipole alone; (b) of the dipole with a reflector and (c) the dipole with reflector and director. From these it may be seen that (c) will obviously provide better discrimination than (a) or (b) between a signal arriving in the direction of the axis of the response and another at right-angles to it.

Vertical Directivity

Where multipath distortion is troublesome owing to passing aircraft, the only cure is to obtain improved directivity so as to provide greater discrimination between the low angle direct signal and the relatively high angle reflected signal.

This is possible by using two aerial systems, one above the other, as shown in Fig. 3. The two dipoles are in effect connected in parallel via a coaxial transformer or some other matching arrangement and then connected to the common coaxial down lead. This, then, causes the **vertical** polar response to become similar to the horizontal response of Fig. 2(b). The spacing of the two arrays has an effect on the vertical response, but a spacing between 4 and 5ft is usually about the best compromise.

Simple Aerials

Most modern receivers feature an internal "compressed" dipole made up of tin-foil or wire in the receiver cabinet. This is not of the correct length to tune the VHF band in itself, but is tuned by the use of a "loading coil" or similar device.

In areas of strong signal such an aerial is adequate, provided there is not a lot of local electrical interference and the set is orientated for the best signal pick-up. However, where the internal aerial provides only mediocre reception, considerable improvement is usually possible by using a simple room or attic aerial.

In its simplest form, this consists of a length of ordinary electrical flex divided at the top to form two lengths of 2ft 6in., as shown in Fig. 4. The remainder of the flex is then used as the feeder or downlead to connect to the "dipole" sockets on the set.

Downlead

An improvement on this is to use proper coaxial or twin feeder downlead from the two dipole sections to connect the dipole to the set. Most sets require coaxial downlead to suit the tuner input circuit, though earlier sets were designed for 300Ω flat twin feeder.

This type of aerial has a polar response similar to that of Fig. 2(a) and is, therefore, somewhat directional which, theoretically, means that it should face the station broadside on. In practice, however, the wavefront tends to alter in direction owing to local structures and, for this reason, the aerial should be positioned for the best signal-to-noise ratio. If local interference is excessive, then the only solution is to use a direction array of two or more elements mounted as high as possible outside the interference field.

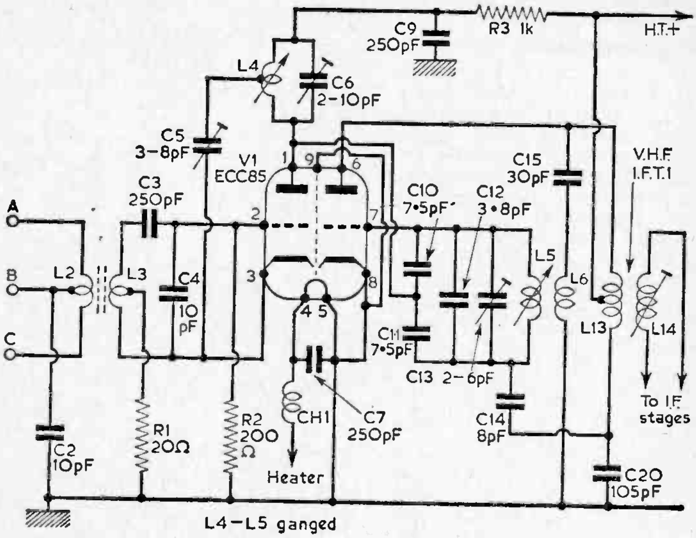

Fig. 5.—The circuit diagram of an F.M. tuner as used in A.M./F.M. receivers.

The VHF Tuner

In most combined A.M./F.M. receivers a separate F.M. tuner sub-chassis is incorporated, a typical circuit of which is given in Fig. 5. Rather like the multi-channel tuner of a television receiver, the F.M. tuner is often independent of the main receiver chassis, but contains its own tuning arrangements which may or may not be ganged to the main A.M. tuning mechanism.

In other sets and in F.M.-only models, the tuner section may be built as part of the actual set on a common chassis. Nevertheless, the R.F. amplifier and frequency changer sections very closely follow the circuit of Fig. 5. Here, a double-triode valve functions in the first section as the R.F. amplifier and in the second section as a self-oscillating frequency changer.

Input Stage

The R.F. amplifier circuit differs slightly from set to set, for in some sets it may be arranged in the earthed cathode mode with neutralisation, as in Fig. 5, and in other sets as a grounded grid stage. There is possibly a slight gain advantage with the earthed cathode arrangement, but this cannot always be fully realised since the first tuned circuit is heavily damped to avoid the need for variable tuning.

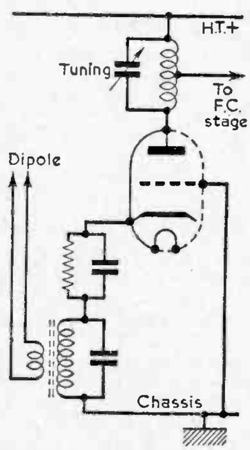

Fig. 6.—An earthed grid R.F. amplifier stage.

In Fig. 5 the first tuned circuit, L3, is fixed-tuned by C3 and C4, and the aerial signal is coupled in by L2. The anode tuned circuit, L4, is fixed-tuned by trimmer C6 and permeability-tuned over Band II by a mechanically-coupled core in L4.

The dipole is coupled to L2 between points A and C when 300Ω feeder is used. Point B may then be connected to the A.M. aerial socket to provide medium-frequency pick-up from the VHF aerial. When 75Ω coaxial is used, then point B is usually connected to chassis and connection made between A and B, with the outer braid to B.

Broad Tuning

The cathode resistor of the first triode is R1, and R2 is the damping resistor so that the grid circuit will tune reasonably flatly over the whole of Band II. The trimmer C5 is for neutralising the capacitance between the anode and grid of the valve (Cag). Without neutralisation, the internal Cag of the valve would cause positive feedback between the grid and anode circuits and the valve would act as an oscillator. The neutralising capacitor provides a negative feedback path which, when accurately adjusted, cancels out the positive feedback, and the stage is made inherently stable and thus works as an amplifier.

With grounded grid R.F. stages, neutralisation is not required since the input signal is fed to the cathode and the grid, being earthed, acts as an electrostatic screen and removes the effects of the internal capacitance. A grounded grid stage is shown in Fig. 6.

The frequency changer section of Fig. 5 is made up of the second triode, the oscillator coils, L5/L6, and the I.F. output transformer, L13/L14. L5 is also permeability tuned, and the core in this coil is mechanically coupled to the core in the R.F. coil L4. To avoid unnecessary coupling of the oscillator signal to the aerial, via the R.F. stage, the coupling from the anode of the R.F. amplifier is made to the frequency changer at the junction of capacitors C10 and C11. At this point the oscillator voltage is almost zero, since it represents the null point of a bridge circuit.

Tuning Variations

Oscillator drift is a common trouble in F.M. receivers, and this causes the tuning point to alter progressively as long as the receiver is switched on. A certain amount of drift during the first five to ten minutes is quite normal, but prolonged drift should first lead to a check on the receiver ventilation. If the set is positioned too close to a wall or if the ventilation slots at the base and rear of the cabinet are not completely clear, the temperature inside the set will become abnormal, making drift inevitable.

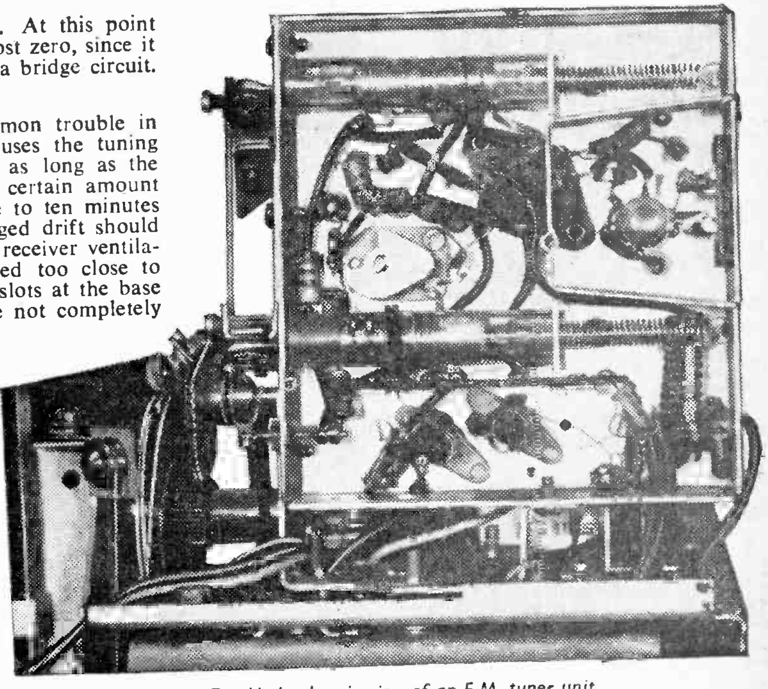

Fig. 7.—Underchassis view of an F.M. tuner unit.

Dirty Valve Pins

A faulty valve or poor connections between the pins and the valveholder sockets is another cause. In obstinate cases, the trouble could be caused by a fault in one of the oscillator tuning capacitors. These are C10, C11, C12 and C13, and since they have a computed temperature coefficient, replacement must be made only with components recommended by the makers. The positioning is also very critical, and the replacement component must occupy exactly the same position as the original.

Critical Layout

The tuner unit is usually screened by screw-on metal panels, and to avoid oscillator drift and microphony it is essential that these are secured tightly after a servicing operation. It is also important not to disturb unnecessarily the wiring in the tuner unit, as this could result in misalignment and also instability which could give the effect of microphony. In Fig. 7 is shown the inside of a tuner unit which employs permeability tuning. The permeability-tuned coils can clearly be seen, as also can the coil-springs which hold the cores under tension against the cord-drive arrangement. The cord-drive is coupled to the main tuning mechanism, and as this is operated, so the cores traverse the coil formers to tune over Band II.

Fig. 7 also shows the components and the short connecting wires in relation to the valveholder. Microphony can sometimes be detected by knocking the tuner chassis sharply with the handle of a screwdriver, and in this event the trouble is often caused by a poorly soldered connection, or small capacitors or resistors touching the chassis or some other component. Loose screening plates or cans produce a similar effect, as also does a microphonic valve and faulty valveholder. The microphony is produced by frequency modulation of the local oscillator, which, of course, gives rise to an audio output from the detector.

(To be continued)

A SIMPLE CONDENSER BRIDGE

(Continued from page 588)

For example, say the range switch is set at 0·001μF and the circuit resistance of the variable resistance is found to be 500,000 ohms. Then—

$$C = \frac{0{\cdot}001 \times 1{,}000{,}000}{500{,}000} = 0{\cdot}002\mu F$$

This measurement is very accurate provided good components are used together with a reliable ohmmeter. (The range switch pointer indicates the lowest capacity to be read on each range.)

By adding a dial and pointer to the variable resistance, it will, of course, be possible to calibrate the instrument, but this can lead to inaccuracies as the dial would have to be rather closely marked.

The standard terminals are used when it is desired to test a condenser which is either above or below the range of the instrument. Suppose a 0·5μF condenser needs testing. First, a similar condenser, but known to be accurate, and say of capacity 0·45μF, is connected to the standard terminals. The range switch is now turned to S and the 0·5μF connected to the test terminals in the usual way.

The formula would now be:—

$$C = \frac{0{\cdot}45 \times 1{,}000{,}000}{\text{Circuit variable resistance}}$$

If the condenser is correct, the variable resistance circuit resistance will be 900,000Ω.

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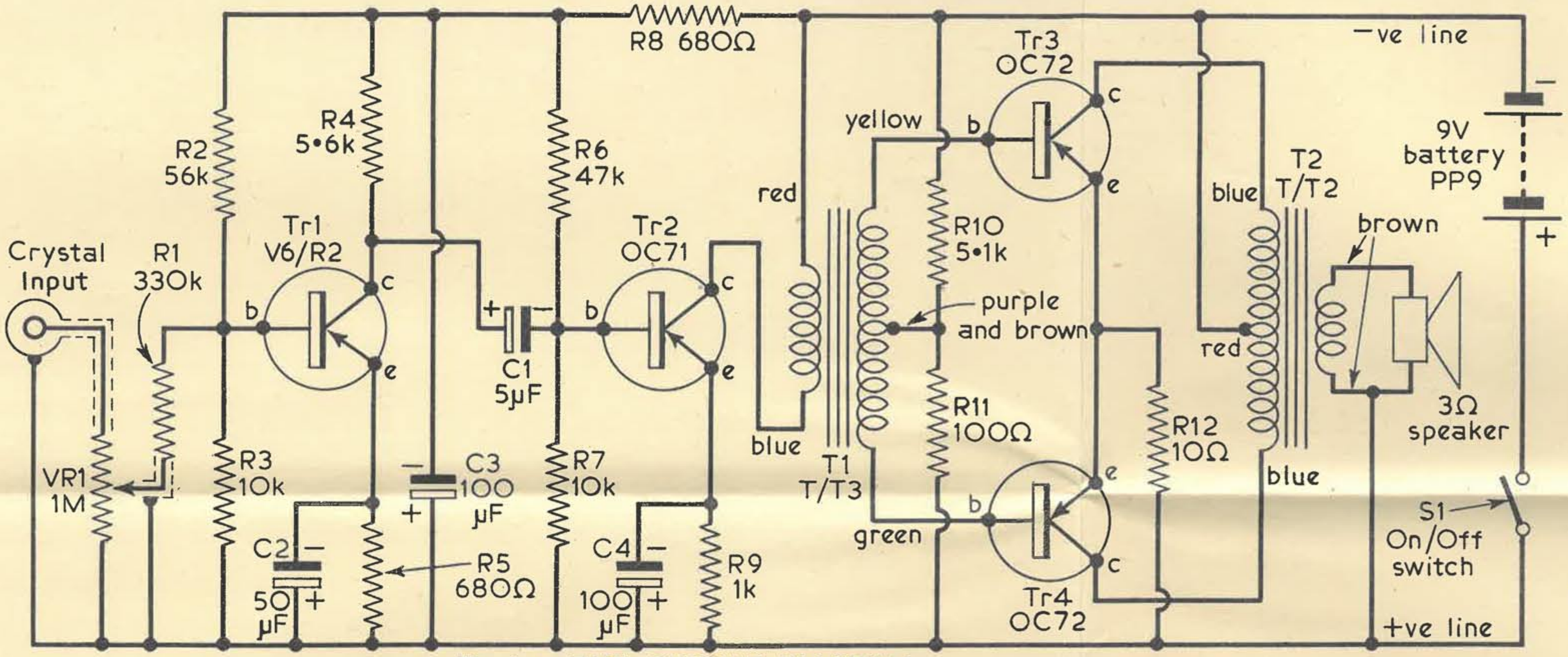
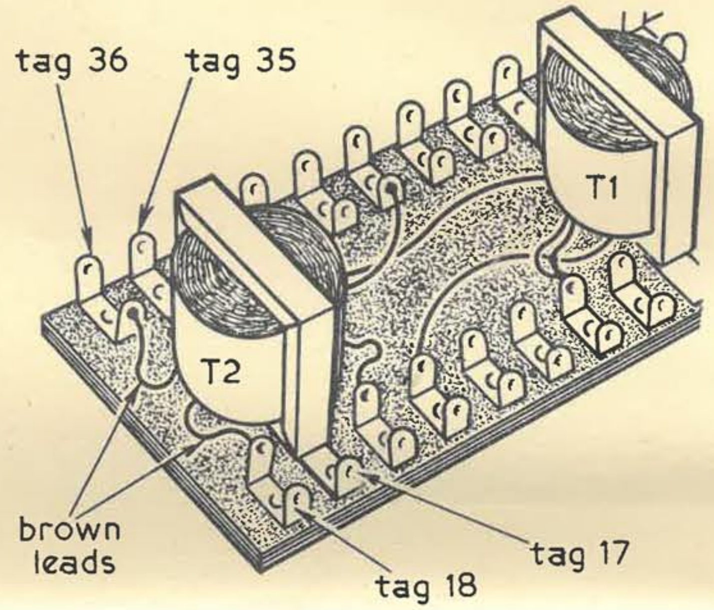


Fig. 1 — THE CIRCUIT DIAGRAM



Inner strip of tags 10, 28, 17 and 35 bent down to take transformer lugs
Fig. 3 — MOUNTING THE TRANSFORMERS

