SEPTEMBER 1961

Practical WIRELESS

1/6

A WOBBULATOR FOR F.M. I.F. ALIGNMENT

Transistorised VHF Superhet

An Intercom Amplifier

Tel: Mitcham 6201
Open Daily to Callers

RST

All Valves Brand New and Fully Guaranteed

211 STREATHAM ROAD, MITCHAM, SURREY

Special 24 Hour Express Mail Order Service

OZ4	5/9
1A5	6/-
1A7	14/6
1D5	14/-
1D6	10/-
1H5	10/6
1L4	6/-
1LN5	4/6
1N5	10/6
1R5	9/-
1S4	8/6
1S5	9/-
1T4	4/-
1U5	10/-
2D21	8/6
2X2	5/-
3D6	14/6
3Q4	8/-
3Q5	10/6
3S4	8/-
3V4	9/-
5U4G	4/6
5V4	8/-
5Y3GT	8/6
5Z3	10/-
5Z4G	10/-
6A7	18/6
6A8	10/-
6AB8	9/-
6AJ8	9/6
6AK5	8/-
6AK8	7/6
6AL5	6/-
6AM5	5/-
6AM6	4/-
6AN5	7/6
6AQ5	8/3
6AQ8	9/3
6AT6	8/3
6AU6	10/-
6B7	10/-
6B8	4/-
6BA6	7/6
6BE6	7/6
6BG6G	21/-
6BJ6	7/6
6BW6	7/-
6BW7	5/-
6BX6	6/-
6BY7	5/6
6C4	6/6
6C5GT	8/-
6C6	6/6
6C9	12/6
6C10	12/6
6CD6G	27/6
6D1	8/-
6D2	5/-
6D3	15/-
6CH6	12/-
6E5GT	10/-
6F1	15/6
6F6	6/9
6F7	15/-
6F12	4/-
6F13	17/6
6F14	17/6
6F15	14/9
6F17	12/-
6F33	5/6
6H6	2/6
6J5GT	4/6
6J6	7/6
6J7GT	9/6
6K7G	3/-
6K7GT	10/6
6K8GT	12/6
6K25	19/6
6L1	15/6
6L6	7/6
6L18	12/6
6L19	21/-
6L34	10/-
6/30L2	10/-
6LD3	9/6
6LD20	15/6
6N7GT	7/6
6M1	10/6
6M2	10/6
6P1	17/6
6P25	19/6
6P28	26/-
6Q7GT	10/6
6SA7GT	7/6
6SG7	7/6
6SH7	6/6
6SJ7	5/6
6SK7	7/6
6SL7GT	6/6
6SN7GT	5/6
6U4GT	11/6
6U5	7/6
6U7	7/6
6V6G	5/-
6V6GT	8/-
6X4	5/-
6X5GT	5/-
7B7	8/-
7C5	8/-
7C6	8/-
7D5	15/-
7D6	15/-
7D8	15/-
7H7	8/-
7K7	10/6
7Q7	11/6
7R7	12/-
7S7	10/6
7Y4	7/6
8D3	4/-
9BW6	14/9
10C1	18/-
10C2	27/10
10F1	26/2
10F3	17/6
10F9	12/6
10LD3	12/6
10LD11	15/-
10P13	21/-
10P14	20/-
11D3	17/6
11D5	17/6
12A6	6/6
12AH3	10/-
12AT6	9/-
12AT7	6/-
12AU7	9/-
12AX7	9/6
12BA6	9/-
12BE6	9/6
12E1	17/6
12J7GT	9/6
12K7GT	8/6
12K8GT	12/6
12Q7GT	8/6
12SC7	8/-
12SG7	8/6
12SH7	4/-
12SJ7	4/-
12SK7	8/-
12SQ7	11/6
12SN7	17/6
12Z3	15/-
13D3	12/6
14H7	12/6
14R7	12/6
14S7	21/-
15A2	17/6
15D2	23/9
19AQ5	10/6
19BG6G	24/4
20D1	12/6
20D2	23/-