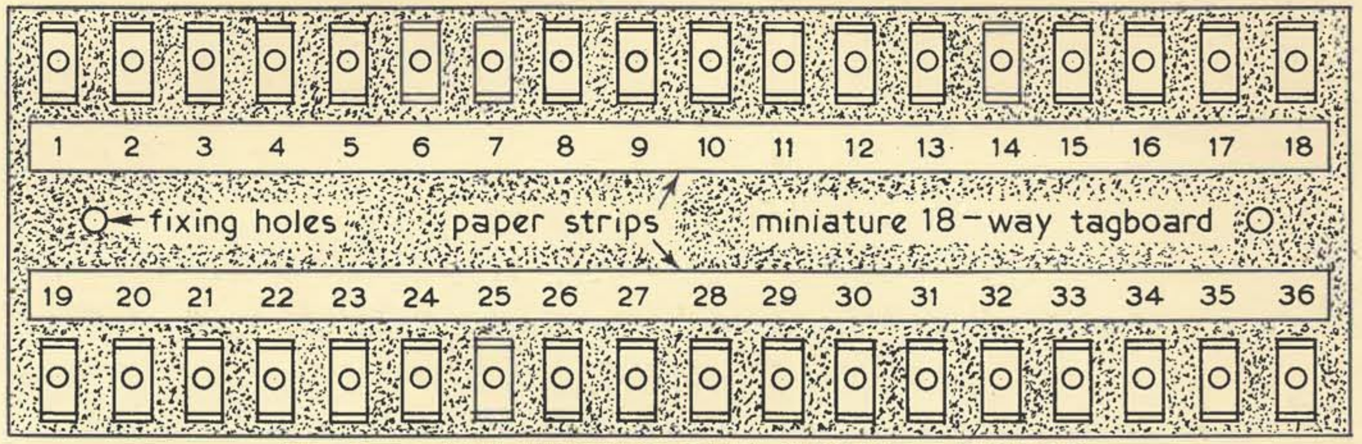


Fig. 2 — NUMBERING THE GROUP-BOARD

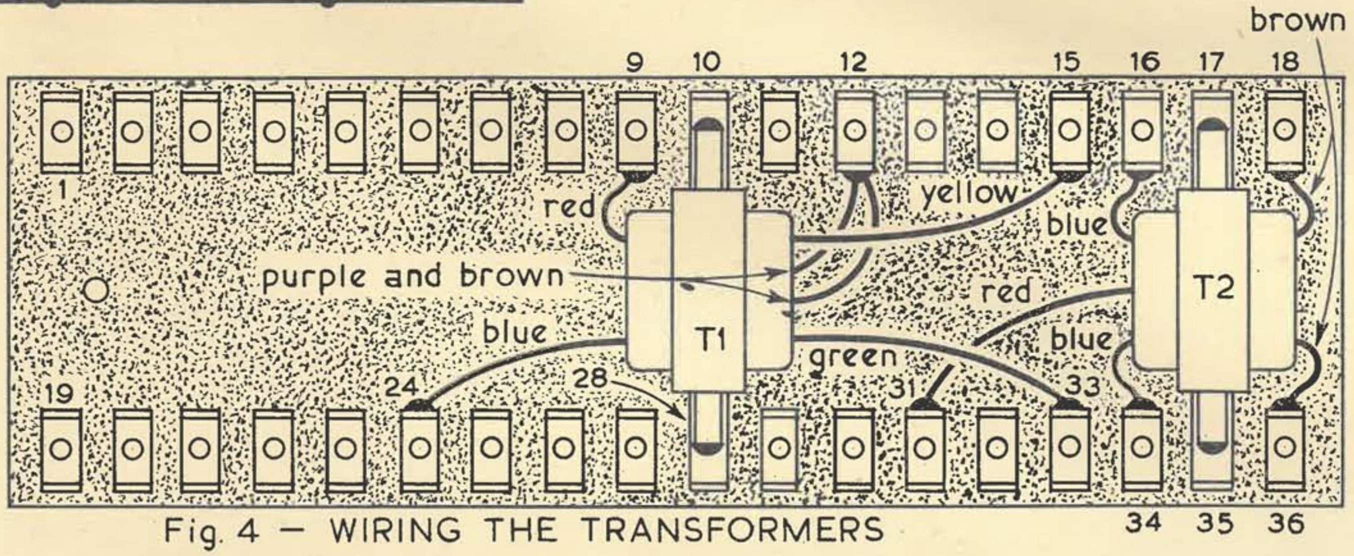


Fig. 4 — WIRING THE TRANSFORMERS

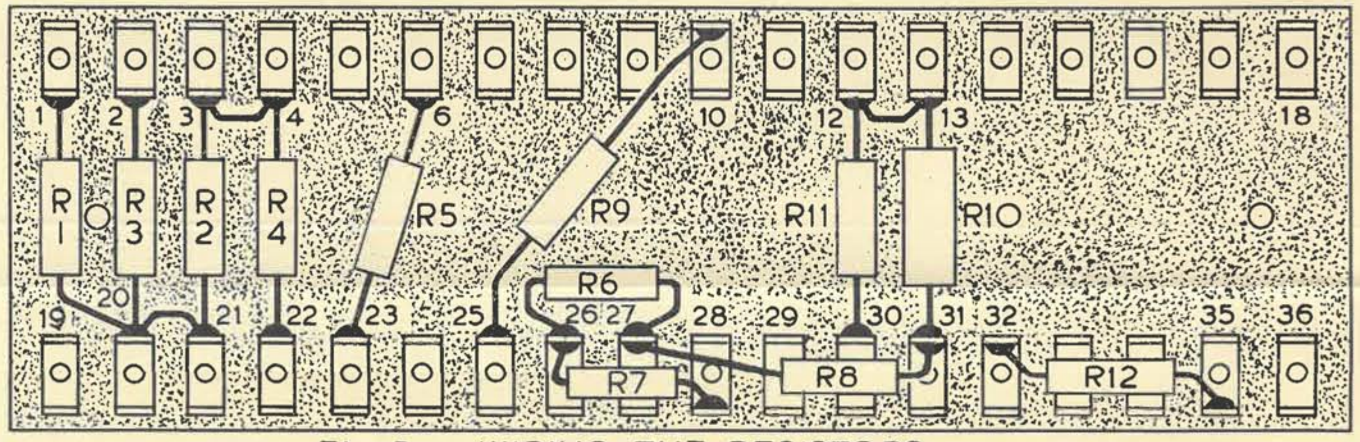


Fig. 5 — WIRING THE RESISTORS

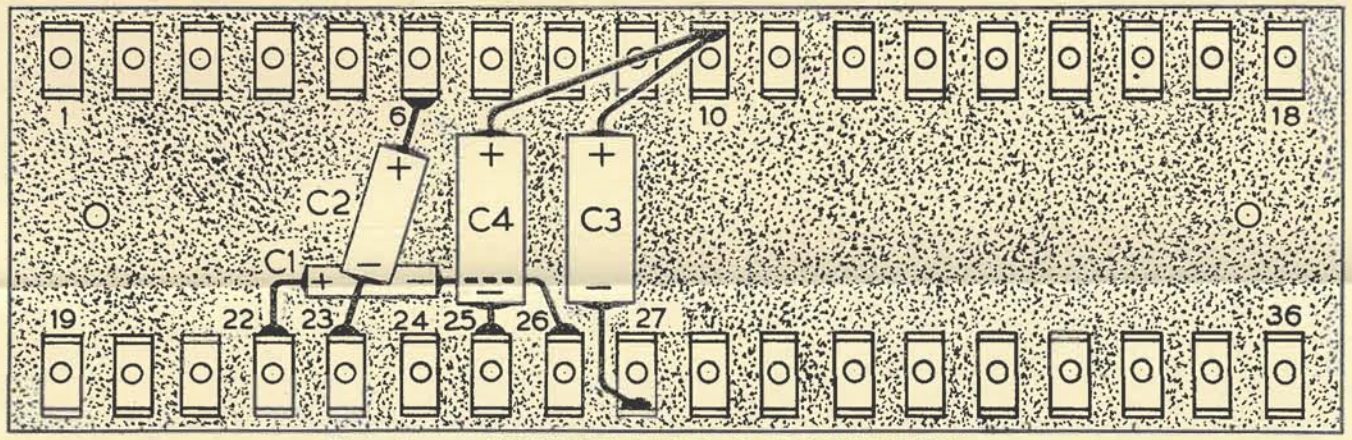


Fig. 6 — WIRING THE CAPACITORS

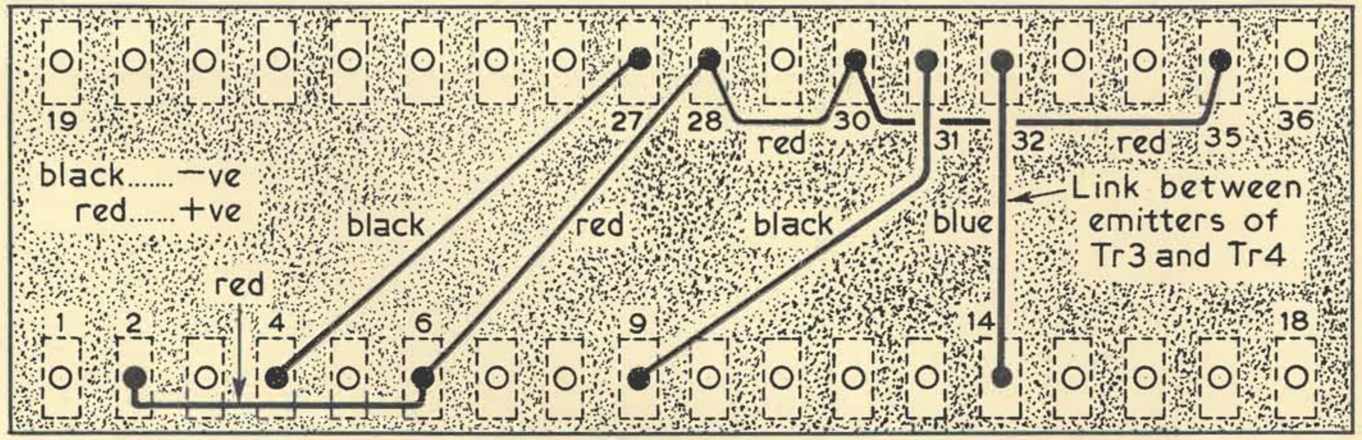


Fig. 7 — WIRING THE CONNECTING LINKS

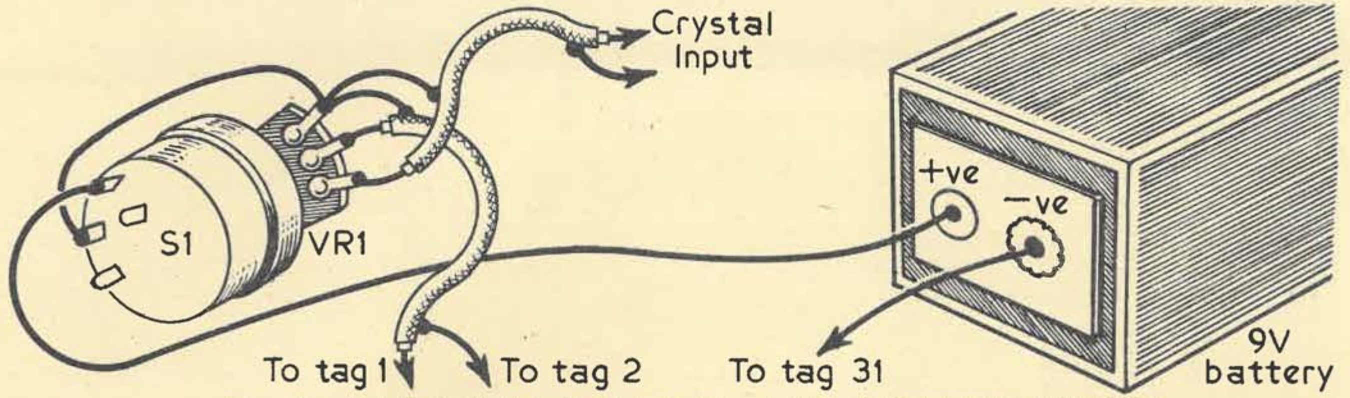


Fig. 8 — VOLUME CONTROL AND BATTERY WIRING

LIST OF PARTS

Resistors
All ½W and 10% tolerance except R10 and R11

R1	330k or 220k	(1 and 20)
R2	56k	(3 " 21)
R3	10k	(2 " 20)
R4	5·6k	(4 " 22)
R5	680Ω	(6 " 23)
R6	47k	(26 " 27)
R7	10k	(26 " 28)
R8	680Ω	(27 " 31)
R9	1k	(10 " 25)
R10	5·1k 1% or 5%	(13 " 31)
R11	100Ω 1% or 5%	(12 " 30)
R12	10Ω	(32 " 35)
VR1	1M Volume control with switch	

All numbers in brackets refer to tags to which components are soldered.

Capacitors

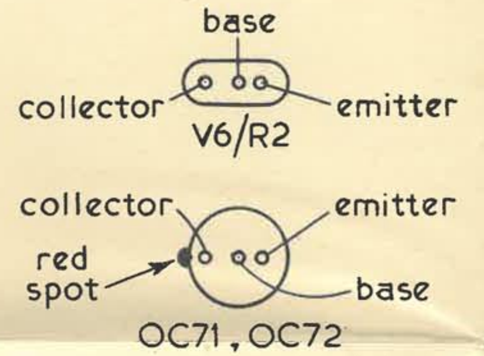
C1	5µF	15VW	(22 and 26)
C2	50µF	15VW	(6 " 23)
C3	100µF	15VW	(10 " 27)
C4	100µF	15VW	(10 " 25)

Transistors
Tr1......V6/R2 (Newmarket)
Tr2......OC71 (Mullard)
Tr3, Tr4......Matched pair of OC72's (Mullard)

Transformers
T1......Driver Transformer type T/T3 3·6 : 1 + 1 (Radiospares)
T2......Output Transformer type T/T2 3·3 + 3·3 : 1 (Radiospares)

Loudspeaker....3in. to 10in., permanent magnet type, 3Ω to 5Ω impedance.
Battery......PP9 with two clips to suit (Ever-Ready)

Miscellaneous
18-way tagboard (Radiospares)
Screened cable, connecting wire, solder etc.



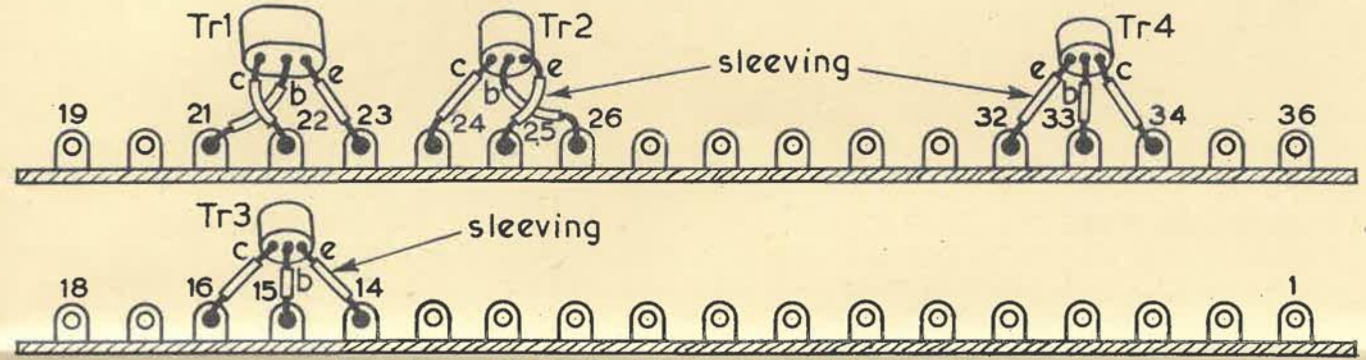


Fig. 9 — WIRING THE TRANSISTORS

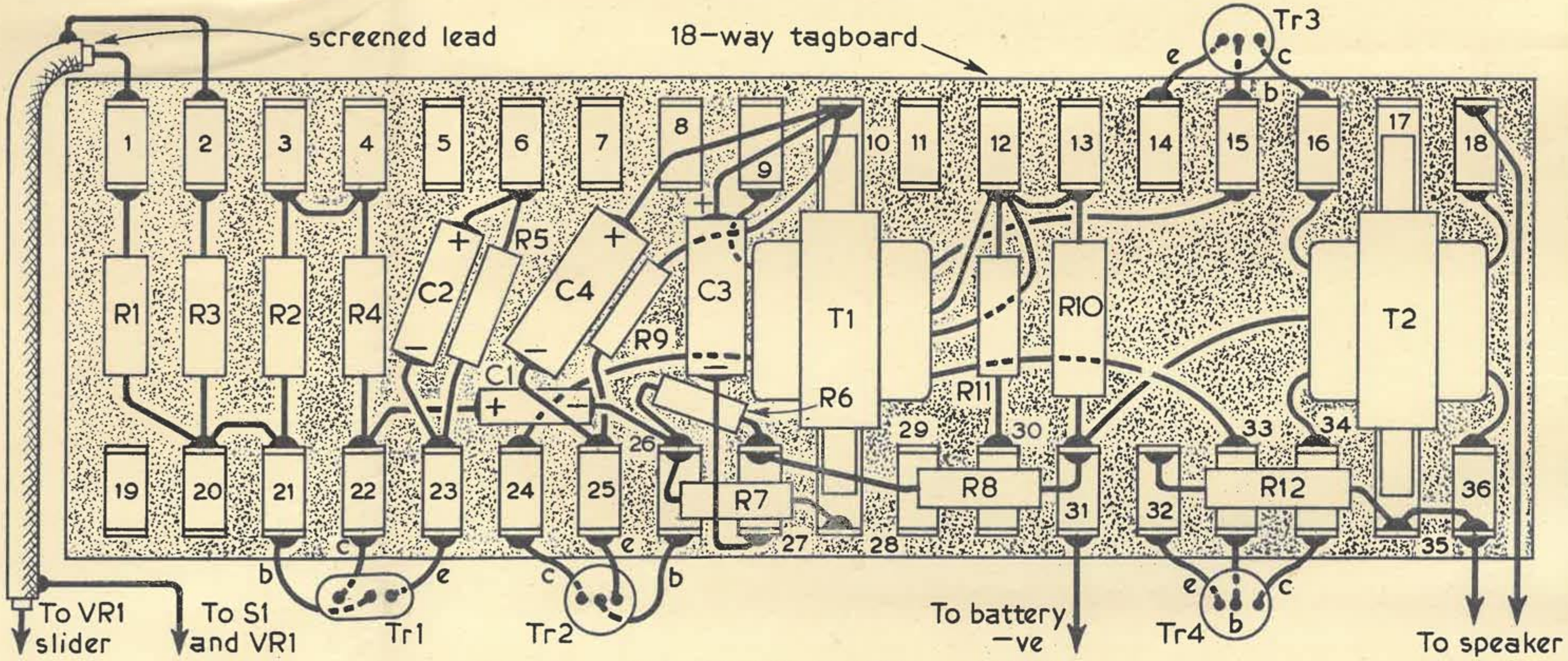


Fig. 10 — COMPLETE WIRING DIAGRAM

Practical Wireless

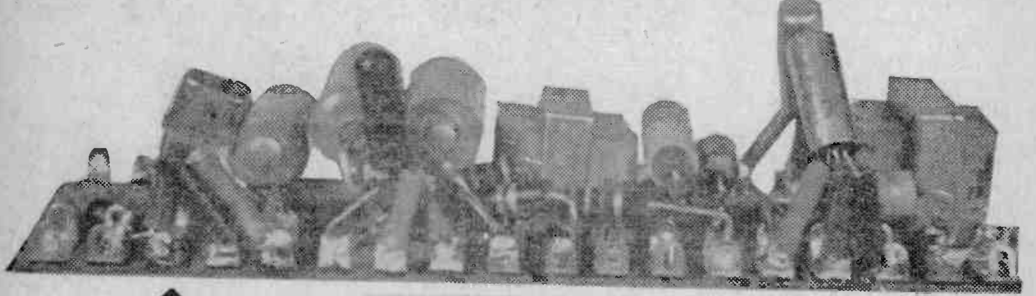
MINI-A

THE circuit of the Mini-Amp is fairly conventional, but the method of construction uses no chassis, printed circuit or nuts and bolts. The finished unit measures 4½in. x 1½in. x 1⅛in. and the volume control (which incorporates the on/off switch) could be fitted over the front end of the tag strip although it has been fitted on an extension screened lead on the prototype.

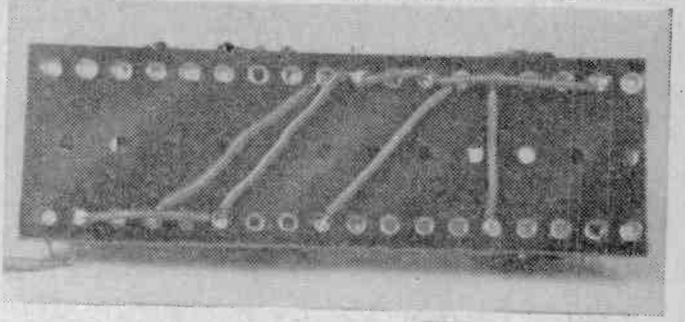
Current Consumption

The amplifier is designed to be fed from any conventional type of crystal pick-up and it is possible to drive a 9V record-player motor from the same battery, although a separate battery is always best. The current consumption is about 4mA when switched on but not playing, and up to 50mA when playing, according to the volume. The amplifier will operate at full volume on one PP9 battery for 70 hours at least, at a cost of under 1d. per hour.

The components are definitely obtainable from any radio dealer to order and substitutes should not be used. The values of R10 and R11 are particularly important and 5% or 1% components should be used (see Blueprint).

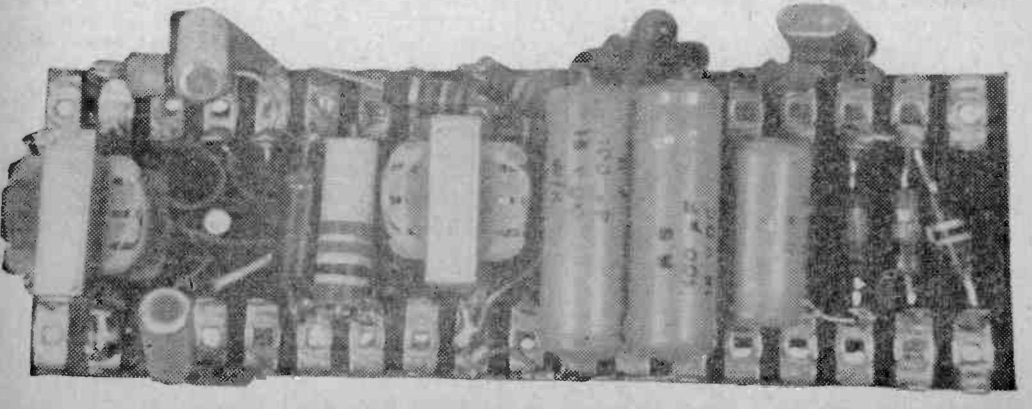


A General view of the Mini-Amp



The wiring on the reverse side of the group-board.

This shows clearly the simple layout of components.



MP

By J. Bisset

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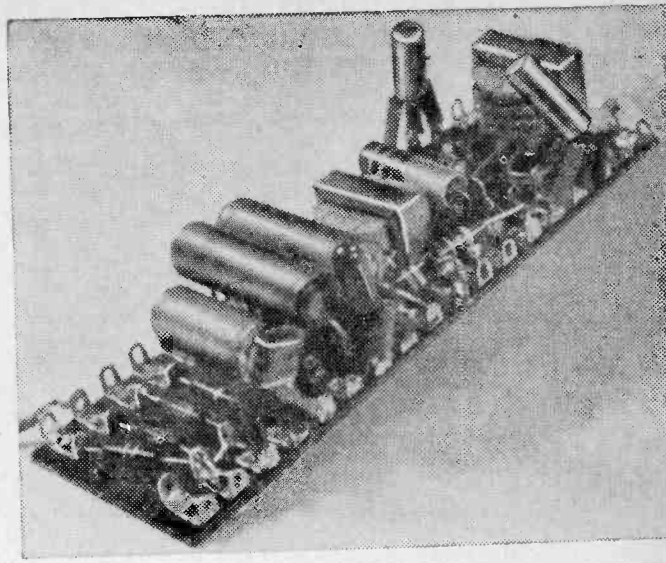


The Mini-Amp.