20F2	26/6
20L1	26/6
20P1	26/-
20P3	23/-
20P5	22/6
25L6GT	9/6
25Y5	10/-
25Z4	9/6
25Z5	9/6
25Z6	10/6
27SU	17/6
30	13/6
30C1	12/6
30F5	11/6
30FL1	10/6
30L1	11/6
30P4	22/-
30P12	11/6
30P16	10/-
30PL1	15/-
32	13/6
35A5	15/-
35L6GT	10/6
35W4	8/-
35Z4	7/6
35Z5	9/6
40SUA	15/-
41STH	23/6
42	15/-
43	15/-
50C5	15/-
50CD6G	32/-
50L6GT	9/-
61BT	17/6
61SPT	17/6
62BT	17/6
75	12/6
77	12/6
78	12/6
80	10/-
85A2	12/6
150B2	12/6
150B3	15/-
185BT	32/-
303	7/6
304	7/6
305	7/6
328	7/6
329	7/6
807	7/6
955	4/-
5763	17/6
9002	7/6
9003	7/6
AC4/PEN	25/-
AC5/PEN	22/6
AC6	21/-
ACTP	32/-
ACHL	12/6
AC/PEN	17/6
ACTH1	34/9
ACVP1	17/6
ACVP2	17/6
AC2/PEN	21/-
AC2 PENDD	21/-
AZ1	15/6
AZ31	10/6
B36	21/-
B65	8/6
B152	8/6
B309	9/6
B329	9/6
B339	9/6
B719	9/7
CBL1	17/6
CBL31	21/-
CCH35	21/-
CL4	12/6
CL33	18/6
CY1	15/9
CY31	15/9
D41	12/6
D42	12/6
D63	3/6
D77	5/6
D152	6/-
DAC32	10/6
DAF91	7/6
DF33	10/6
DF91	4/-
DF92	7/-
DF96	9/6
DF97	9/6
DH63	10/-
DH76	7/6
DH77	8/3
DH107	13/6
DH719	7/6
DK91	9/-
DK92	9/6
DK96	10/-
DL33	9/-
DL35	12/6
DL92	8/6
DL94	9/-
DL96	9/6
EA50	2/-
EABC80	7/6
EAC91	7/6
EAF42	10/-
EB41	7/6
EB91	5/-
EBC41	9/6
EBF80	9/6
EBF89	7/6
EBL21	22/-
EBL31	21/6
EC90	9/6
EC91	9/6
ECC31	10/-
ECC32	10/-
ECC33	5/-
ECC34	15/-
ECC35	8/-
ECC40	21/-
ECC81	6/-
ECC82	9/6
ECC83	9/6
ECC84	9/6
ECC85	8/-
ECC91	5/6
ECF80	12/6
ECF82	12/6
ECH21	22/-
ECH35	21/-
ECH42	10/-
ECH81	9/-
ECH83	12/6
ECL80	9/-
ECL83	12/6
EF9	21/-
EF22	17/6
EF36	7/6
EF37	8/6
EF37A	8/6
EF39	4/-
EF40	15/-
EF41	9/3
EF42	10/6
EF50(E)	3/6
EF50(A)	4/-
EF80	5/-
EF85	5/6
EF86	11/-
EF89	10/-
EF91	4/-
EF92	5/-
EF93	7/6
EF95	15/-
EL31	12/6
EL32	5/-
EL33	12/6
EL35	12/6
EL37	18/6
EL38	23/9
EL41	10/6
EL42	10/-
EL81	14/9
EL84	7/-
EL85	10/6
EL90	8/6
EL91	5/-
EM80	10/-
EM81	10/-
EY51	8/6
EY81	10/6
EY84	10/6
EY86	9/6
EY91	9/-
EZ35	7/-
EZ40	7/6
EZ41	7/6
EZ80	7/6
EZ81	7/6
EZ90	7/6
FC2	21/-
FC13	17/6
FC13C	21/-