Method of Construction

Full constructional details are given in the Blueprint, and wiring and assembly of the "Mini-Amp" should follow the layouts given in the correct order.

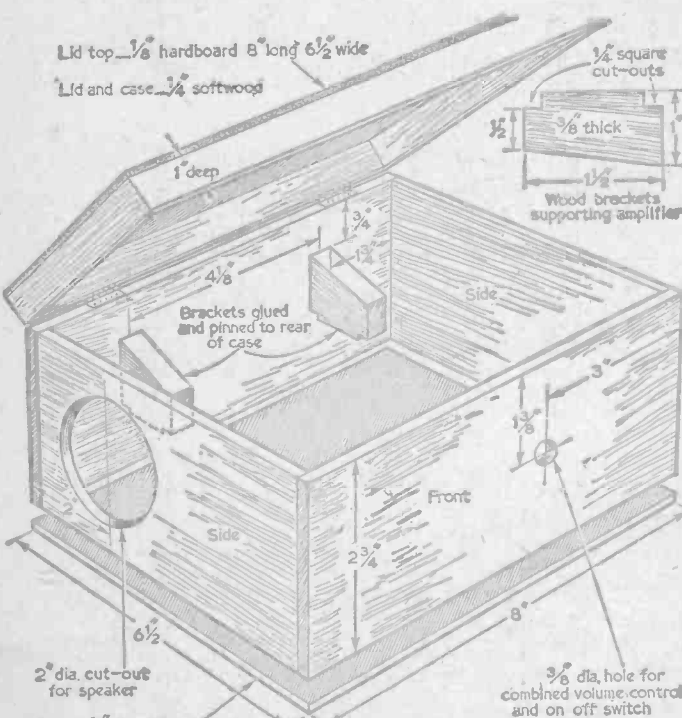


Fig. 11.—Details of a suitable cabinet for the Mini-Amp used in a record player.

The complete circuit diagram is given in Fig. 1 on the Blueprint, but it is not strictly necessary to understand this fully in order to build the "Mini-Amp". The first step in building the unit is to glue two strips of paper—numbered as indicated in Fig. 2—to the group-board so that it will not be necessary to count the number of each tag to which the components have to be soldered. If glue is applied only at the ends of each strip, then they may easily be removed when construction is complete.

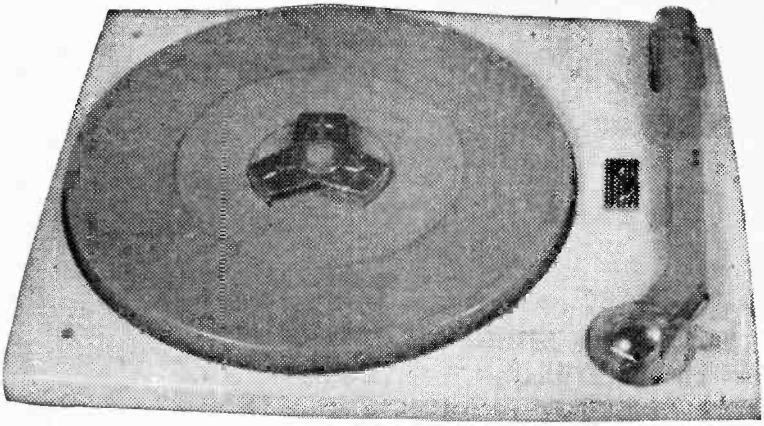
Mounting the Transformers (Fig. 3)

The two transformers are then mounted in the manner shown in Fig. 3. The fixing tags, which are bent under the transformers when they are purchased, are bent outwards, and the inner tags of the group-board (17 and 35) are bent flat on the paxolin panel. Transformer T2 is then soldered in position with the side having two brown wires towards tags 18 and 36.

The other transformer (T1) is mounted on tags 10 and 28 in the same way with the two-wire side towards tags 1 and 19. The first stage of construction is now completed and should look like Fig. 4. The transformer leads are now shortened carefully so as to reach the tags shown. They are then carefully soldered to the tags exactly as in Fig. 4. The wires of miniature components are very fragile and care is required in removing the insulation if the wires are not to be severed within the transformers.

Fixing the Resistors in Circuit (Fig. 5)

The numbers in brackets on the components list are the tags to which the resistors are soldered. These can also be seen in Fig. 5 which shows the additional wiring to that of Fig. 4. Where wires solder to tags to which the transformers are mounted, do not use too much heat (tags 10, 17, 28 and 35). Keep the wires of all the resistors as short as possible and check that no solder falls between adjacent tags.



The record player deck used in this design (available from many advertisers and distributed in this country by Greencoat Electronics Ltd., 2 Princes Row, Buckingham Palace Road, London, S.W.1).

Fixing the Condensers in Circuit (Fig. 6)

The small condenser C1 is the first to be fixed in circuit between tags 22 and 26, it must be laid almost flat on the paxolin, but care is required so that it will not touch resistors and leads. The other condensers are then fixed as shown in Fig. 6. Note the polarity, usually denoted by the positive ends having red markings or a red or black rubber washer. Condensers with insulating sleeves over the metal case are best in this position as then they may be positioned close to the other components.

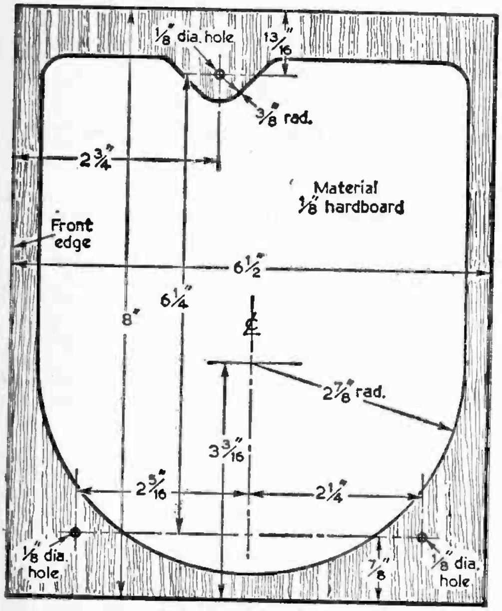


Fig. 12.—Dimensions of the motor-board and cut-out.

Wiring on the Back of the Group-board (Fig. 7)

Certain wires between tags are required and the layout is shown in Fig. 7. One red wire, one blue, and two black wires are required. The red wire is the conventional earth or chassis wire. The blue wire joins the emitters of the output transistors and the black wire is for the negative "H.T." line.

External wiring (Figs. 8 and 10)

Two leads are required for the 3Ω P.M. speaker (any size up to 10in. will work well, but a 3in. loudspeaker gives good results and is little bigger than the "Mini-Amp").

Connecting the Screened Cable

Screened cable consists of a plastic-insulated wire which is surrounded by a tubular, woven-wire screen, which, in turn, is insulated with a plastic covering. When making connections to screened cable, the first step is to expose the screening of the cable by stripping off about 1in. of the outer covering of the cable—taking care not to cut the fine wires of the screen in the process. Next, unravel the woven screen with a large needle or pointed object. When it is unravelled, twist the strands together so that they form a connecting wire separate from the inner wire (which should now be exposed). The insulation of the inner wire may now be removed for a length of about ¼in. and the strands twisted together. The screening and inner wire are now ready to be soldered where required.

A screened lead is taken from tags 1 and 2 to the volume control, the *inner* lead going to the middle (slider) tag, and the screening of the cable is soldered to the tags shown in Fig. 8. A similar wire is taken to the crystal pick-up, the screening and inner lead being soldered as shown in Fig. 8.

The screening acts as one battery lead and is also connected to one tag of the switch, the other tag going to the *positive* battery terminal.

Fixing the transistors (Fig. 9)

The leads of the four transistors are cut to $\frac{3}{4}$in. *carefully* and coloured sleeving slipped on. A suggested scheme is:—

Collectors — Black
Bases — Green
Emitters — Red.

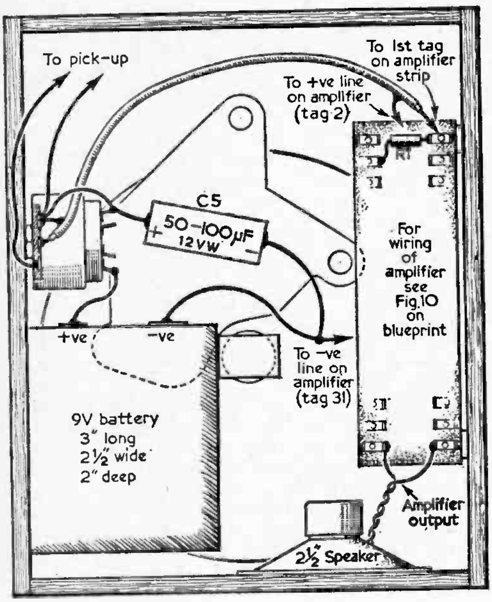


Fig. 13.—The wiring diagram of the record player.

The leads of the transistors should be soldered into circuit as quickly as possible so that the leads do not become too hot. A heat sink should be used to conduct the heat away from the transistors themselves as each lead is soldered into position. Complete details of the procedure, together with illustrations, were given on page 509 of the October issue in the article on the "Tutor". The method described used a pair of long-nosed pliers as a heat sink, but it is possible to use a small piece of damp cloth wrapped round the leads if care is taken not to allow other components to become damp.

The complete layout is given in Fig. 10 and the wiring should be checked carefully against this diagram before testing the unit. It is most important that all components have been connected correctly, especially the condensers and transistors. The battery must be connected correctly or the transistors will be ruined.

The transistors may be bent over gently so as to take up less space, but the leads should not be bent nearer than $\frac{1}{8}$in. to the transistors.

The completed layout is shown in Fig. 10.

Using the Mini-amp

The ideal use for an amplifier of the small size of the Mini-Amp is in a battery-operated, record player. A suitable turntable unit can be seen in the illustration (page 610). This deck is for playing 45rev/min records—EP's—and it can be powered from the same battery as the Mini-Amp, provided that a condenser of 100μF 12VW is wired across the "H.T." line of the amplifier and motor. This condenser prevents any interaction between the motor and the amplifier, and is clearly shown in Fig. 13. This condenser must not be wired on the battery side of the on/off switch or excessive battery drain may may take place. The dimensions and construction of a suitable case for the record player are shown in Fig. 11, and the small size of the finished unit is illustrated. The case is of simple box form and has a hinged lid; when finished, it may be covered in an adhesive plastic material or rexine if desired. The dimensions of the motorboard are given in Fig. 12, and an underside view of the record player in Fig. 13—this diagram also shows the simple wiring needed to link up the deck with the amplifier.

The loudspeaker recommended for the EP record player is the 2½in. Whiteley model P2.585. It should be noted that the leads of the gram motor are taken from battery negative and the on/off switch so that the switch functions for both the Mini-Amp, and the motor.

Next month's article and free gift Blueprint will deal with the construction of a superhet frequency-changer and I.F. amplifier of which the Mini-Amp will form the output stages. ■

Electrolytic Capacitors

(Continued from page 596)

Capacitors which have been stored for any length of time may well suffer from a relatively high leakage current, but before they are thrown away an attempt should be made to re-form them. This is accomplished by connecting the capacitor across a D.C. supply giving a voltage approximately 10 per cent in excess of the working voltage of the capacitor. A 15W 230V bulb should be connected in series with the circuit, as shown in Fig. 3 (page 596). The current should be measured on a milliammeter, and for the sake of safety it is desirable to shunt the movement by a switch as shown by S.

Before switching on, S should be closed, and when the power is applied the bulb will glow fairly brightly to start, but will quickly dim right down and eventually go out as the capacitor re-forms. At this stage it will be safe to switch in the milliammeter, and the resulting reading will represent the leakage current of the capacitor.

If the bulb or bulbs light brightly and remain so, then the capacitor is useless. Similarly, if the bulb lights momentarily at random intervals during the re-forming process, the capacitor has an intermittent short and should not be used. The curve in Fig. 4 gives some idea how the leakage current will diminish with time in a capacitor which responds normally to treatment.

It should be noted that temperature increase affects the leakage current, and a curve illustrating this effect is given in Fig. 5.

High Gain Amplifier

A VERSATILE UNIT WITH VERY LOW NOISE AND DISTORTION LEVELS

By R. Murray-Shelley

THE high sensitivity of this amplifier, together with its lack of distortion and low noise level, makes it suitable for use where a low input (such as is obtained from certain types of record player pick-up units, and the majority of tape playback heads) is available. The output of the amplifier is more than adequate for domestic purposes.

The Circuit

A novel feature of the circuit, the complete diagram of which is shown in Fig. 1, is the provision of both high and low input impedance facilities. In the normal way, a low impedance supply is matched to the naturally high input impedance of the valve amplifier using a matching transformer. This method has drawbacks, in that the transformer, unless it is very carefully screened, both electrically and magnetically, is a source of hum. In this circuit, therefore, a transistor is used to replace the matching transformer. It is connected in such a way that, while its input impedance is low, its output impedance is sufficiently high to match the valve amplifier. This circuit has the added advantage that the transistor provides a considerable amount of gain.

The remainder of the circuit is fairly conventional. Three amplifying valves are used. The first is an EF86 working as a voltage amplifier. This valve is particularly suitable in this position owing to its freedom from microphonic effects. This is resistance/capacity coupled to the following stage, a 6BR7—the 6BR7 is a B9A-based version of the better known octal-based 6J7, which could equally well be used in its place. The output stage comprises a single EL84, which is quite capable of giving up to 4½W output.

Feedback

Volume is controlled in the normal manner, by attenuating the input to the EF86 as required. A simple, but none the less effective, top-cut treble control is taken from the anode of this valve.

Negative feedback is used within the amplifier, both to reduce distortion, and to stabilise the operation of the unit. The main loop is taken from the secondary of the output transformer to the cathode of the 6BR7. This circuit is frequency selective, and by using a variable resistor in the loop as shown, control may be exercised over the bass response of the amplifier. This serves as a very efficient bass control circuit. A second negative feedback loop is between the anodes of the EF86 and the 6BR7, via a 2·2M resistor.

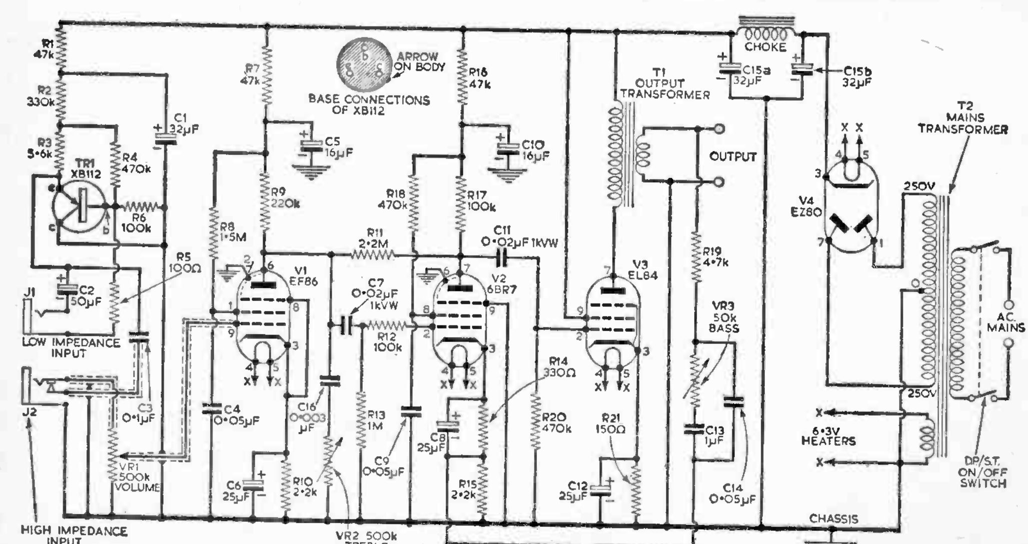


Fig. 1.—The circuit of the amplifier.

Power Supplies

It is very important when designing equipment of this kind, to ensure that adequate smoothing circuits are provided. This is particularly true, when, as in the case of this amplifier, the signals handled by the earlier stages are of a low magnitude. To this end it has been found necessary to decouple each stage using fairly high value electrolytic condensers.

The power unit itself is conventional. An EZ80 rectifier was used in the prototype, but almost any valve, preferably having an indirectly heated cathode, could be used. The mains transformer should be capable of supplying 250-0-250V at 65-70mA, and 6·3V at 1·5A for the valve heaters. If a rectifier having a 5V heater is used, then provision must be made for this when obtaining the mains transformer.

The transistor obtains its power from the smoothed H.T. line, thus eliminating the need for any form of battery.

Components

The transistor used in this circuit is the XB112, and it is recommended that this specific component should be employed. The resistors in all cases need only be of 10% tolerance, and they should be rated at ½W, with the exception of the cathode resistor, R21 (150Ω), which should have a rating of at least 3W.

The output transformer should be capable of handling 5W. If a 3Ω impedance speaker is to be used with the unit, then a transformer ratio of 40:1 will be required; for a 15Ω speaker, the ratio is 15·5:1.

The coupling condensers (C7 and C11) should be of 1,000VW D.C., and beyond suspicion as regards leakage. The valveholders, all B9A types, should, if possible, be of moulded or nylon loaded construction, to minimise the possibilities of breakdown or tracking.

It will be noticed from the circuit diagram (Fig. 1) that connections are made to the amplifier using jack plugs and sockets. Two jack sockets will be required for the inputs. One of these has

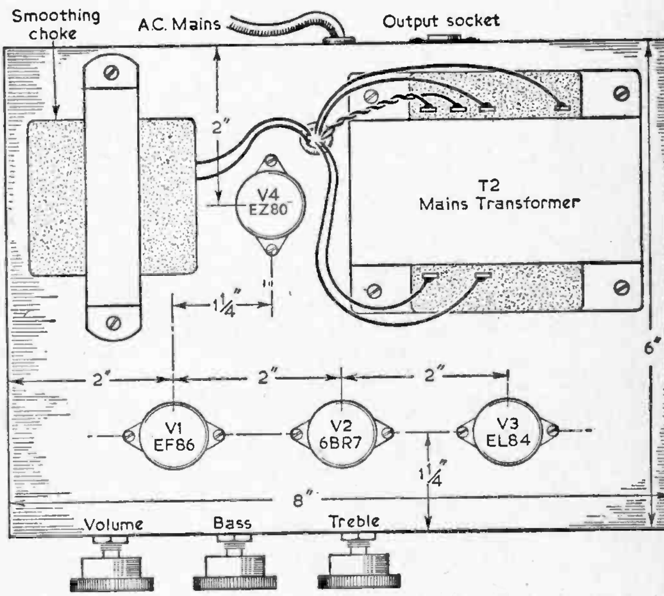


Fig. 2.—The above chassis layout of components.

COMPONENTS LIST

Resistors

R1	47k	R12	100k
R2	330k	R13	1M
R3	5·6k	R14	330Ω
R4	470k	R15	2·2k
R5	100Ω	R16	47k
R6	100k	R17	100k
R7	47k	R18	470k
R8	1·5M	R19	4·7k
R9	220k	R20	470k
R10	2·2k	R21	150Ω 3W
R11	2·2M		

Capacitors

C1	32μF 350VW	C7	0·02μF 1,000VW
C2	50μF 25VW	C8	25μF 25VW
C3	0·1μF 250VW	C9	0·05μF 500VW
C4	0·05μF 500VW	C10	16μF 350VW
C5	16μF 350VW	C11	0·02μF 1000VW
C6	25μF 25VW	C12	25μF 25VW

C13 1μF 150VW
C14 0·05μF 250VW
C15 32+32μF 450VW
C16 0·003μF 500VW

VR1 500k potentiometer—log with D.P. switch
VR2 500k potentiometer—log
VR3 50k potentiometer—linear

J1 Jack socket (Bulgin type J11)
J2 Jack socket (Bulgin type J12)

T1 Output transformer (see text)
T2 Mains transformer—Primary to suit mains supply
Secondary, 250-0-250V 70mA 6·3V 1·5A

V1 EF86
V2 6BR7
V3 EL84
V4 EZ80

TR1 XB112 transistor.

Chassis, connecting wire, B9A valveholders, output socket, tagboards, etc.

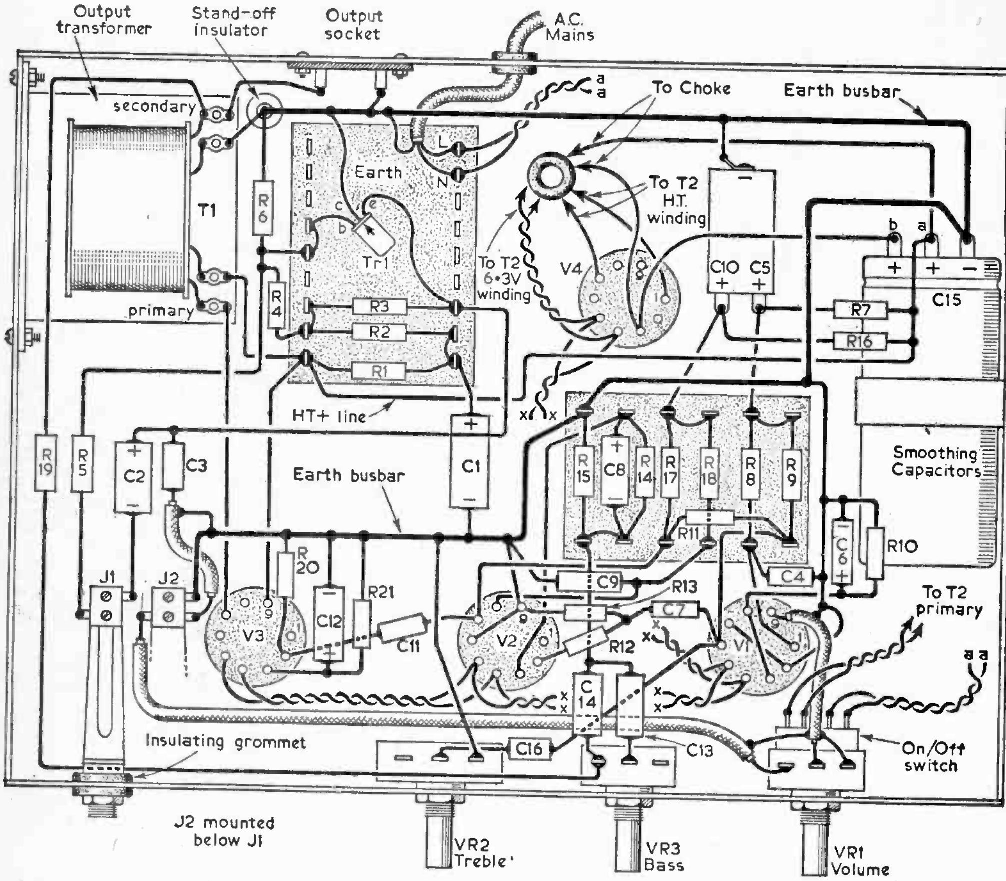


Fig. 3.—The underchassis wiring diagram.

integral switching contacts, which open the circuit when a plug is inserted. Thus, the effect of these contacts, when connected as shown, is to switch out the transistorised stage of the amplifier when a high impedance input is connected.

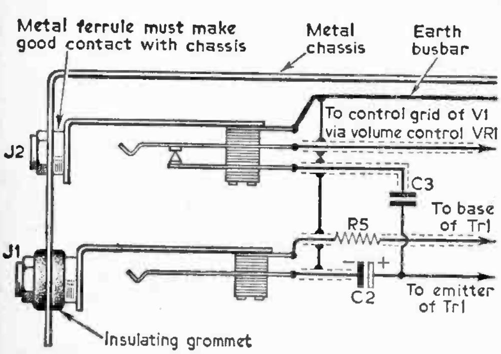


Fig. 4.—The method of mounting the jack sockets and the connections to them.

Construction

The prototype amplifier was built on an aluminium chassis, size 8in. x 6in. It would be impractical to use a chassis of smaller dimensions than these. On the other hand, the use of a very much larger chassis is not to be recommended, since all connections should be kept as short as possible to reduce the effects of induction and feedback which lead to noise and instability.

With a view to keeping down the hum level of the amplifier, all earth returns are made to an earth bus-bar, which is itself connected to the chassis at only one point. This bus-bar is made from a length of 16 or 18s.w.g. tinned copper wire, which is mounted on the chassis in the manner shown in Fig. 3.

The chassis itself is earthed. If it were left "floating", i.e. not connected to earth, then trouble might be experienced due to hum.

Mounting Components

It will be seen from the diagram (Fig. 3) that the output transformer is mounted below the chassis. This transformer is mounted first.

(Continued on page 622)

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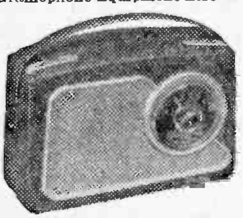

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Full details of any of the above supplied free on request.
The AVO Models 7 and 8 are both latest models from current production—not to be confused with Government Surplus.

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ALL CARRIAGE FREE	Cash Price	Deposit	Hire Purchase Mthly/Pmts.
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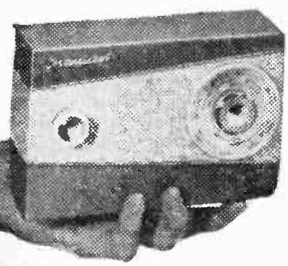

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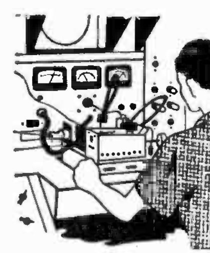

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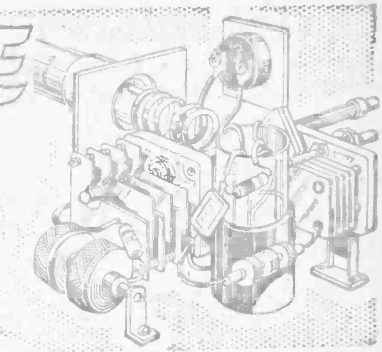

A VARIABLE FREQUENCY AUDIO FILTER FOR 'PHONE AND C.W. RECEPTION WHICH CAN ALSO BE USED AS AN AUDIO OSCILLATOR

By J. B. Dance, M.Sc.

THIS unit is a device which provides either greatly increased or greatly decreased amplification over a chosen narrow band of frequencies with a fairly level response over the remainder of the audio frequency spectrum. The frequencies in the chosen band are said to be either "selected" or "rejected".

Uses

Such a device is useful in 'phone reception when switched to the "reject" position because a narrow band of frequencies can be tuned out so as to remove a heterodyne whistle with negligible effect on other audio frequencies.

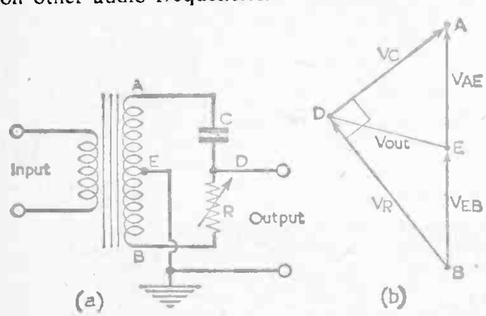

Fig. 1(a).—Simple circuit for variable phase output.

Fig. 1(b).—The voltage vector diagram for the circuit of Fig. 1(a).

In C.W. reception the wanted audio beat note can be selected from all other audio frequency noise by using the instrument in the "select" position where positive feedback is applied. If the amount of positive feedback is increased, oscillation will occur and the device can be used as a variable frequency audio oscillator which gives a constant output voltage as the frequency is altered.

Principle of Operation

Let us first consider the circuit of Fig. 1(a). The voltages at the points marked A and B are in push-pull so that $V_{AE}=V_{EB}$ where V_{AE} is the voltage between points A and E. If the current taken from the output is negligible, the voltages in the circuit of Fig. 1(a) can be represented by the simple vector diagram of Fig. 1(b) in which V_C=voltage across the condenser C and V_R=voltage across R. The voltages V_C and V_R are 90° out of phase and therefore the angle between them in the vector diagram is a right angle. From geometry it can be seen that as V_R varies with R, the path traced out by the point D is a semicircle of which E is the centre. Therefore the length of ED is constant but changes in direction. This means that the output voltage from the circuit of Fig. 1(a) is constant in amplitude but changes in phase as R varies. At one particular value of R (where ED in Fig. 1(b) is perpendicular

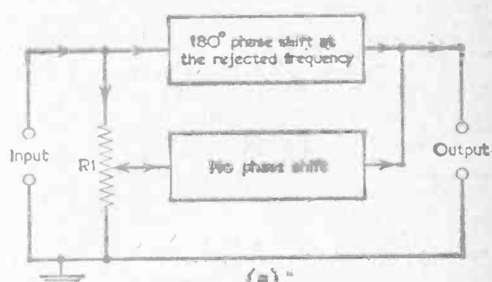

Fig. 2(a).—Block diagram of the filter unit switched to "reject".

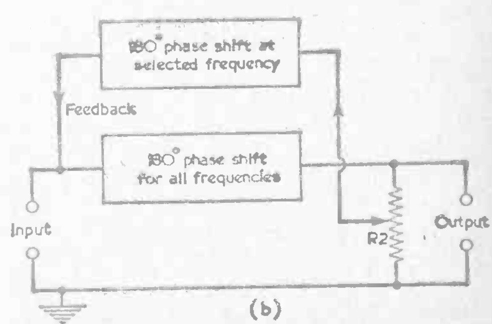

Fig. 2(b).—Block diagram of the filter unit switched to "select".

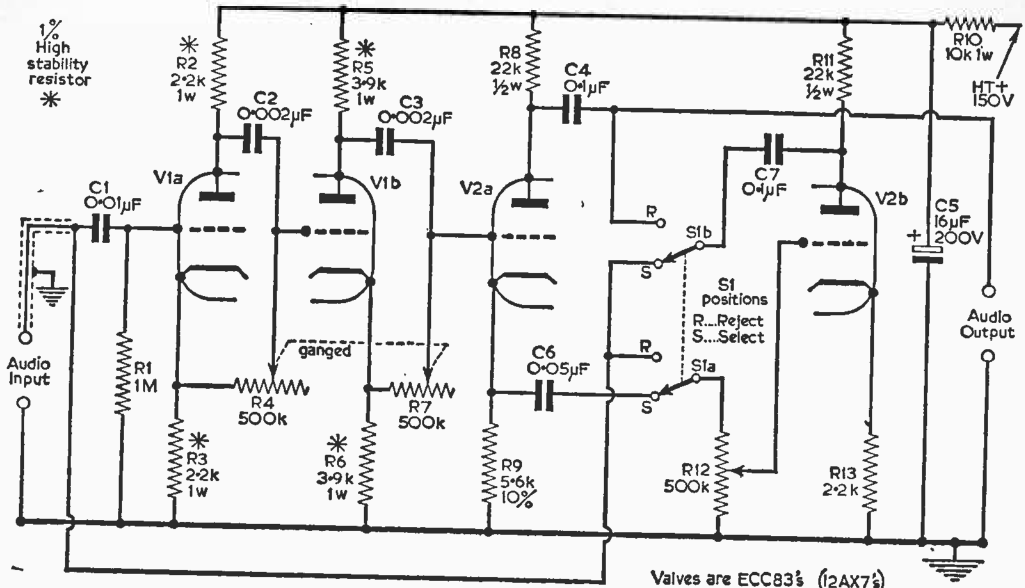

Fig. 3.—The series filter unit.

to AB) the output from Fig. 1(a) circuit will be 90° out of phase with the input at a certain frequency. Two such circuits in series can be used to obtain a phase shift of 180° at that frequency, the two variable resistors R being ganged together. At the frequency concerned the impedance of the condensers C will each equal the resistance of either of the resistors.

The block diagram of Fig. 2(a) shows how the arrangement discussed above can be used to give the rejection property of the filter. The audio input is applied to the circuit which will give 180° phase shift at the chosen frequency and is also applied via the potentiometer R1 to an amplifier which gives no phase shift (or alternatively 360° phase shift). If the potentiometer R1 is adjusted so that the gain of both the paths is the same, the two outputs will completely cancel at the chosen rejection frequency. At other frequencies the phase of the signal in the upper path will not be altered by 180° and cancellation will not occur at the output.

By simple switching the arrangement may be converted to that of Fig. 2(b); in this form a certain frequency can be "selected" or the circuit can be used as an oscillator. At the chosen frequency the upper amplifier gives 180° phase shift and the feedback is positive. The amount of feedback is determined by the setting of R2. If enough feedback is used, the unit will oscillate at the frequency at which the phase shift in the upper network is exactly 180°.

Practical Circuits

A practical circuit is shown in Fig. 3. It is not convenient in practice to use the transformer phase splitter circuit shown in Fig. 1(a) and cathode follower phase splitters are used (V1a and V1b in Fig. 3). The frequency determining components are R4, C2 and R7, C3. Resistors R4 and R7 are ganged together; slight tracking errors in the ganging of these variable resistors is of no practical importance, as it does not affect the amount of attenuation of unwanted frequencies. The valves used are two ECC83 or 12AX7 miniature high impedance double triodes. Two 6SL7 valves would give somewhat similar results and could be used if octal valves are preferred. In order to obtain the best results, R2 and R3 should be high stability components matched to each other to within ±1per cent. The same requirement applies to R5 and R6. Although the power dissipated in these resistors is not large, it is advisable to use 1 or 2W components, as these will tend to retain their values better than the smaller types. The resistors recommended are fairly small in value so that the output impedance of each circuit is small and the circuit is not therefore affected by the very small currents taken by the succeeding valves. The cathode resistors R3, R6 and R9 have been made progressively larger so that direct coupling can be employed between the stages (this reduces unwanted phase shift, but the cathode bias of each stage is applied to the grid of the succeeding stage).

In the "reject" position, R12 may be adjusted for maximum rejection of the unwanted signal. In the "select" position it should be adjusted to give the desired amount of emphasis to the wanted audio frequency. If it is advanced too far, oscillation will take place.

If the ganged components R4 and R7 are of the linear type, the frequency scale will be crowded at one end. An inverse semi-log type will give a scale which is much more evenly spread out. A 2-pole, 2-way rotary switch is required for S1a and S1b. In the position marked "S" in Fig. 3,

(Continued on page 621)

(Continued from page 618)

the circuit is in the "select" position whilst in the position marked "R" it is in the "reject" position.

Use in Receivers

The values shown in the circuit of Fig. 3 have been chosen so that the output voltage is about the same as the input voltage. The unit can therefore be inserted in the receiver audio chain without affecting the gain of the receiver appreciably. It should normally be placed at a low level, high impedance point. Usually it is best to disconnect the diode detector in the receiver from the succeeding audio stage; the output from the detector is then fed into the unit and the output from the unit into the first audio stage of the receiver. This method of connection does not apply to the shunt circuit of Fig. 4 which is described later. If it is desired to obtain a gain of more than unity, the resistors R8 and R11 may be increased in value several times.

The frequency coverage is about 200c/s to 7kc/s. If a lower limit of about 75c/s is required, C2 and C3 should be increased in value to about 0·004μF or alternatively the resistance of the ganged variable resistors (R4 and R7) can be doubled to 1M each. If operation at high frequencies is desired, the values of C2 and C3 may be reduced to between 500pF and 1,000pF.

The H.T. supply should be well smoothed or H.T. fluctuations may cause the unit to oscillate when being used in the "select" position. A stabilised H.T. supply is, of course, ideal.

The Shunt Circuit

The circuit of Fig. 3 must be placed in series with the receiver audio circuit between, say, the detector and the first audio stage. This is not always easy in practice and therefore the shunt circuit shown in Fig. 4 has been evolved. Only a single connection (other than the power supplies) is required between the receiver and the unit. The input to the unit is connected to the output of the receiver detector, but the detector is not disconnected from the following audio stage. The shunt circuit may therefore be connected to an existing receiver much more easily than the circuit shown in Fig. 3. A single coaxial connection may be used from the detector output so that the unit can conveniently be placed with its controls on the front panel. The input to the unit must be taken from a point of high impedance; this is normally the output of a diode detector, but if a cathode follower detector is used, a 220k resistor should be inserted immediately after the detector.

Signals of any undesired audio frequency are shorted to earth by the shunt unit when in the "reject" position, but, in the "select" position, the signals of the chosen frequency are greatly amplified by feedback.

Low impedance miniature 12AU7 double triodes are used in the Fig. 4 circuit, but 6SN7 octal based valves will give a similar performance. V1b and V2a are the cathode follower phase splitters. The resistors R5 and R6 should be matched to ±1per cent. tolerance and should be high stability components. The same requirements apply to R11 and R12. A 6-pole, 2-way rotary switch is required for "select"/"reject" and it should have at least two wafers to avoid instability problems.

The ganged variable resistors R14 and R10 determine the frequency of operation. The tracking need not be perfect.

(Continued on page 650)

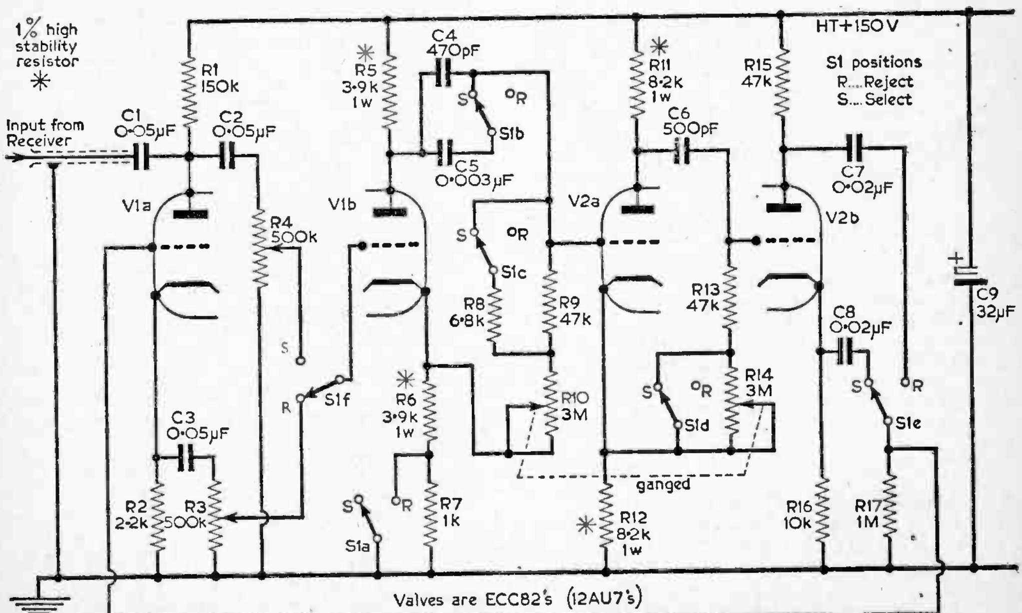

Fig. 4.—The shunt filter unit.

Club News

REPORTS OF CURRENT ACTIVITIES

AMATEUR RADIO MOBILE SOCIETY
Hon. Sec.: G3FPK, 79 Murchison Road, London E.10.
Many A.R.M.S. members attended the National Mobile Rally on September 10th at Woburn Abbey, Bedfordshire. Amongst other items, the competition for the Mobile Measurements Trophy was run. On September 24th the Surrey Radio Contact Club's 2 metre D.F. hunt was held.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derbyshire.
In connection with the Golden Jubilee Year celebrations the society have co-operated with the Museum authorities in the presentation of an exhibition covering fifty years of wireless. The exhibits include apparatus constructed in 1911 by members of the Derby Wireless Club. On September 6th the society held a surplus sale and on the 13th of the same month a direction finding practice run was held. Also during September members took part in the direction finding contest for President's Trophy.
Future Event:
October 11th—"The History and Development of Electric Storage Battery."

GOSPORT AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. J. Gilbert, G3OYL, 45 Queens Road, Gosport, Hampshire.
The first meeting on September 4th of this newly formed club, was held at the Gosport Community Centre, Bury House, Bury Road, Gosport. The club will meet every Monday evening at this address, at 7.30 p.m. A varied programme has been drawn up to cater for most aspects of amateur radio and anyone interested is welcome to attend the meetings.
It is hoped to have a club station operating at most meetings and if possible a simple constructional course will be held for beginners.

GUILDFORD AND DISTRICT RADIO SOCIETY
Hon. Sec.: J. R. Barker, G3PDX, 35 Banders Rise, Merrow, Guildford, Surrey.
At the moment many members are away on holiday but those who attended the meeting on September 14th heard a talk and discussion on S.S.B.

HOVE AND DISTRICT RADIO CLUB
Hon. Sec.: E. M. Large, School House, Frout Road, Hove 4, Sussex.
This new radio club holds its meetings every Wednesday from 7 to 9.45 p.m. at the Marmion Centre, Marmion Road, Hove 3. Anyone interested in any branch of amateur radio is welcome to attend the meetings.