FW4,500	10/-
FW4,800	10/-
GZ30	10/6
GZ32	11/6
GZ34	13/6
H30	5/6
H63	9/6
HBC90	9/6
HL92	6/6
HL133DD	10/-
HL23	12/6
H23DD	10/6
HL41	12/6
HL41DD	13/6
HL42DD	13/6
HY90	8/-
IW4/350	10/-
IW4/500	10/-
KBC32	9/6
KF35	8/6
KL32	10/6
KLL32	11/6
KL35	9/6
KT2	7/6
KT32	10/-
KT33C	10/-
KT36	28/6
KT41	22/6
KT44	13/6
KT55	22/6
KT61	18/6
KT63	8/6
KT66	17/6
KT71	9/-
KT74	12/6
KT76	12/6
KT101	25/-
KTW63	7/6
KTZ41	8/-
KTZ63	10/-
L63	4/9
LN309	15/-
LZ319	12/6
MH4	8/6
MHD4	17/6
MHL	10/-
MKT4 (5/7)	17/6
MS4B	17/6
MSP4	17/6
MU14	9/-
MX40	17/6
N18	8/-
N19	8/-
N37	18/6
N78	17/6
N108	18/-
N142	9/6
N147	18/6
N150	10/-
N153	11/6
N309	11/6
N329	10/-
N727	7/6
N729	8/-
P2	10/-
PCC84	9/-
PCF80	9/6
PCF82	8/6
PCL82	10/-
PCL83	12/6
PENA4	17/6
PENB4	17/6
PEN4DD	22/6
PL33	18/6
PL38	23/9
PL81	14/9
PL82	8/-
PL83	10/6
PL820	21/-
PM2A	12/6
PM2HL	14/-
PM22A	13/6
PM24M	21/6
PM202	16/-
PY31	16/6
PY32	15/6
PY80	8/-
PY81	7/6
PY82	8/-
PY83	8/6
PZ30	18/6
QP25	14/6
QP230	17/6
QP21	12/6
R10	21/-
R19	19/6
SD6	8/6
SP4	14/6
SP41	3/6
SP42	12/6
SP61	3/6
T41	22/6
TDD4	17/6
TDD13C	17/6
TH41	23/9
TP22	17/6
TP25	17/6
U14	15/9
U16	10/-
U18/20	10/-
U22	10/-
U24	29/6
U25	14/-
U26	12/6
U31	9/6
U33	21/-
U35	21/-
U37	25/-
U45	21/-
U47	21/-
U50	8/6
U52	7/-
U76	7/6
U78	7/-
U142	8/-
U145	15/-
U147	7/-
U153	9/6
U191	20/-
U251	17/6
U281	20/-
U282	22/-
U301	22/6
U329	17/6
U339	19/-
U403	11/6
U404	10/-
U801	29/-
U4020	15/6
UABC80	7/-
UAF42	9/6
UB41	9/-
UBC41	9/6
UBF80	9/6
UBF89	7/6
UCC85	10/-
UCH42	8/6
UCH81	8/6
UCL82	12/6
UCL83	13/6
UF41	9/-
UF42	11/6
UF80	9/-
UF85	9/-
UF89	8/-
UL41	9/-
UL44	24/6
UL46	21/-
UL84	7/6
UU6	20/11
UU7	15/-
UU8	26/-
UY21	15/6
UY41	7/6
UY85	6/6
VP2B	17/6
VP4B	17/6
W17	8/6
W76	7/-
W77	5/-
W81	6/-
W142	9/-
W719	7/6
W727	7/6
X18	11/6
X61M	21/-
X65	23/9
X66	21/-
X78	21/-
X79	21/-
Y61	10/6
Y63	9/-
Z21	12/6
Z63	7/6
Z66	19/6
Z77	4/9
Z153	8/6
Z719	7/9
ZD152	9/6