MALMOE DX CLUB
This Swedish club invites DX-ers and short-wave enthusiasts in Britain to communicate with its members. Full details of the club, which caters for both SWL's and amateurs can be obtained from G. Traynor, 52 Kilbarchan Road, Johnstone, Renfrewshire, Scotland.

MITCHAM AND DISTRICT RADIO SOCIETY
Hon. Sec.: M. Pharaoh, G3LCH, 1 Madeira Road, Mitcham.
Meetings of this society are now only held once every fourteen days. This means that the club station meetings will be discontinued. From and including 6th October, meetings will start at 7 p.m. The first hour will be devoted to morse classes.
The society will be operating a station as part of the Fourth International Jamboree-on-the-air. This is organised by the Boy Scouts International Bureau and the station will be at the headquarters of the 3rd Mitcham Group on behalf of the Mitcham District Boy Scouts' Association. The Jamboree-on-the-air is to be held on October 20-22nd.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.
Recent activities have included a spares sale and a film show. On October 4th G8CB gave a talk about "144 Mc/s". Meetings are held at the Sportsman Inn, Ogden, Halifax at 7.45 p.m.
Future Event:
October 18th—Ragchew Night.

SUTTON COLDFIELD RADIO SOCIETY
Hon. Sec.: L. E. R. Hall, G3IGI, 24 Calthorpe Road, Walsall.
Maurice Capewell, the vice-chairman of the society, is leaving the district to take a teaching appointment in Cheshire.
Future Events:
October 26th—"DX TV Reception"; a tape recorded lecture by Charles Rafarel.
November 9th—"G.D.O.—its construction and use"; by P. Darragh.
November 23rd—The Fourth Annual General Meeting.

TEES-SIDE AMATEUR RADIO CLUB
Hon. Sec.: A. L. Taylor, G3JMO, 12 Endsleigh Drive, Acklam, Middlesbrough, Yorkshire.
The most important event in the club's programme in the next few months, is the Annual Dinner. This year it will take place on Saturday, December 9th at 8 p.m. at the Corporation Hotel, Corporation Road, Middlesbrough. The club meets fortnightly at Settlement House, 132 Newport Road, Middlesbrough on Fridays at 8 p.m.

COURSES OF INSTRUCTION

MORLEY COLLEGE
61 Westminster Bridge Road, London S.E.1.
J. M. Falconer is giving a series of lectures entitled "Introduction to Electronics: Its Principles and Applications" on Wednesdays, 7 to 9 p.m. The first part of this series is to give the student the simple principles of electronics. The latter part will be devoted to applications of electronics. The treatment of all subjects will be non-mathematical and no previous knowledge of electronics will be assumed. The course will be illustrated with films and demonstrations, and some practical work may be undertaken by students.

High Gain Amplifier

(Continued from page 614)

together with the mains transformer, valveholders, smoothing choke, the controls and the jack sockets. A point to note is that the low impedance input jack socket must be insulated from the chassis, since neither side of the low impedance input is connected to earth. In the prototype, this insulation was effected using a rubber grommet (see Fig. 4). An alternative method would be to mount the socket on a piece of paxolin or other insulating material, and to bolt this to the chassis, taking care that no part of the jack socket touched the metal of the chassis. Having mounted the above-mentioned components, the heater wiring should be completed. This takes the form of a pair of wires, twisted tightly together, and pressed hard against the chassis. One side of the heater wiring should be earthed. The earth bus-bar is then fixed in position.

No special precautions need be taken when wiring the amplifier, other than the fact that all connections should be kept short, and that any earth connection which may be required should be made to the earth bus-bar, and not directly to the chassis. Screened leads should be used where they are indicated in the circuit diagram (Fig. 1).

Output Sockets

In the prototype amplifier, the output was taken via a coaxial plug and socket, and coaxial cable. There is no reason, however, why any other form of socket may not be used. Since one side of the output is earthed, then a normal jack socket bolted directly to the chassis may also be used. ■

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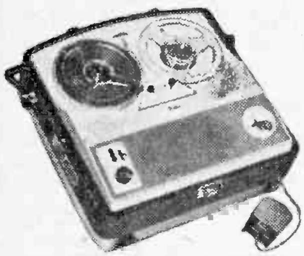

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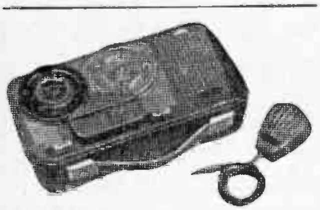

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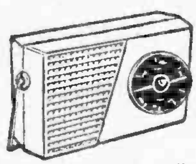

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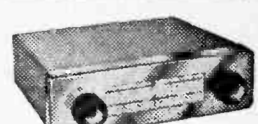

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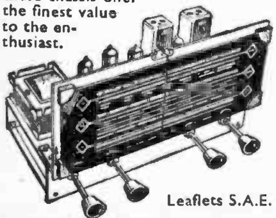

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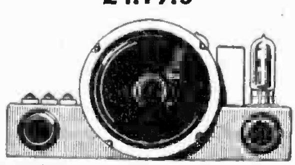

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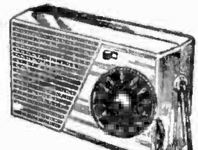

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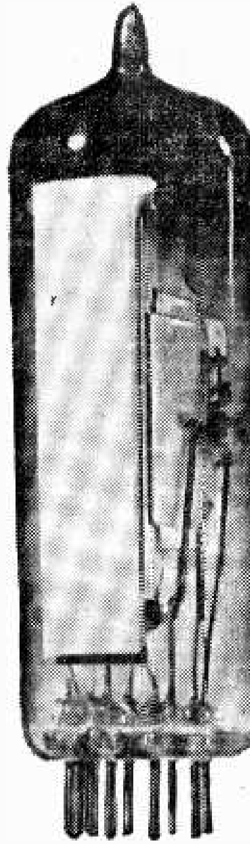
The EM87

A new recording level indicator

(from "Mullard Outlook," September, 1961 issue)



IN many present-day tape recorders, the recording output available for driving the voltage-level indicator is about 10V, which is often insufficient to close the display of existing types of indicator. For this reason, Mullard have designed a new indicator—the EM87—which has a grid base of only 10V.

An additional feature of the EM87 is that a recording signal greater than 10V will cause the luminous areas of the display to overlap, thus giving a brighter section at the centre of the display. These large voltages can result in distorted recordings, and the brighter section of the display thus serves as a useful indication of when the recording signal modulation is excessive.

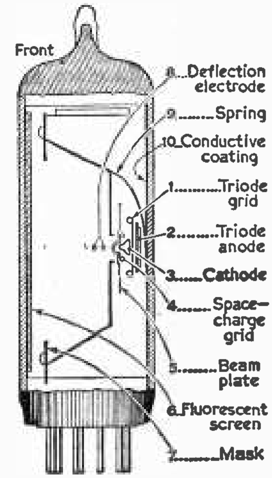


Fig. 2.—The construction of the EM87.

These features are illustrated in Fig. 1, in which the control characteristic of the EM87 is shown. The intersection of the full curve with the horizontal axis shows the control-grid voltage at which the separation L between the luminous areas of the display is zero—that is, the voltage at which the display closes.

The excursion of the line below the horizontal axis indicates the overlapping of the luminous areas at recording signals in excess of 10V. At a target voltage of 250, the overlap will be 1·5mm for an input of 15V.

The broken line in Fig. 1 is the control characteristic of the EM84—the previously recommended Mullard voltage indicator. The grid base of this type is seen to be 22V.

Construction

The electrode structure of the new valve is shown in Fig. 2. The triode section is to the rear of the cathode, and the indicator section is in front of it.

The specially shaped cathode (3), 10mm long and coated on both surfaces, is mounted horizontally between two micas. Behind the cathode is the grid (1) and anode (2) of the triode section. A space-charge grid (4) is mounted immediately in front of the cathode, and is connected to the cathode. The space charge formed at this grid promotes a more uniform flow of electrons to the fluorescent screen or target (6). Next to the grid, and also maintained at cathode potential, is the beam plate (5). A slit in this plate ensures that the edges of the fluorescent display are sharp.

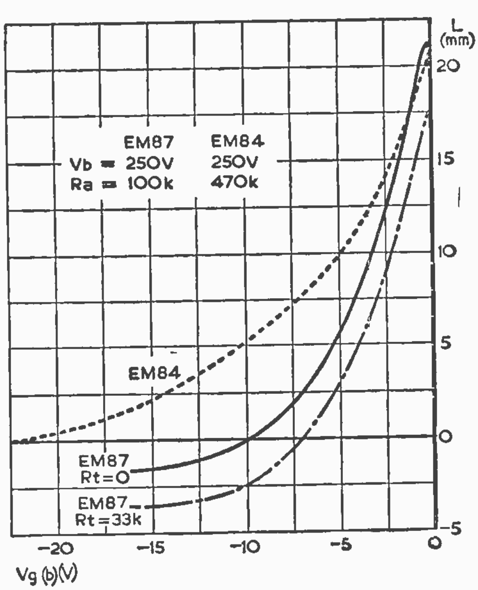


Fig. 1—Control characteristics: variations of display lengths with control grid voltage.

The deflection electrode (8) is situated in front of the slit in the beam plate. This electrode consists of two horizontal rods which are taken out to a base pin.

The mask (7), which is normally connected to the H.T. line, serves to limit the size of the display on the fluorescent screen. A spring (9) on the mask assembly makes contact with a conductive coating (10) of stannic oxide on the inside of the bulb, and this coating is in contact with the fluorescent screen.

Operation

In a typical circuit (see Fig. 3) the deflection electrode is connected directly to the anode of the triode. With no signal, the current in the triode load is large, and the voltage of the deflection electrode is therefore about 50. The electrode is thus about 200V negative with respect to the screen, which is at the H.T. line voltage. The electron beam is thus caused to diverge widely, and the display is fully open.

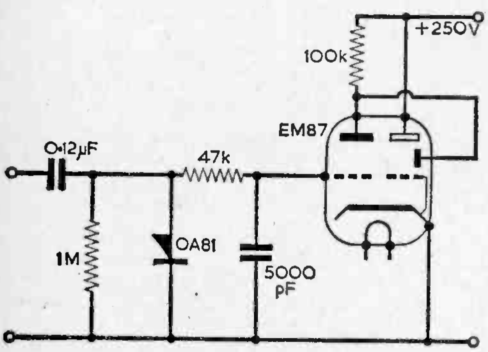


Fig. 3.—A typical circuit for the EM87.

When a signal is applied to the triode grid, the load current falls, the anode voltage rises, and the deflection electrode becomes less negative with respect to the screen. The divergence of the beam is therefore less, and the display is partially closed. When the input is 10V, the display is fully closed.

Load Resistance

The deflection-electrode potential of the EM87 is always positive, so that part of the electron stream to the target is intercepted by it and forms the deflection-electrode current. Thus, the current flowing in the load resistor in Fig. 3 has two parts: the anode current of the triode section, and the deflection-electrode current. The ratio of these two parts depends on the value of the load resistance used—the higher the resistance the greater the contribution of the deflection-electrode current, and hence the greater the dependence of the closing voltage on this part.

The electron beam impinging on the deflection electrode gives rise to secondary-emission electrons, and at certain voltages, some of these travel from the electrode to the target, thus reducing the deflection-electrode current. Because of this dependence on secondary emission, the current/voltage characteristic of the deflection electrode will vary considerably from one EM87 to another. Thus in Fig. 3, if the load current contains a high proportion of deflection-electrode current, the closing voltage may be quite different for different EM87.

To reduce this variation in closing voltage, it is necessary therefore to reduce its dependence on the deflection-electrode part of the load current, and for this reason, the EM87 is designed for operation with a load resistance of only 100k. With this value, the anode-current part of the load current at the closing point is several times as great as the deflection-electrode component. The closing voltage is thus determined primarily by the triode characteristics of the EM87, and will change very little from valve to valve.

The low value of load resistance necessitates high values of amplification factor and mutual conductance in the triode section of the valve to produce sufficient voltage gain to drive the indicator section. The amplification factor of the EM87 is about four times that of the EM84 (which was designed to operate with a load resistance of 470k) and the mutual conductance is about 1·5 times as large.

Increased Sensitivity

A typical circuit for the EM87 is given in Fig. 3. With the circuit values given in the figure, the display of the EM87 closes with a peak input of 10V, and an overlap in the display of 1·5mm occurs at an input of 15V.

The target voltage in Fig. 3 is 250. A shorter grid base can be obtained if the target voltage is reduced by connecting a resistor in series with the target. This therefore provides a simple means of increasing the sensitivity of the EM87. The effect of including a 33k resistor between the target and the H.T. line is shown as the chain-dotted line in Fig. 1. The closing voltage is reduced to approximately 7, and a greater overlap for voltages greater than this is indicated.

A reduction in target voltage results in a loss of brightness. With the reduction obtained with the 33k resistor, the loss of brightness is not serious, but to maintain a satisfactory level of brightness, the target voltage should not be reduced below 170.

Other methods of increasing the sensitivity of the EM87 are possible, but these necessarily sacrifice qualities of the valve such as the sharpness of the display, or involve greater complexity of the circuit. However, when used in the simple circuit of Fig. 3, the new voltage-level indicator will fulfil the sensitivity requirements of most present-day tape records, and give also the facility of an indication of signal over-loading.

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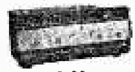
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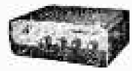
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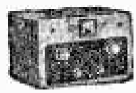
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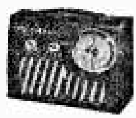
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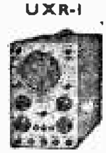
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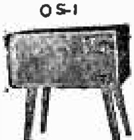
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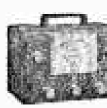
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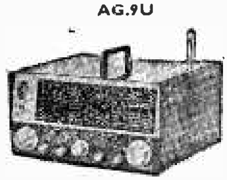
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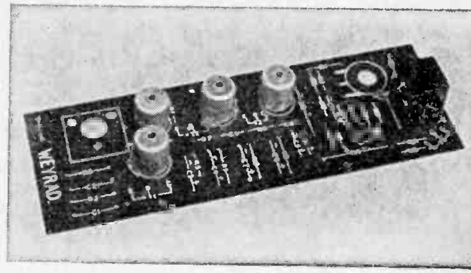

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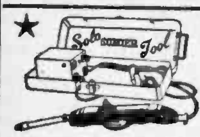

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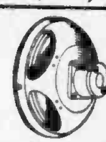

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5in., 6in., 8in. and 7 x 4in. Ex-manufacturers' stock. Money back guarantee. P. & P. 3/-.
SPEAKERS NEW. 15/9 each. Slot type. 7 x 4in. and 8 x 3in. Ideal for our record cabinets. (Send for our list). Carr. 3/3.

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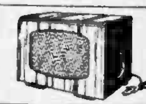

Polished cabinet. With 8in. P.M. speaker, flex and switch. Ideal for kitchen, bedroom, workshop, etc. Carr. 3/9.

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Trade News

NEW RANGE OF POTENTIOMETERS

A NEW range of miniature carbon potentiometers intended for use in small battery radios has been introduced recently by Mullard Ltd.

The potentiometers can be obtained either with three soldering tags for wire connection or three terminal pins for direct mounting on a printed wiring board.

Logarithmic and linear types are available with values ranging from 1k to 500k, the tolerance on the nominal resistance being ±20%. They are available complete with a single pole rotary switch if required. The case diameter of these potentiometers is 16·8mm.

Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

TRANSISTOR HEAT SINK

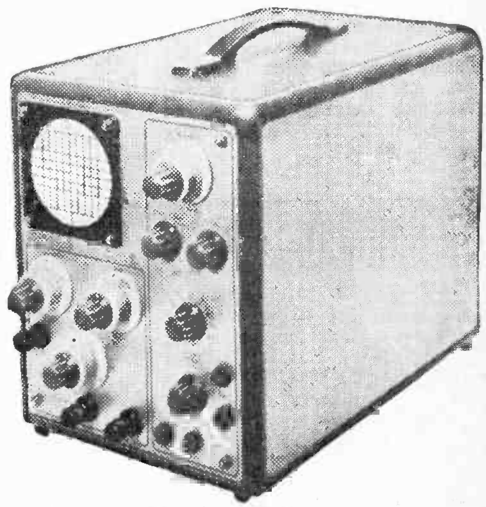
A HEAT sink has recently been put on the market by Antex Ltd., to protect transistors from damage when soldering them into a circuit. It is made of a light metal and has been designed so that it will clip easily on to the transistor lead and support itself in any position. The price of this heat sink is 1s. 4d. and it is made by *Antex Ltd., 7/8 Idol Lane, London, E.C.3.*

TRANSISTOR TESTER

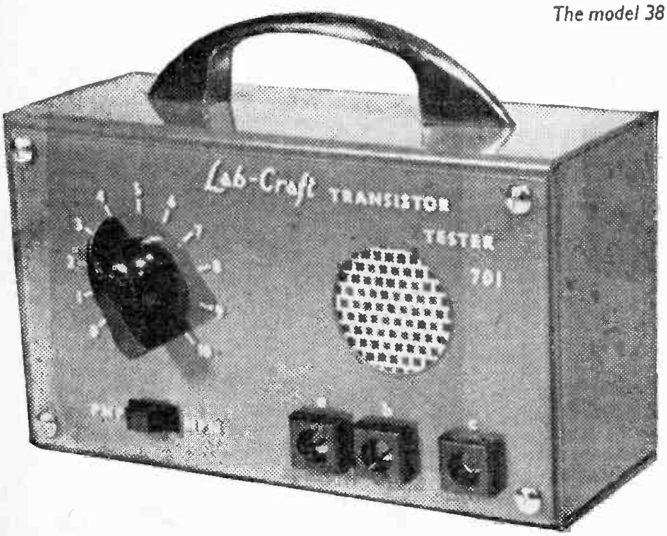
THIS instrument will provide a positive check on all types of transistors and will detect short circuit or open circuit transistors. It will also detect high leakage currents and determine whether an unknown transistor is a p.n.p. or n.p.n. type.

The Lab-Craft model 701 transistor tester will also match transistor gains for push-pull circuits.

Lab-Craft Ltd., 83 Ilford Lane, Ilford, Essex.



The model 381 oscilloscope made by Dartronic Limited.



The Lab-Craft transistor tester.

GENERAL PURPOSE OSCILLOSCOPE

THE model 381 oscilloscope, made by Dartronic Limited, is a high performance 3in. instrument. The cathode-ray tube is completely enclosed within a mu-metal shield for protection against spurious deflection from stray magnetic fields. It is housed in a metal cabinet which provides efficient convection cooling. The model 381 is a completely portable instrument.

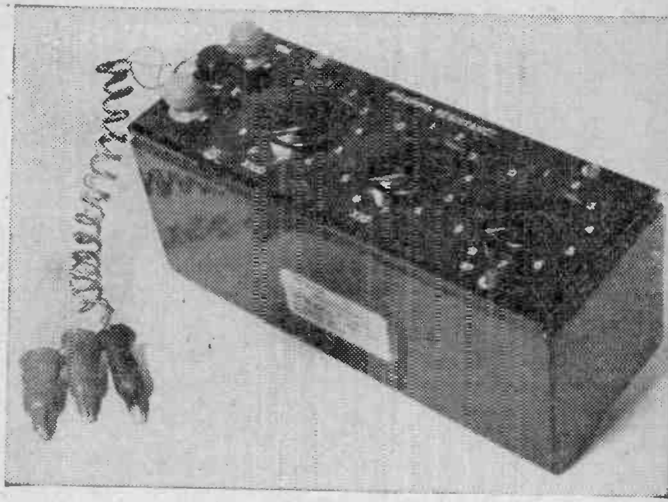
The oscilloscope costs £36 and is made by *Dartronic Limited, 3/7 Windmill Lane, London, E.15.*

RESISTANCE DECADE UNIT

THIS unit is manufactured by Bristol Electronic and Light Engineering Co.

The resistance range is from 1k to 999k by increments of 1k, and the tolerance ±1% of the selected value.