METAL RECTIFIERS

RM1	6/-	18RA 1-1-8-1	4/6	16RE 2-1-8-1	8/6
RM2	8/-	18RA 1-1-16-1	6/6	18RA 1-2-8-1	11/-
RM3	9/-	16RA 1-1-16-1	8/6	14A86	17/-
RM4	16/6	14RA 1-2-8-2	18/-	14A97	23/6
RM5	22/-	14RA 1-2-8-2	21/-	14A100	24/-

SPECIAL OFFER
1T4 4/-, 5U4G 4/6, 6K7G 3/-, 6K8 8/-, 6V6G 5/-, 6X4 4/6, EBC33 4/-, EF39 4/-, EF80 5/-, EF85 5/6, EF91 4/-, EL84 7/-,

TERMS OF BUSINESS C.W.O. or C.O.D. 2/9 PACKING CHARGE ON ALL C.O.D. ORDERS. POSTAGE 3d. PER VALVE

OBSOLETE VALVES A SPECIALITY. QUOTATIONS GIVEN ON ANY TYPE NOT LISTED

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 leaflets.

BEFORE YOU BUY —YOU SHOULD HEAR THESE RECORDERS. THEY ARE COMPARABLE TO THE MUCH HIGHER-PRICED MODELS

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

All prices quoted provide for the COMPLETE RECORDER including CRYSTAL MICROPHONE and 1,200 ft. Spool of Tape.

Each Model incorporates the highly successful HF/TR3 Amplifier (described below) thus ensuring truly "Hi-Fi" record and playback facilities.

MODEL TR3/Mk.V1 Incorporates the New TRUVOX Mk. VI TWIN TRACK 2-speed Tape Deck operating at 3¾" and 7½" speeds **£49.10.0**
H.P. Terms: Deposit £9.18 and 12 months of £3.12.7

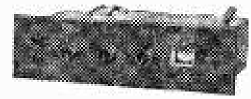
TAPE AMPLIFIERS and PRE-AMPLIFIERS PRESENTED FROM MULLARD DESIGNS

MODEL HF/TR3 TAPE AMPLIFIER

(Mullard Type "A" design)
A very high quality Amplifier incorporating 3-speed treble equalisation, by the latest FEROXCUBE POT CORE INDUCTOR. FOR COLLARO-TRUVOX-BRENELL WEARITE Tape Decks, has GILSEN Output Transformer. Includes separate Power Supply Unit.

KIT OF PARTS **£13.13.0** OR ASSEMBLED **£17.0.0**
H.P. Deposit £3.8.0 and 12 months at £1.4.11.

MULLARD TYPE "C" TAPE PRE-AMPLIFIER—ERASE UNIT



The "Hi-Fi" link to add full tape recording facilities to High Fidelity home installations. Incorporates FEROXCUBE POT CORE PUSH PULL OSCILLATOR and 3-speed treble equalisation by FEROXCUBE POT CORE INDUCTOR FOR WEARITE-COLLARO-TRUVOX OR BRENELL TAPE DECKS. Includes separate power Supply Unit.

KIT OF PARTS **£14.0.0** H.P. £3.8.0 Deposit and 12 months £1.4.11 OR ASSEMBLED **£17.0.0**
(Excluding power unit £11.15.0 and £14.10.0 respectively).

FOR THE HOME CONSTRUCTOR SPECIAL 'COMBINED ORDER' PRICES

(a) The COLLARO "STUDIO" TAPE DECK and our Mullard Type "C" PRE-AMPLIFIER and POWER Unit Assembled and Tested..................... **£29.10.0**
H.P. Deposit £4.18.0 and 12 months £2.3.3.
(b) As above but TYPE "C" PRE-AMPLIFIER supplied as complete KIT OF PARTS.............. **£26.10.0**
(c) The TRUVOX Mk. VI DECK and the assembled Type "C" Pre-amplifier and Power Unit.......... **£40.0.0**
H.P. Deposit £8.0.0, and 12 months £2.18.8.
(d) As above but Type "C" as complete KIT OF PARTS **£36.10.0**
(e) The BRENELL Mk. V DECK and the assembled Type "C" PRE-AMPLIFIER and POWER UNIT **£46.0.0**
H.P. Deposit £9.4.0, and 12 months £3.7.6.
(f) As (e) but Tape "C" as complete KIT OF PARTS **£43.0.0**
(g) THE WEARITE 4A DECK with TYPE "C" assembled and tested............................ **£56.0.0**
H.P. Deposit £11.4.0, and 12 months £4.2.1.