The unit is housed in a metal box, 3in. x 3in. x 8in., and costs £9 10s. *Bristol Electronic and Light Engineering Co., 31 Charlton Road, Kingswood, Bristol.*

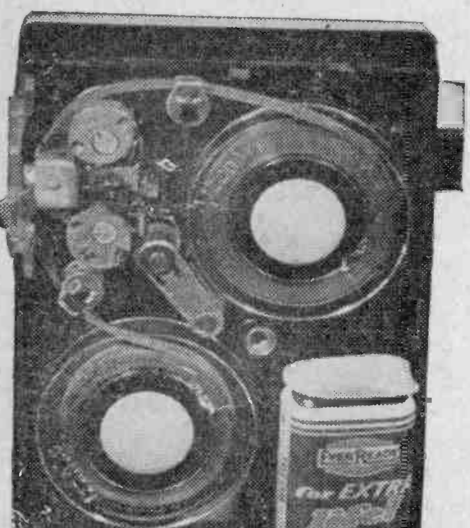


This resistance decade unit is made by the Bristol Electronic and Light Engineering Co.

PORTABLE DICTATING MACHINE

THE Stuzzi Memo-Cord is a tape recorder measuring only 4½in. x 3⅛in. x 1½in., and which weighs only 11oz. One tape gives 1 hour's playing time. It has a built-in microphone and loudspeaker and is powered by a transistor battery and a pen light cell. An extension loudspeaker may also be used with it.

The Memo-Cord costs 25 guineas complete with tape and case. It is made by *Stuzzi Recording Devices Limited, 44 Southern Row, Kensington, London, W.10.*



The Stuzzi Memo-Cord.

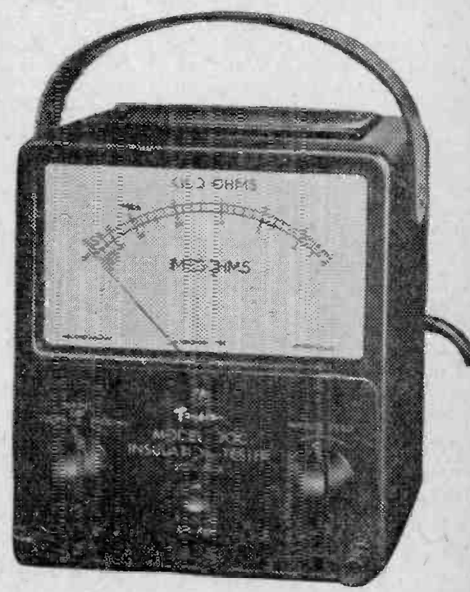
INSULATOR TESTER

A NEW insulator tester—model 130C—has been released by Taylor Electrical Instruments Ltd.

The model 130C covers a wide range of resistance readings and enables tests to be made on all types of component. The total resistance measurements covered are from 20Ω to 1,000M.

The meter movement has a sensitivity of 37·5μA and is very robust. The meter is also magnetically shielded and this is an important feature when using the instrument in proximity to R.F. fields. The instrument is supplied in a rugged bakelite moulding and is light and portable.

It is designed to operate from an A.C. mains supply between 110V and 240V, 40 to 60c/s. The model 130C insulation tester is made by *Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Buckinghamshire.*



An insulation tester made by Taylor Electrical Instruments Ltd.

TRANSISTOR PRICES DOWN!

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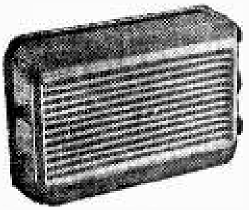
MEDIUM, LONG WAVE AND TRAWLER BAND EXTENDING TO 80 METRES WITHOUT COIL CHANGING



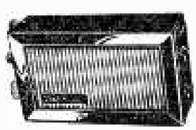
350 Mw XC101's push-pull output Transistors. Powerful magnet 3in. high grade speaker. Push-pull transformers. This is a top performing receiver. Nearly 30 stations listed in one evening including Luxembourg loud and clear. A pleasure to listen to. **FERRITE ROD AERIAL.** All parts sold separately, including pale blue gleaming polystyrene case with duo-diffusion grilles in red. Uses 9 volt battery. Sockets for car aerial.

Total building cost **£5.19.6** P.P. 2/6. Size 6½ x 4½ x 1½in.

"Agreeably surprised with Trawler Band reception. Luxembourg as loud as local. Your easy build diagram helped a lot . . . my first attempt."—H.S., Penzance, Cornwall (poor reception area).
"Super car radio."—L.B.V., Liverpool.

TRANSONA-4

(4 Ediswan Transistors, plus 2 Diodes)



Miniature speaker. **FERRITE ROD AERIAL.** MW/LW and Trawler Band coverage down to 80 metres. On test tuned in nearly 30 stations inc. Luxembourg. This sensational new radio is simple to build with our easy-build plans. Handsome pocket case.

May be built for **52/6** P.P. 2/6.

"Best transistor set I have ever built—dozens of stations."—A.G.H., Deal, Kent.

POCKET RADIO

(5 Ediswan Transistors and 2 Diodes)

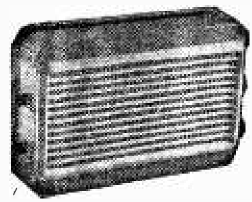
MEDIUM, LONG WAVE AND TRAWLER BAND TO 80 METRES. Designed round super sensitive ferrite rod aerial and 3in. speaker. Attractive 2-tone pocket size case No aerial required. On test Home, Light, Radio Lux. and many others. Easy-build plans for beginners. Powered by 4½ volt battery.

Total cost of parts required. **£3.19.6** P.P. 2/6

Send 1/3 for parts price list and easy build plans.

TRANSONA-5

(MW/LW and TRAWLER BAND)
(5 Ediswan Transistors plus 2 Diodes)



250 mW output in push/pull for superb tonal quality. 2 R.F. stages for sensitivity. FERRITE ROD AERIAL. Pale blue polystyrene case with speaker grilles in red. Volume/sensitivity control.

Total building cost **£4.15.0** P.P. 2/6

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Push-Pull Pocket Six

MEDIUM AND LONG WAVES AND TRAWLER BAND WITHOUT COIL CHANGING.

Sensitivity of a superhet, tonal quality of a TRF. Volume control. Tuning condenser. Latest type switches. Handsome two-tone pocket case. Ferrite rod aerial. 3in. quality speaker. Easy-build diagrams. 6 Transistors (including Ediswan and Semiconductors) plus 2 diodes. First class components throughout including transistors.

Total cost of all parts **£5.9.6** P.P. 2/6

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NEW TRANSONA-4

With 3 inch Deep-toned Speaker

(4 Transistors plus 2 Diodes)

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Send 1/3 for parts price list and assembly plan.

Ferrite Rod Aerial, M/L wave (7in.) 8/6
Ferrite Rod Aerial, M/W (4in.) 5/-
High Fidelity Headphones with miniature earpieces and transformer with lead and jack plug for high or low impedance, matching. Brand new. Boxed 25/-
The above in slightly used condition .... 17/6, post free
Sensitive 2½in. Speakers. Only ¾in. deep, 3 ohm 16/6

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Improving Selectivity

By P. McGoldrick

THE idea of the "Q" Multiplier was brought into this country from the United States several years ago. Briefly, it boosts the "Q" of a tuned circuit many times beyond its normal value. It is in this condition that it can reject or amplify a narrow frequency bandwidth. The valve "Q" multiplier usually employs a 12AU7 (ECC82) or 12AX7 (ECC83), and many variations of circuitry are obtainable. One example is shown in Fig. 1. This article describes a transistor unit, which makes use of the very cheap "white-spot" transistor (an OC45 or an XA103 may be used if one is available).

Theory and Practice (see Fig. 2)

Parallel-tuned circuits have been used for many years as trap circuits. Increasing the "Q" of the trap circuit reduces the width of the rejection notch. The transistorised "Q" multiplier makes use of this effect for its operation. A tuned circuit is made regenerative to increase its "Q" and is coupled to the I.F. stage of a receiver. By changing the frequency of the regenerative circuit (C4) the frequency of the unit, found by the formula $F = \frac{1}{2}\pi\sqrt{LC}$ (where L is the inductance of the primary of the first I.F. transformer), the sharp notch can be moved about the pass-band of the receiver. The width of the notch is changed by controlling the amount of regeneration (R2). Regeneration is controlled by varying the D.C. operating voltage through the dropping resistors R1 and R2.

Construction

The original intention was to put the power supply in the same box as the unit. It was found, however, that the battery could make the box side-heavy, and so give it a tendency to fall over. Therefore it was decided to stand the battery behind the unit. The unit was originally built in a box which measured 4½in. x 3½in. x 2in., and provided ample room.

The only fixtures to be made are the tuning condenser, the regeneration control, and a central group board (one of the fixing bolts to be made a common earth). There are also two ½in. holes to be drilled on the side of the box opposite the control panel, which are for grommets and through which the connections to the receiver and to the battery are made. The 1mH coil is not critical, and in the author's unit an old "19" set coil, which read 1·2mH on an inductance bridge, was used. However, if such a meter is unavailable some firms market R.F. chokes rated at 0·8mH which are quite adequate for its purpose and are cheap.

Power is obtained from a 7½V battery which has non-reversible connections, and so far the drain on the battery has never exceeded 0·3mA.

The connection to the receiver is made by any sort of shielded or coaxial cable, and it is made across the primary of the first I.F. transformer.

The transistor should be soldered in last, and to prevent heat damage to it the usual heat dissipation rules should be adhered to.

Operation

When the unit has been completely wired (and double-checked), the battery is connected (making sure the poles of the battery are properly connected). The unit is then joined to the receiver.

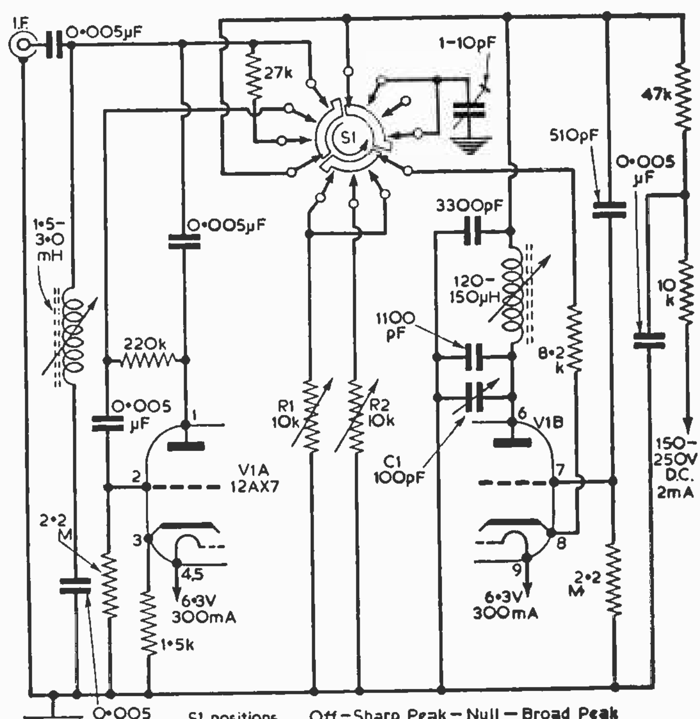

Fig. 1.—A valve "Q" multiplier; C1—tuning, R1—peak adjustment, R2—null adjustment.

COMPONENTS LIST FOR FIG. 2

R1	15k
R2	25k pot. (regeneration)
R3	39k
R4	100k
C1	0·01 µF
C2	0·001 µF
C3	25pF
C4	15pF (tuning)
C5	100pF
L1	1mH
7½V	battery
OC45, etc., transistor	

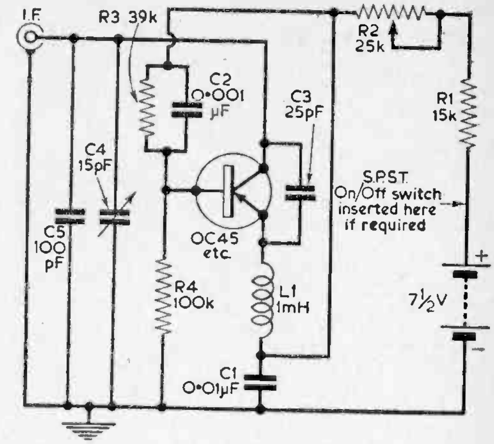

Fig. 2.—A transistorised "Q" multiplier.

When off, it should not affect receiver performance. When switched on, with the receiver set to a clear spot, the BFO to the centre of the pass-band and the tuning condenser and the regeneration control advanced to about half-way, a beat note should be heard from the receiver. If this is not heard at the central capacity of the tuning control, but in another position, the value of C5 should be adjusted accordingly.

To make the final alignment, the aerial should first be removed from the receiver, which is tuned to a broadcast station. With the BFO beating with the incoming signal, it will produce an audio tone. Adjust the BFO for a tone of about 1kc/s. Back off the control R2 until the oscillator becomes regenerative by alternately adjusting the tuning control C4 and the regeneration control R2 until a point can be found where the audio tone disappears, or at least is attenuated.

If, by any chance, a super-active "white-spot" transistor is used (or OC45 or XA103) and the regeneration control does not have the range to stop oscillator action, the value of R1 should be increased. Also, if the transistor does not appear to oscillate, then the value of R1 should be decreased.

Practice with the controls will produce better results, and it will be found after a while which are the ideal positions of the regeneration control to produce the best null, and the best peak.

This unit will increase the selectivity of any short-wave receiver, and will, at low cost, add immeasurably to the pleasure of amateur radio, especially on the reception of single side band. ■

465kc/s SIGNAL GENERATOR USING BFO UNIT ZA30038

THIS ex-Government unit which measures only 2½in. x 4½in. x 1in., can be easily modified to a signal generator providing the usual I.F. of 465—470kc/s simply by changing R1 (33k) to 2·7M ¼W. The unit as found in local radio component shops is ready for use and employs a single valve (IS5). The H.T. supply required is between 60 and 90V D.C. and the L.T. 6·3V D.C., but for convenience R2 (91Ω) can be shorted out and L.T. is then 1·4V. A battery giving 69V + 1½V is the most convenient source of H.T. and L.T. and can be strapped to the unit with adhesive tape.

A short length of coaxial cable is joined to pins 9 and 2, the centre wire to pin 9 and the braiding to pin 2. The crocodile clips are joined to the other end for use on the radio to be lined up.

The other connections required are H.T.+ to pin 4; H.T.— to pin 2; L.T.+ to pin 3; L.T.— to pin 2.

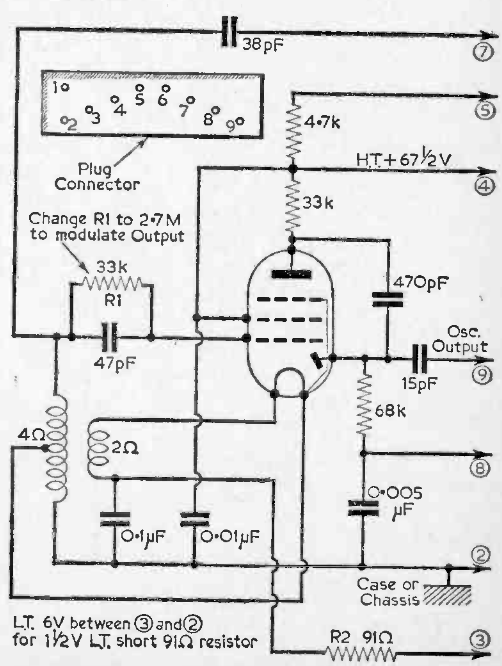

Fig. 1.—The circuit and plug connections of BFO Unit ZA30038.

★ POST HASTE ★

TRANSISTORS REDUCED PRICES
MULLARD HAVE REDUCED THE PRICE OF MANY TRANSISTORS To

OC44	11/-	OC71	6/6	OC76	8/-
OC45	10/-	OC72	8/-	OC78	8/-
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THESE ARE THEIR NEW LIST PRICES
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OSMOR printed circuit version. Osmor Rod Aerial 10/-. I.F.T.s and Osc: Coils, 22/6. Osmor Driver, 11/6. Osmor Output, 10/6. Set MULLARD transistors, 53/6. OA81 Diode, 3/-. J.B. Gang. 11/-. Trimmers, 2/8 pr. Set Condensers, 15/-. Set Resistors, 6/6. Ardente Vol. Control, 8/-. Ardente W/C, 3/6. Speaker, 19/10. Hardware, 4/6. Printed Circuit, 9/-. Case and Knob, 7/6. Dial, 6d. Battery PP4, 2/-. Leaflet giving full illustrated details, 1/9. **All the above components if purchased at one time £9.9.0.** OSMOR undertake to align this receiver for a charge of 10/-.

"WEYRAD"

WEYMOUTH RADIO 6 Transistor Superhet using the P50 coils, as they advertise in this journal.
P50/1AC Osc: Coil, 5/4. P50/2CC 1st and 2nd I.F.T.s, 5/7 ea. P50/3CC 3rd I.F.T., 6/-. RA2W Rod Aerial, 12/6. LFDT2 Driver, 9/6. PCA1 Printed Circuit, 9/6. Instruction Book, 2/-. Set Resistors, 7/6. Vol. Control D.P., 5/6. Set Condensers, 20/-. J.B. Gang, 11/-. Beehive Trimmers, 1/3 ea. W/C, 3/6. Dial and Knob, 3/6. Battery PP11, 5/6. OA81, 3/-. Set MULLARD transistors, 53/6. 35 ohm 5in. round L/S, 15/-.

JASON F.M. TUNER KITS

We are the Authorised Jason Dealer and the whole kit is as supplied by them. You can therefore safely return to Jason for alignment without them rejecting it for non-standard components. We can also align for the standard charge.

FMT1	Is the standard variable tuner for cabinet mounting, unpowered. Supplied complete with four EF91 valves	£6.17.6
	Hire purchase deposit £1.7.6 and 6 monthly	£1.1.8
FMT1	Power pack ready drilled chassis complete...	£2.12.6
FMT2	Is a new tuner in a modern case, green, which can be used for shelf or cabinet mounting, and has the space for power supplies if required. Supplied complete with four EF80 valves......	£7.17.6
	Hire purchase deposit £1.11.6 and 6 monthly	£1.4.4
FMT2	With power. Complete kit........................	£9.15.0
	Hire purchase deposit £1.19.0 and 6 monthly	£1.9.4
FMT3	Is the fringe version and should be used when farther than 70 miles from the transmitter. Supplied complete with 6 valves.................	£9.12.6
	Hire purchase deposit £1.18.6 and 6 monthly	£1.9.0
FMT3	With power. Complete kit.........................	£12.0.0
	Hire purchase deposit £2.8.0 and 8 monthly	£1.6.6

The instruction book is included in all kits, but otherwise 2/6.

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	Hire purchase deposit £3.0.0 and 12 monthly	£1.1.6
Mercury 2	complete with valves and book..............	£10.15.0
	Hire purchase deposit £2.3.0 and 8 monthly...	£1.4.0
	Power pack kit for Mercury 2 ready drilled chassis	£2.12.6

Instruction book for switched tuners 4/-.

REQUIRED CHANNELS MUST BE SPECIFIED FOR SWITCHED TUNERS

A more detailed list can be sent upon request.

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The amplifiers are packed in special cartons with instructions which enable anyone to build. We are confident you will find these Recorders very good value, they have been built up to a standard and not down to a price.

B.S.R. TD3 Monardeck. latest model 5¾in. spools CASH	£9. 9.0
Hire purchase deposit £1.19.0 and 6 monthly	£1. 8.4
Tape Amplifier for B.S.R. deck, printed circuit ready wired, with ECC83, ECL82, EM85 and EZ81. Complete with all plugs, sockets, panels, knobs, etc. The whole amplifier mounts on to the deck, making a self contained unit. CASH PRICE	£8. 8.0
Hire purchase deposit £1.14.0 and 6 monthly	£1. 5.8
Cabinet for above including 7 x 4in. speaker............	£4. 4.0
Total kit as above. CASH	£22. 0.0
Hire purchase deposit £4.10.0 and 12 monthly	£1.12.1
The above recorder can be supplied complete with Mic: tape assembled and tested for CASH PRICE	£25. 0.0
Hire purchase deposit £5.0.0 and 12 monthly	£1.16.8
Collaro Studio Deck. Very latest model 3 speeds...	£12.10.0
Hire purchase deposit £2.10.0 and 8 monthly	£1. 7.6
Tape Amplifier for Studio deck, with ready wired printed circuit, control and input panels, mains and output trans., complete with knobs, plans screws, etc., EF86, ECC83, EM84, OA81 and 2 EL84, 3 watts output. Magic eye, Radio and Mic. inputs. Superimposing facilities, EX L/S socket, Low level output, tone control. Can be used as an amplifier. COMPLETE CASH	£11.11.0
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Hire purchase deposit £6.0.0 and 12 monthly	£2.2.2
We can supply the above recorder, complete with tape and Mic., in a DE LUXE cabinet, assembled for...	£35. 0.0
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Microphone for the above recorders, Acos MIC 40, 25/-. S/C plug, 4/6.