(Carriage and Insurance on above quotes 10/- extra).
EACH OF THE ABOVE CAN BE SUPPLIED IN A PORTABLE CASE FOR £5.10.0 EXTRA, THUS FORMING A COMPLETE PORTABLE PRE-AMPLIFIER. FULL DETAILS ON REQUEST.

(a) COMPLETE KIT to build the HF/TR3 Amplifier, together with the COLLARO "STUDIO" DECK. **£26.0.0**
(b) As above but with HF/TR3 supplied ASSEMBLED and TESTED **£29.10.0**
H.P. Deposit £5.18.0 and 12 months £2.3.3.
(c) COMPLETE KIT to build the HF/TR3, together with the NEW TRUVOX Mk. VI TAPE DECK.. **£36.10.0**
(d) As above but HF/TR3 supplied ASSEMBLED and TESTED **£40.0.0**
H.P. Deposit £8.0.0, and 12 months £2.18.8.
(e) COMPLETE KIT to build the HF/TR3 AMPLIFIER with the BRENELL Mk. V TAPE DECK **£42.0.0**
(f) As above but HF/TR3 supplied ASSEMBLED and TESTED **£45.10.0**
H.P. Deposit £9.2.0, and 12 months £3.5.9.
(g) THE WEARITE 4A DECK with assembled and tested HF/TR3 Amplifier including WEARITE Head Lift Transformer **£55.0.0**
H.P. Deposit £11.0.0, and 12 months £4.0.8.

Carriage and insurance on each above is 10/- extra.
Attractive PORTABLE CASE is available to accommodate the TRUVOX or COLLARO TAPE DECKS and we offer it, together with ROLA/CELESTION 10 x 6in. LOUDSPEAKER—ACOS CRYSTAL MICROPHONE—and 1,200ft. SPOOL E.M.I. TAPE—ALL FOR £9.0.0. Carriage and Insurance 5/- extra.

SPECIAL OFFER OF TAPE

spools. New, boxed and guaranteed. P.V.C. base on latest type plastic

225ft. on 3in. Spool..........	5/9
900ft. on 5in. Spool..........	18/6
1200ft. on 5¾in. Spool......	21/-
1800ft. on 7in. Spool......	21/-
1200ft. on 7in. Spool......	32/6

TAPE ACCESSORY KITS

(a) E.M.I., includes 3 reels leader tape, splicer, jointing tape and stop foil.......................... **37/6**
(b) SCOTCHBOY, includes 3 reels leader tape, splicer, and jointing tape........................ **29/6**

A LARGE PURCHASE OF BRAND NEW AND FULLY GUARANTEED GARRARD TAPE EQUIPMENT

ENABLES THESE OUTSTANDING PRICE REDUCTIONS

The "MODEL HFG/2R" PORTABLE TAPE RECORDER

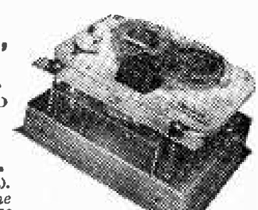
(Original Price £33.0.0)

FOR ONLY 22 gns.

H.P. Dep. £4.14.0. 12 months £1.13.9. *(Carr. & ins. 10/- extra).* Incorporates THE LATEST GARRARD "MAGAZINE" TAPE DECK and a HIGH QUALITY AMPLIFIER which is entirely based on the very siccessful 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 (Carr. & Ins. 10/- extra). **18 Gns.**
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 ON ALL OF ABOVE ARE AVAILABLE—BUT PLEASE ENCLOSE S.A.E. AND STATE WHICH LEAFLET IS REQUIRED.

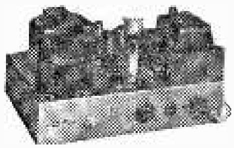
STERN RADIO LTD.

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

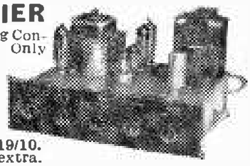
Employing two EF86 valves, and designed to operate with the MULLARD **MAIN AMPLIFIERS**, but also perfectly suitable for other makes.