Synchrotape	5in.	600ft.	15/-	5in.	900ft.	19/6
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Boxed	7in.	1200ft.	22/6	7in.	1800ft.	32/6

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Axiom 300 12in., £11.5.9. Deposit 45/9 and 8 mthy. 25/-
Triaxiette 8in., £13.10.0. Deposit 54/- and 12 mthy. 21/4
Cross overs XO5000, 39/-. ARU172, £3.5.6.

Whiteley
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Wharfedale
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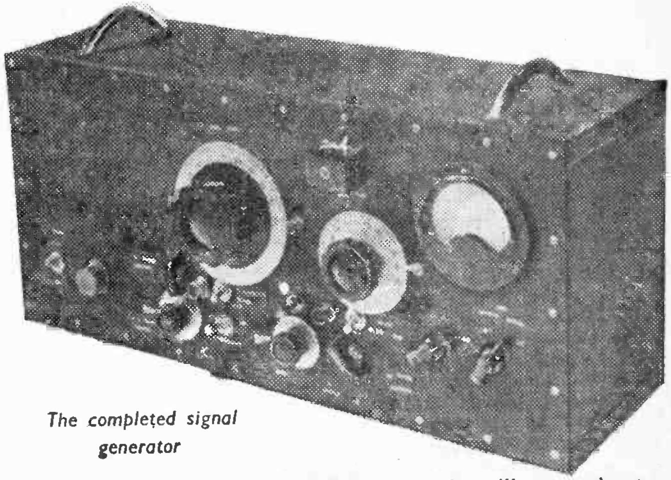
THE P.W. SIGNAL GENERATOR

THE CALIBRATION OF THE R.F. AND A.F. GENERATORS

By E. V. King

(Continued from page 518 of the October issue)

BEFORE the R.F. unit can be used for aligning receivers and similar purposes, it is necessary to calibrate it so that the frequencies corresponding to the settings of the tuning dial on the generator are known accurately. The way in which this signal generator will be calibrated is by preparing four graphs in which dial rotation is plotted against frequency for each of the four ranges.



The completed signal generator

Calibration of Range 1—150kc/s to 700kc/s

Set up the generator and a receiver as shown in Fig. 39. Switch on the R.F. unit (Chassis No. 2) and the Crystal Check Oscillator Unit (Chassis No. 4), for 20 minutes before beginning the calibration, so that the two units have time to reach their operating temperature.

1. Tune in the L.W. Light programme on the receiver (1500m). Remove the Aerial lead and retune the receiver slightly, if necessary, until the crystal "note" is heard, to verify that the crystal circuit is working.

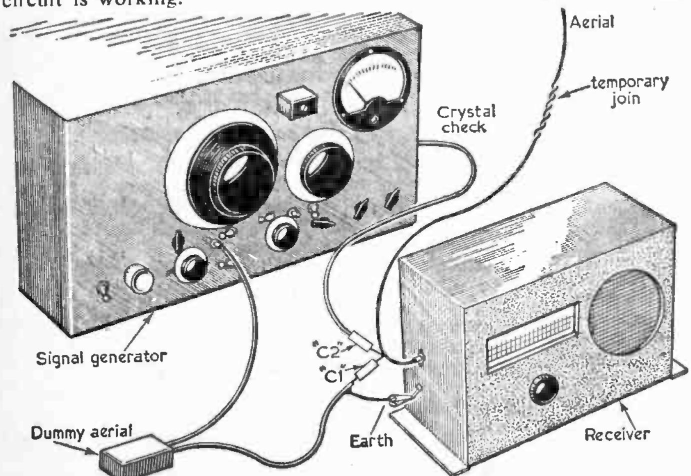


Fig. 39.—The method of interconnecting the R.F. generator and a receiver for the calibration procedure. (C1 and C2 are 2—500pF; the modulator should be switched off the crystal check oscillator to '100kc/s' and the R.F. generator to Range 1.)

2. Switch off the crystal oscillator and retune the receiver to the Light programme, and, with the R.F. range switch at position 1, and the output control full on, rotate the main frequency dial. Note the point at which the loudest heterodyne whistle is heard—this is where the crystal oscillator beats with the Light programme on 200kc/s. The dial reading for this position is then noted accurately.

3. Switch on the crystal oscillator and the receiver. Now rotate the dial of the receiver towards the longer wavelengths until the next "note" from the crystal is heard — this will be 100kc/s further on and another heterodyne will be heard on rotating the tuning dial of the generator. This dial reading—the 300kc/s point—should be noted accurately.

4. Repeat (3) above and note the dial reading corresponding to 400kc/s (provided that the receiver will tune to this frequency).

5. Retune the receiver and the generator to the Light programme. Then, switch the Crystal Check Oscillator to the 10kc/s position. Now, as the dial of the generator is moved towards the 300kc/s point, from the 200kc/s point, a "swish"

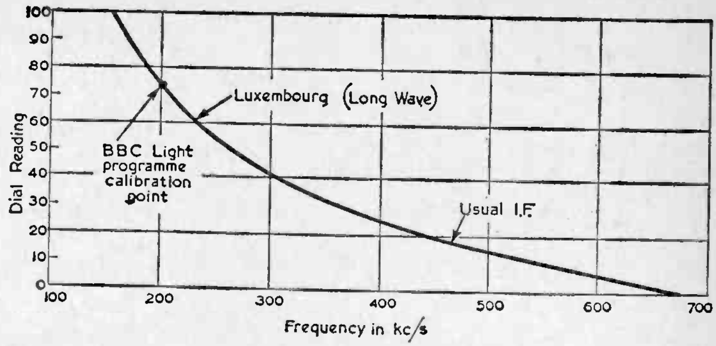
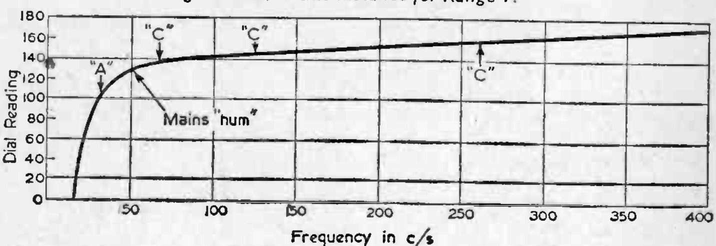


Fig. 40 (above).—The type of curve produced during the calibration (the results for Range I are illustrated above).

Fig. 41 (below).—The type of curve obtained during the calibration of the A.F. generator, in this instance for Range I.



will be heard every 10kc/s and these points can be noted to give more accurate calibration. When the operation is finished, a set of frequencies will have been obtained together with their corresponding dial positions. These values can now be transferred to a graph similar to Fig. 40 (larger in size, of course). To make the graph, a large sheet of squared paper (graph paper) is used. It is arranged with the longest side horizontal, and regular divisions are marked off along the bottom to represent increase in frequency of 100kc/s. The dial readings are similarly marked off on the left-hand side of the squared paper. The readings and values noted during the calibration are then transferred to the squared paper. For example, in Fig. 40, the Light programme point was marked by putting a dot at the position corresponding to the frequency of 200kc/s and a dial reading of 74. Dots are made for all of the dial readings that were taken. Finally, the row of dots is inspected and it should be found that they lie on a smooth curve. If any of the dots appear to be odd, or out of place, then the point corresponding to that dot should be checked.

A curve can now be drawn to link up the dots—it should be made a smooth curve, and it may be that some of the dots are to one side of the curve and some to the other. The aim should be to draw the curve so that about the same number of dots are on each side of it. If calibration has been carried out accurately, most of the dots should fall very near to the curve.

At the lowest and highest frequencies, it was probably not possible to tune the receiver to hear the beats between the crystal oscillator and the R.F. unit. However, by noting the shape of the curve, it can be extended to cover these frequencies. The graph in Fig. 40 has been extended in this way.

Calibration of Range 2—600kc/s to 2·5Mc/s

1. Switch the receiver to the Medium Wave band. Tune it to the Light programme on 1·2Mc/s. (If reception of this station is poor, then another will have to be used. The frequencies of local stations can be obtained from the local edition of the "Radio Times".) Switch the R.F. generator to Range 2 and turn the tuning control to the loudest heterodyne; the unit will now be set to 1·2Mc/s or the frequency of the station used.

2. Switch on the crystal check oscillator and tune the receiver towards the longer wavelengths until the crystal "note" is heard. The receiver will now be tuned to 1Mc/s, or to the nearest multiple of 100kc/s lower in frequency than the station to which the receiver was tuned. The generator can then be set to this frequency. The receiver can then be tuned to the next crystal marker—up or down in frequency—and the dial position on the generator noted for this frequency.

3. A set of readings of the dial should now be made similar to those obtained for Range 1, but every 100kc/s instead of every 10kc/s—the 10kc/s points would come very close together and it would be very difficult to take readings.

4. Construct a graph similar to the one made for the first range. When the graph is finished, it can be checked by tuning the receiver to a station of which the frequency is known, and tuning the generator to the setting indicated by the graph. If the graph is correct, then a heterodyne should be heard between the station and the generator.

Calibration of Range 3—1·9Mc/s to 8·5Mc/s

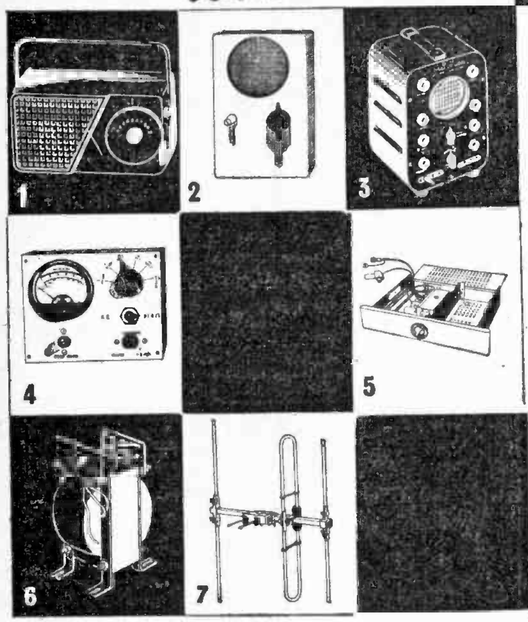
This will be somewhat more difficult than the previous two ranges. The easiest way is to pick up an Amateur on the 40m band (on a Sunday morning) and take the frequency as 7Mc/s. Alternatively, a broadcasting station of known frequency can be used. In the same way as for the other two ranges, calibration points can be made every 100kc/s, but these points will be very close together. Another method would be to pick up stations of known frequency and use the dial readings to make up the graph.

Calibration of Range 4—4·5Mc/s to 20Mc/s

This will prove even more difficult than Range 3. The only practicable way is to use known stations for making the graph—the crystal check points will be very close together, and some of them will be very weak.

(Continued on page 650)

CHECK *with these* BARGAINS



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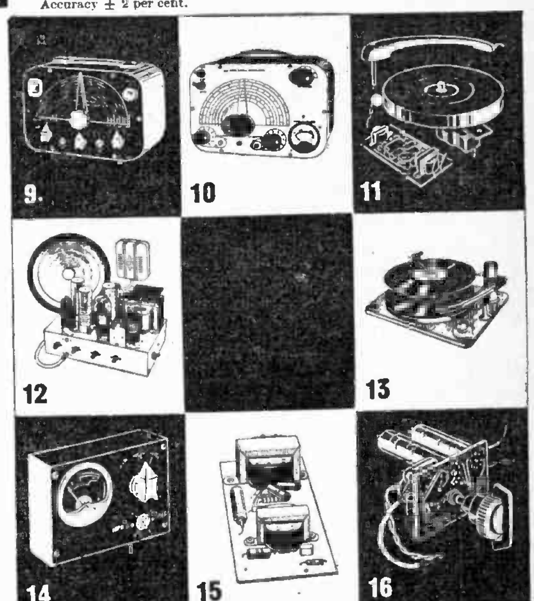

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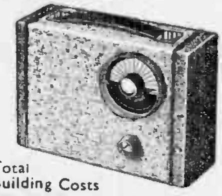

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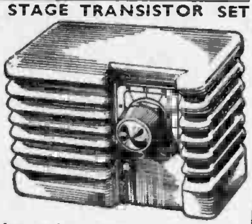

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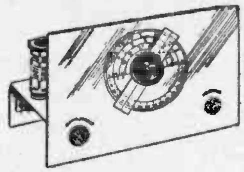

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A SMALL, SIMPLY CONSTRUCTED TRANSMITTER INTENDED FOR THE BEGINNER

By J. G. Ransome

(Note:—A transmitting licence is needed in order to operate this unit).

THIS small "table-top" transmitter was originally built for demonstration purposes—to show that a transmitter need not be elaborate. The power supply was obtained from a straightforward power unit, the total power requirements being only 40mA at 300V D.C. and less than 1A at 6·3V A.C. The R.F. power output is not great, being of the order of 2W; this power is sufficient for local contacts up to a range of about 7 miles or so.

The transmitter is designed to operate in the 7Mc/s band on C.W. or 'phone but, with a little modification, the output may be modified for C.W. in the 14Mc/s band with very little change in output power.

The Circuit (Fig. 1)

The R.F. oscillator is crystal controlled and although this results in a loss of flexibility of operation, crystal control has the twin advantages of stability and cheapness over the variable frequency oscillator, besides which the crystal controlled oscillator is much more easily constructed and is very easy to set up. The oscillator is constructed around the triode section of an ECL80 (see Fig. 1), there being nothing original about the circuit. The oscillator output is taken to the grid of the output stage from the anode end of the crystal.

The modulation stage consists of the "other half" of the ECL80. This is used in conventional mode save for the A.F. choke in the anode circuit. It will be seen that screen series modulation is employed and as a result of this the anode of the pentode section of the ECL80 is directly coupled to the screen of the P.A. stage. It will be found that the value of R4, which feeds the screen of the EL41, has an effect on the power output from the P.A. stage. However, a compromise has to be made since too low a value of R4 will result in distorted audio. Screen series modulation is employed to avoid the use of a modulation transformer. Any type of L.F. choke may be used in the anode circuit of the modulator, provided that it will carry the anode current (30mA), and is of sufficient inductance.

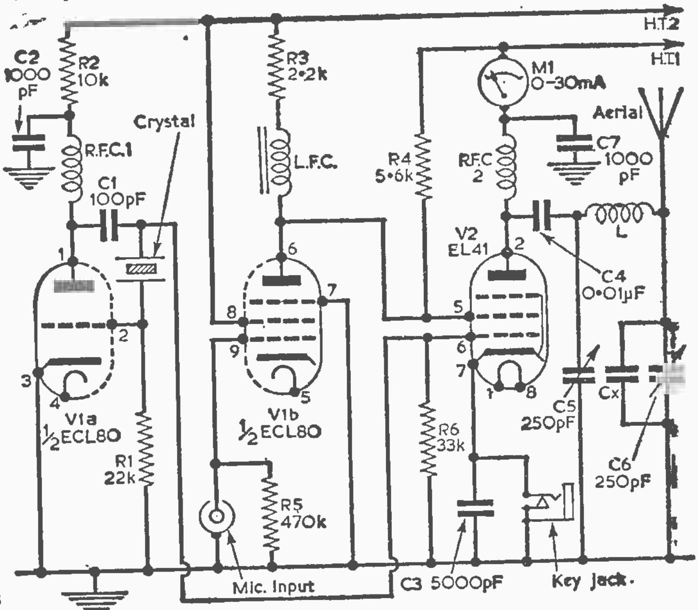

Fig. 1.—The circuit diagram of the transmitter.

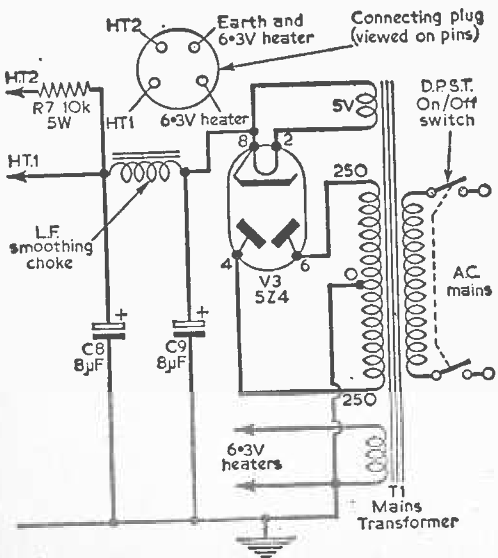

Fig. 2.—The circuit of the power supply.

The P.A. stage is R.C. coupled to the R.F. generator by way of C1 and R6. The output from the final stage is coupled to the aerial by a π-network, this being the easiest circuit to set up and also a reasonably efficient output network. C6 tunes the aerial to the network; it may be found that C6 has insufficient capacity to tune into the aerial (this will especially be so if a long aerial is used), in which case a capacitor, Cx, should be wired in parallel with C6 to raise the capacitance of the circuit. A suggested value for Cx would be about 300 pF. The actual value will have to be found by experiment, as it will depend on the length and position of the aerial (see also the article "Calculating π-Networks" in the October issue).

Construction

"Old Hands" may find much to criticise in the layout of the unit. However, the layout adopted has the advantage that the various sections of the circuit may be constructed and tested individually, each section being tested before the next stage is carried out. This should be of considerable help to the constructor who has never made up a circuit of this type before. The constructional details, therefore, will be given in parts with testing instructions for each section.

1—Power Unit (Fig. 2).

The power unit is straightforward. As it is probable that the reader has a suitable power unit to hand, the power requirements were outlined earlier (page 641). For the constructor who does not have a suitable power unit, a circuit is given in Fig. 2. No constructional details are given as no complications should arise.

2—R.F. Oscillator

The transmitter is made up on a chassis 7½in. x 3½in. x 2in. deep. The main holes to be made are shown in Fig. 3. The remainder of the holes to be drilled will depend upon the physical size of the components used. Holes for all the major components should be drilled to prevent the damage to components and wiring which would occur if chassis drilling were carried out at a later stage. The theoretical circuit for the R.F. oscillator is shown in Fig. 1 and a suggested wiring diagram shown in Fig. 4. In wiring this and all subsequent stages it is preferable to keep the wiring as short as possible. If the wiring diagrams are followed, no difficulty should be experienced.

Testing

Having checked connections for dry joints, etc., the unit should be connected to the power supply and a milliameter placed in series with the H.T. supply. When the valve (ECL80) has warmed up it should be found that the current reading on the milliameter is of the order of 10mA or so. If an unscreened aerial wire connected to an S.W. receiver tuned to the crystal fundamental is brought near to the valve or wiring of the oscillator stage,

(Continued on page 645)

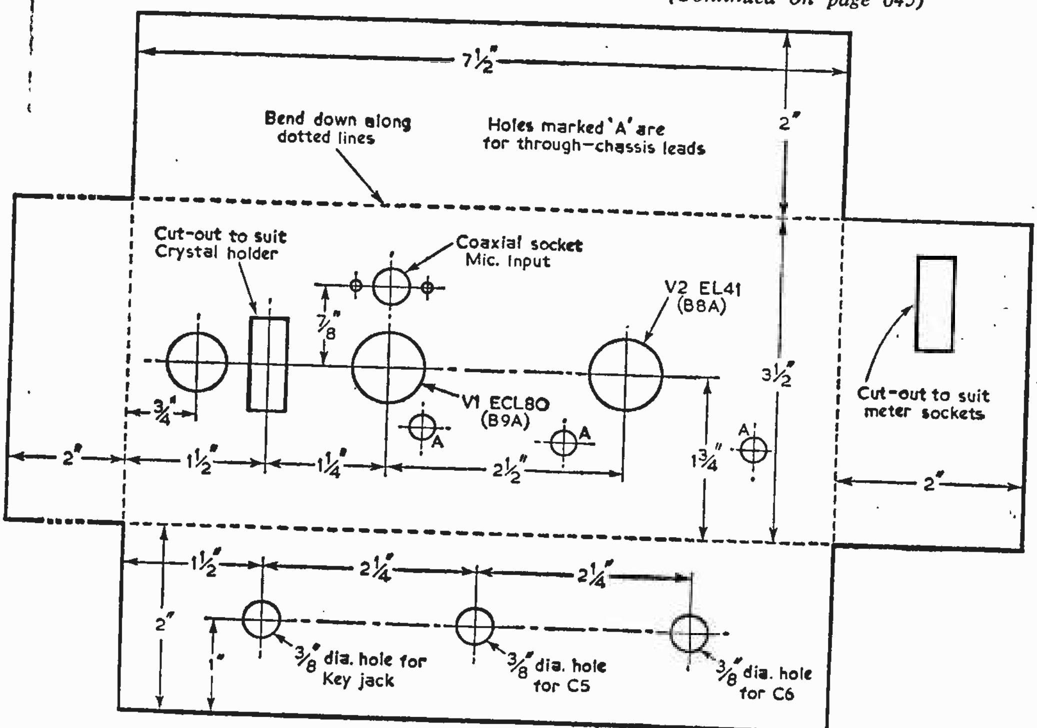

Fig. 3.—The chassis drilling details.