PRICE COMPLETE KIT 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

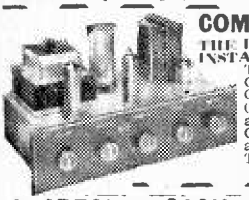


The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Only Specified Components and new **MULLARD VALVES** are supplied including **PARMEKO MAINS TRANSFORMERS** and choice of the latest **PARMEKO** or **PARTRIDGE** ULTRA-Linear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

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.**

A 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.

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.	**£10.10.0**
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.

Dept. P.W. **109 FLEET ST., LONDON, E.C.4**
Telephone: FLEET STREET 5812/3/4

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.

STEREO PRE-AMPLIFIER

This model 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

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.

STEREO PRE-ANNOUNCEMENT

To meet the increasing demand for stereophonic sound equipment our Design Engineers are producing.

STEREO TAPE PREAMPLIFIER

for operation with the latest MINIFLUX and COLLARO ¼ track tape heads.

The Unit incorporates the latest circuitry, the design being based on the very popular MULLARD TYPE "C" Unit, and employs a sensitive meter for accurately setting the record level. High-grade Tape Decks incorporating the MINIFLUX Heads will be available and in keeping with our normal practice will be offered with the Pre-amplifier. Full details and the assembled Preamplifier will be available in September.

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 and as in all our designs only new high grade and guaranteed components are incorporated.

PRICES... MASTER UNIT and ONE EXTENSION

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

The equipment consists of a MASTER UNIT, size only 8¼ x 5¼ x 6in. and ONE EXTENSION (a second extension may be added at any time). The Master Unit incorporates switching and power supply and with the chassis completely isolated from the mains is operated in absolute safety. Attractively presented in Cases covered in quality leatherette.

BENTLEY ACOUSTIC CORPORATION LTD.

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

EXPRESS POSTAL SERVICE. ALL ORDERS DESPATCHED SAME DAY AS RECEIVED. TELEPHONE AND TELEGRAM ORDERS FOR CASH ON DELIVERY SERVICE ACCEPTED UP TO 3.30 P.M.