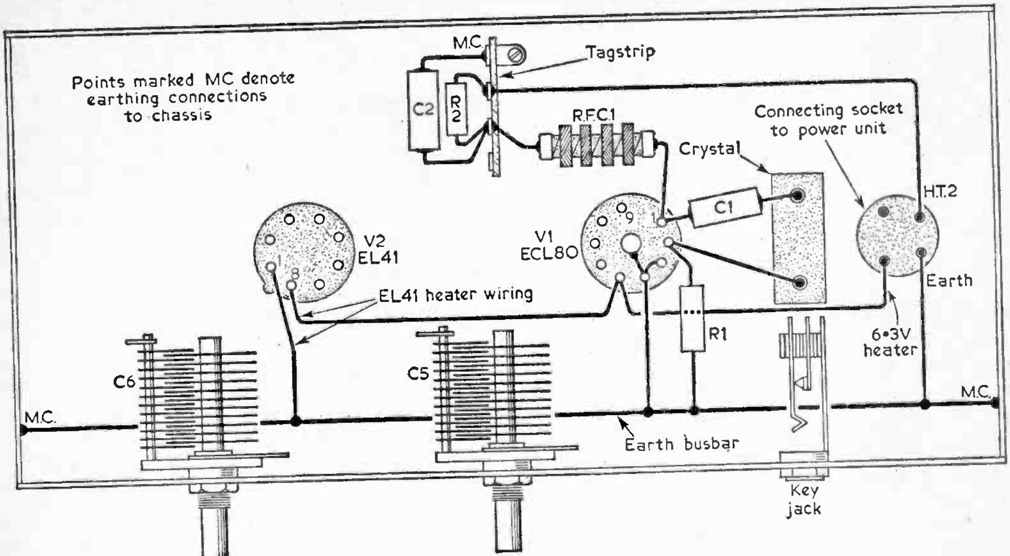

Fig. 4.—The wiring of the crystal oscillator.

(Continued from page 642)

the carrier will be detected by the set, and if the receiver is equipped with a BFO, a note will be heard. If the stage fails to oscillate, check the crystal by substitution.

3—The P.A. Stage

The P.A. or output stage is logically the next stage to wire. The wiring diagram is shown in Fig. 5. The switch in the cathode circuit can either be a switch proper or a closed circuit jack socket in order that the stage can be keyed for C.W. purposes. The condenser C3 across the switch prevents key-clicks and was found to be indispensable in the original unit. The aerial coil (L) comprised in the original, 25 turns of 20s.w.g. enamelled copper wire wound on a 1½in. diameter former, each turn spaced from the next by a distance equal to the diameter of the wire (see Fig. 7).

Testing

Having checked the wiring thoroughly (in particular make sure that C1 has been connected to pin 6 of the EL41, and that the H.T. line is connected correctly), remove the milliammeter from the anode circuit of the R.F. oscillator and insert it in the anode circuit of the EL41.

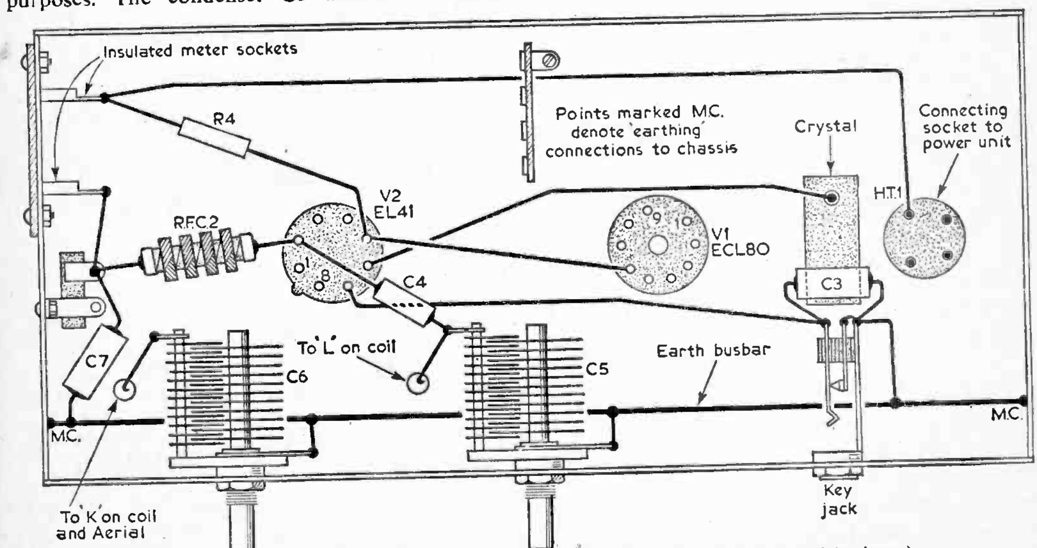

Fig. 5.—The wiring of the P.A. stage (only wiring additional to that in Fig. 4 is shown).

The power unit is then switched on and the milliameter should read between 10 and 30mA, depending on the state of the circuit. The aerial may then be connected to the coil. C5 should be adjusted so that the maximum current possible flows in the anode circuit. With the aerial connected C6 should be adjusted so that the anode current "dips"—this dip can be as much as 20mA. If it is found that the dip is not great, or if no dip is shown, a capacitor of about 300pF should be wired across C6 (this new capacitor is Cx) and C6 again adjusted for maximum "dip". The value of Cx should be chosen so that maximum dip occurs when the vanes of the capacitor are half closed. The H.T. current checks must, of course, be made with the cathode connected to the chassis. The final check of the output of the transmitter may be made by listening to the carrier on the S.W. receiver (if the set is at all sensitive it is advisable to keep the R.F. gain low).

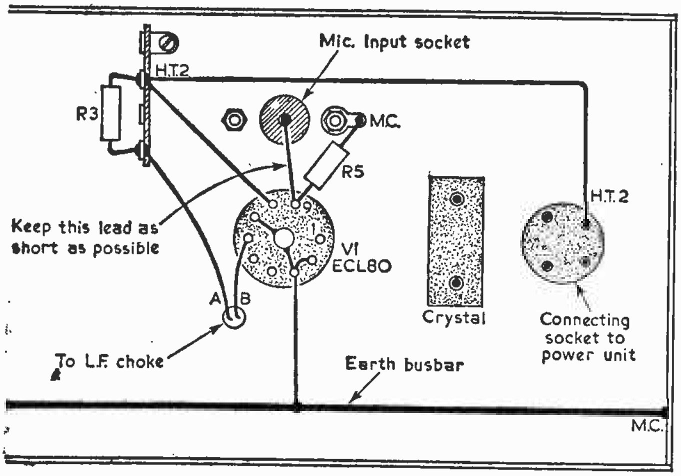

Fig. 6.—The wiring of the modulator stage (additional wiring only).

With these two stages complete, the set-up now comprises an ordinary keyed-carrier CW transmitter and it may be used as such. It must be emphasised that a Post-Office Transmitting Licence will be required before the operation and testing of this last stage. If the transmitter is to be used purely for C.W. and the modulator stage not used at all, it is advisable to strap the cathode, g1, g2 and g3 of the pentode section to earth and connect the anode to H.T.+ via a 47k resistor. The meter in the anode lead of the EL41 should be kept as a fixture and then a permanent check on transmitter efficiency is possible.

4—The Modulator

The wiring diagram is shown Fig. 6. The connection from the coaxial socket should be as short as possible to avoid hum. The input required for a reasonably modulated output is about ½ to 1V.

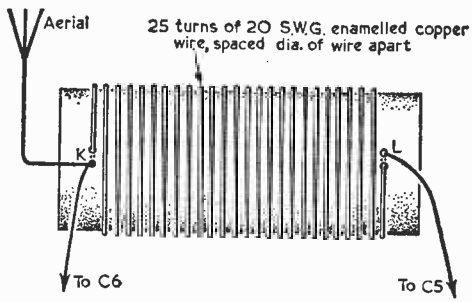

Fig. 7.—The tank coil.

The final testing must be carried out with the aid of a suitable receiver which can be tuned to the fundamental frequency of the transmitter, which should be modulated by a suitable source of A.F. and the receiver tuned to the transmitter. The quality of the modulation should be checked and the maximum possible modulation level used without distortion. The transmitter is now complete.

If it is required to use the transmitter in the 14Mc/s band, it will be found that it will cover this band if half of the turns on the coil are shorted out. It will be appreciated that it is only possible to use the transmitter for C.W. in this condition. Simple band switching may be accomplished by using a simple shorting switch. ■

COMPONENTS LIST

Resistors:

R1	*22k ½W*	*R5*	*470k ½W*
R2	*10k 1W*	*R6*	*33k ½W*
R3	*2·2k ½W*	*R7*	*10k 5W*
R4	*5·6k 1W*		

Condensers:

C1 100pF (mica)
C2 1000pF (ceramic)
C3 5000pF (mica)
C4 10,000pF (mica)
C5, C6 } 250pF variable capacitor
C7 1000pF capacitor
C8 8μF 350VW   C9 8μF 350VW

Valves:

V1 ECL80   V2 EL41   V3 5Z4

RFC 1, RFC 2 R.F. chokes
LFC L.F. choke—almost any smoothing choke will be satisfactory
M1 Milliameter (0-30mA)
Crystal suitable for a channel in the 7Mc/s band (with holder)
D.P.S.T. mains on/off switch
Mains transformer 250V-0-250V 90mA, 5V 2A, 6·3V 2A
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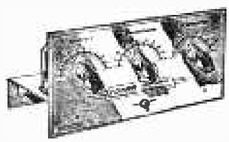

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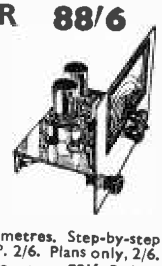

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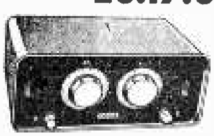

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Letters to the Editor

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

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commerical or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of the cover.

SWL AND HAMS

SIR,—With reference to E. L. W.'s letter in the September issue, I am sure that he must have caught the ham he visited at an inconvenient time or didn't have the right approach. I have always found them most friendly and helpful, and have obtained many useful tips from them. I advise E. L. W. to try again, he evidently caught the ham in a bad mood.—B. J. CHAPMAN (Birmingham).

SIR,—With reference to E. L. W.'s letter in which he complains of being badly received when visiting a local ham, I can assure him that most operators are willing to help SWLs with their problems.

At one time I was looking for a decent S.W. receiver so I went for some advice from a local ham. He was most helpful, and immediately found an advertisement for a set, the same as his own. I have since bought this receiver and its performance is very satisfactory.

In my experience I have found all operators very helpful.—I. CATLEUGH (East Lothian, Scotland).

TRANSMITTER LICENCES

SIR,—I notice that once again the controversy about "low power transmitting" is rearing its head.

There is a solution to this problem which may be of interest to readers. By all means let those who wish to become genuine "hams" continue with the Radio Amateurs Exam and GPO morse test. On the other hand there is an easy way for others to enjoy using "speech only" equipment of a very high standard, with no cost to themselves.

Any person over 18 years of age can join the Signal Section of the Civil Defence Corps. Here they will receive a thorough training in wireless procedure, maintenance of equipment, station siting and other relevant subjects.

All the wireless equipment used is VHF and ranges from walkie-talkies to 5 channel fixed mains sets.—G. D. THORNTON (Fife).

CORRESPONDENTS WANTED

SIR,—I am a regular reader of P.W. I am interested in radio technology and have started a radio repair shop of my own. I would like to correspond with any radio technician from anywhere. I will answer all letters received promptly.—S. J. D. RODRIGO (Miriskotuwa, Kahagolla, Diyatalawa, Ceylon).

TRANSISTOR SET RECEPTION

SIR,—Mr. James appears to have been exceedingly unlucky in his choice of circuits. In his letter in the June issue he says that designers should state in what part of the country they have tested the set. I fully agree with this, but, that in itself will give no criterion as to the performance to be expected elsewhere. I feel that it is time a measurement test should be given, say so much output with so much input, or in other words a sensitivity rating such as the manufacturers give with their products.—G. BOOTH (Norwich).

BBC TV RECEPTION

SIR,—I notice that Mr. Bickham suggests that radiation from an I.F. stage may be the cause of listeners hearing television on the short waves (August issue). I do not agree. Truly, it may be radiated, but not from the I.F. stages. I think most receivers have AVC and other arrangements which would prevent this, and after all the I.F. transformers are invariably totally screened. No, I think the radiation comes from the output stages or at least somewhere in the audio section, where screening is not introduced. This was, in fact, often experienced by TV amateurs when ITV started and receivers were in use with **straight** circuits. This did not occur with the superhet, as the signal at the output stage was not at the signal frequency.—G. KIMBER (Manchester).

YOUNG ENTHUSIASTS

SIR,—On reading the letter by D. Hill of Edinburgh in your last issue I thought he would be interested to know that I received the same transmission on 14·3Mc/s on an ex-naval R1110 receiver.

This transmission is also heard on the same frequency during the day.—V. J. ROWLEY (Plymouth).

SIR,—In the October edition of P.W., Mr. D. Hill requested information on a station announcing itself as "Rome Radio". I have myself received this particular station several times, at reasonable strength, between 27 and 29m, at all times of the day. The full announcement reads as follows: "This is Rome Radio, Maritime Radio Telephone Service. This is a test transmission for receiver adjustments."

Occasionally, on the same wavelength, a programme can be heard, so this station is presumably a commercial broadcasting station.—B. DEMPSTER (Mapperley).

SIR,—With reference to D. Hill's letter which appeared in your October issue, the transmission which he heard comes from a station situated near Rome, on the West Coast of Italy. The purpose of this station is to maintain a radio-telephone service with nearby ships. The recording which Mr. Hill heard is radiated when the radio-telephone service is not being used. The purpose of this is to enable the neighbouring ships to tune accurately to the station before calling. The recording goes as follows: "This is Rome Radio, Maritime Radio-Telephone Service. This is a test transmission for receiver adjustment purposes." This station operates on several frequencies but is usually heard at the H.F. end of the 19 and 16m band.—B. PEARS (Rowlands Gill, Co. Durham).

[The above are only three of many letters received in reply to Mr. Hill's letter, and we thank all of the readers who went to the trouble of sending informaiton. This is the true 'ham' spirit.—Editor.]

TRANSISTOR RADIO IN THE ALPS

SIR,—Some time ago I built a small reflex pocket receiver (with an earphone) and subsequently took it with me on my annual Continental tour. Most of the time I was on the high Alpine passes in several countries. I was surprised that radio reception was uniformly very bad, even with an external aerial. I did not receive any signals during day light hours but there was plenty of 60 cycle hum from the power transmission lines. Even after dark it was only possible to receive one or two stations, and these were of poor strength. The surrounding high peaks would, of course, act as barriers in some directions, but one would have expected good signals where there were no obstructions. In S.E. Austria, where the topography is comparable with England, I found reception to be quite normal. It would have been interesting to have tried the set on the Comet aircraft, but this was out of the question, as I read recently that the use by passengers of portable radios had interfered with the normal radio services of several planes.—F. CHURCHILL (Warrington).

SHORT-WAVE SECTION

(Continued from page 621)

Performance

If the unit is used in the "reject" position with the frequency of maximum rejection at 2kc/s, frequencies of 1850c/s and 2150c/s will be reduced in amplitude by about eight times, whilst rejection of 2kc/s signals will be virtually complete. A frequency of 1500c/s would not be greatly attenuated. The width of the rejected band is proportional to the rejected frequency.

The input should always be less than 1V; overloading gives very poor results.

As an Oscillator

When the circuit is used as an oscillator, the regeneration control should be advanced just enough for oscillation to occur.

Power Supplies

The power requirements for either the circuit of Fig. 3 or that of Fig. 4 are 6·3V at 0·6A (or 12·6V at 0·3A) for the valve heaters and about 150V at a few mA for the H.T. This can easily be obtained from the power pack of almost any mains receiver which employs a 6·3V heater supply.

Construction

A sub-chassis of size 5in. x 4in. x 2½in. will easily accommodate the unit. The ganged frequency control, the regeneration control and the select/reject switch must, of course, be brought to the front panel of the receiver or of the unit if the latter is separated from the receiver. Leads should be reasonably short where possible, but any leads which must be more than a few inches long should be screened if they carry audio frequency currents. It is probably unwise to attempt to accomadate all of the elements of the select/reject switch on one wafer.

THE P.W. SIGNAL GENERATOR

(Continued from page 638)

Calibration of the A.F. Oscillator

The procedure for calibration of the audio generator is very similar to that for the R.F. generator; dial readings corresponding to known frequencies are noted, for each range, on a graph (see Fig. 41). Before actual calibration, the dial suggested (Bulgin 2/K402) has to be modified by extending the scale to 170°. This can be carried out with Indian ink, which is varnished when dry.

Procedure

Connect the output of the audio oscillator to a loudspeaker or amplifier and switch it to Range 1. To another loudspeaker, connect the 6·3V heater supply via a resistor of 1000Ω (take care not to short-circuit the 6·3V supply). Tune the generator to "zero beat"—the point at which the two notes appear to merge. This will establish the 100c/s point. It should also be possible to establish the 150c/s and 200c/s points.

The use of a standard tuning fork will enable the frequency of 256c/s to be located (a C fork). For other frequencies, a piano can be used—Middle C will give about 260c/s, one octave lower giving 131c/s, the next 65c/s and the next 33c/s. Finally, a graph can be drawn of frequencies and dial readings.

For Range 2, a piano can be used or the various tuning signals of the BBC—the one used early in the mornings, before programmes begin, is 1000c/s and the one before the Third programme and Network Three is 440c/s.

For Range 3, which is rather more difficult, a piano can be used for 2kc/s to 4kc/s (by a good musician). The graph will have to be drawn in by estimation for frequencies above about 15kc/s because many people cannot hear above this frequency. ■

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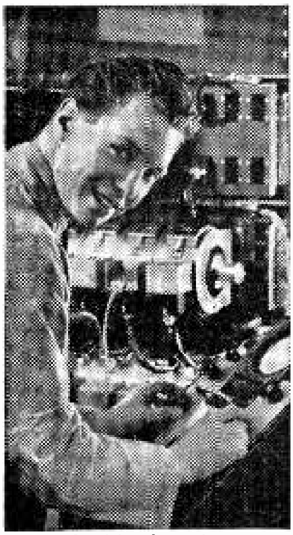

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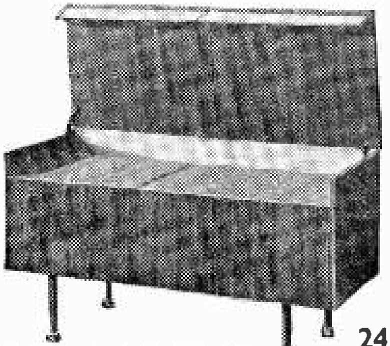

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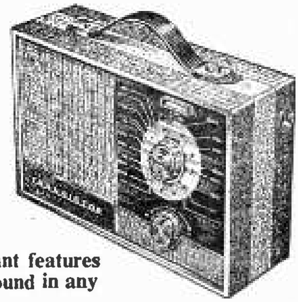

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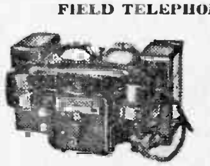

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Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

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PRACTICAL WIRELESS, NOVEMBER, 1961

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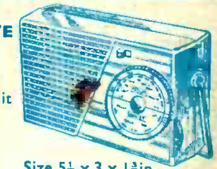

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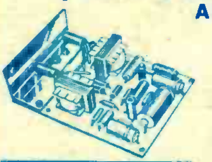

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59/6
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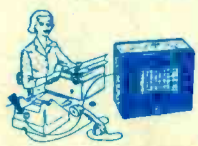

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