OA2	17/6	6F6G	7/-	10F1	26/6	35Z4GT	6/-	DH76	5/-	EF40	15/-	HN309	24/7	PL84	12/8	UABC80	9/-	XFY34	17/6
OB2	17/6	6F11	17/3	10F9	11/6	35Z5GT	9/-	DH77	7/-	EF41	9/-	HVR2	20/-	PL820	18/8	UAF42	9/6	XH(1.5)	6/6
OZ4	5/-	6F12	4/6	10LD11	15/11	43	10/-	DK32	12/-	EF42	10/6	HVR2A	6/-	PM84	17/7	UB41	12/-	XSG(1.5)	6/6
1A5	6/-	6F13	11/6	10P13	15/-	50C5	10/-	DK91	6/6	EF50(A)	7/-	KF35	8/6	PX4	10/6	UBC41	8/6	Y63	7/6
1A7GT	12/-	6F15	15/3	10P14	19/3	50CD6G		DK92	9/-	EF50(E)	5/-	KL35	8/6	PY31	16/7	UBC81	11/4	Z63	7/6
1C5	12/6	6F23	10/6	12A6	5/-		36/6	DK96	8/6	EF54	5/-	KLL32	24/7	PY32	12/6	UBF80	9/-	Z66	17/6
1D6	10/6	6F24	12/6	12AC6	15/3	50L6GT	9/6	DL33	9/6	EF73	10/6	KT2	5/-	PY80	7/6	UBF89	9/6	Z77	4/6
1G6	17/6	6F32	10/6	12AD6	17/3	53KU	19/11	DL66	17/6	EF80	6/-	KT33C	10/-	PY81	8/6	UBL21	23/3	Z719	6/-
1H5GT	10/6	6F33	7/6	12AE6	13/11	77	8/-	DL68	15/-	EF85	6/-	KT36	29/10	PY82	7/-	UCC84	14/7		
1L4	3/6	6G6	6/6	12AH7	8/-	78	6/6	DL72	15/-	EF86	10/6	KT41	23/3	PY83	8/6	UCC85	9/-	*Transistors*	
1LD5	5/-	6H6	3/-	12AH8	12/6	80	9/-	DL92	7/-	EF89	9/-	KT44	12/6	PY88	13/3	UCF80	16/7	*and diodes*	
1LN5	5/-	6J5	5/-	12AT6	7/6	83	15/-	DL94	7/6	EF91	4/6	KT61	12/6	PZ30	19/11	UCH21	23/3	CG1C	7/6
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1S5	6/-	6K7G	5/-	12AV6	12/8	90C1	16/-	E83F	30/-	EF183	18/7	KTW61	6/6		10/6	UCL83	19/3	CG10E	7/6
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2D21	15/-	6K8G	6/6	12BE6	9/-	150B2	18/-	EABC80	9/-	EL32	5/-	KTZ41	8/-	R19	19/11	UF80	10/6	OA70	3/-
2P	26/6	6K25	19/11	12BH7	21/3	161	10/6	EAC91	4/6	EL33	12/6	KTZ63	7/6	RG1/240A		UF85	9/-	OA73	3/-
2X2	4/6	6L1	23/3	12E1	30/-	185BT	33/2	EAF42	9/-	EL34	15/-	L63	6/-		54/-	UF86	17/11	OA79	3/-
3A4	6/-	6L6G	8/-	12J5GT	4/6	304	10/6	EB34	2/6	EL38	26/6	MHL4	7/6	RK34	7/6	UF89	9/-	OA81	3/-
3A5	10/6	6L6M	9/6	12J7GT	9/6	305	10/6	EB41	8/6	EL41	9/-	MHLD6	12/6	S130	22/6	UL41	9/-	OA86	4/-
3B7	12/6	6L7GT	7/6	12K5	17/11	807	7/6	EB91	4/-	EL42	10/6	ML4	8/6	SP4(7)	14/6	UL44	26/6	OA91	3/6
3D6	5/-	6L18	13/-	12K7GT	5/6	956	3/-	EBC3	23/3	EL81	16/7	MS4B	23/3	SP41	3/6	UL46	14/6	OA95	3/6
3Q4	7/6	6L19	23/3	12K8GT	14/-	1821	16/7	EBC33	5/-	EL83	19/11	MU12/14	8/-	SP42	12/6	UL84	8/6	OA210	11/-
3Q5GT	9/6	6LD20	15/11	12Q7GT	5/-	4033L	12/6	EBC41	8/6	EL84	7/6	N37	23/3	SP61	3/6	UM4	17/3	OA211	20/-
3S4	7/-	6N7	8/-	12SA7	8/6	5763	12/6	EBC81	8/-	EL85	13/11	N78	19/11	SU25	26/6	UM34	17/3	OC16	48/-
3V4	7/6	6P26	19/11	12SC7	8/6	7193	5/-	EBF80	9/-	EL86	17/3	N108	23/3	T41	9/-	UM80	15/3	OC19	48/-
5R4GY	17/6	6P28	26/6	12SG7	7/-	7475	7/6	EBFB3	13/11	EL91	5/-	N308	20/7	TDD4	12/6	URIC	18/7	OC23	87/-
5U4G	6/6	6Q7G	6/6	12SH7	8/6	9002	5/6	EBF89	9/6	EL95	10/6	N339	15/-	TH41	26/6	UU6	19/11	OC26	25/-
5V4G	10/-	6Q7GT	11/-	12SJ7	8/6	AC/PEN		EBL1	29/6	EL820	18/7	P61	3/6	TH233	33/2	UU7	16/7	OC28	25/-
5Y3	6/6	6R7G	10/-	12SK7	6/-	5-pin	23/3	EBL21	23/3	EL822	19/-	PABC80		TP22	15/-	UU8	26/6	OC35	25/6
5Z3	19/11	6SA7GT	8/6	12SQ7	11/6	7-pin	15/-	EBL31	23/3	EM34	9/6		13/11	TP25	15/-	UU9	7/6	OC44	11/-
5Z4G	9/-	6SC7	7/6	12SR7	8/6	AC2PEN/		EC52	5/6	EM71	23/3	PCC84	8/-	TP2620	33/2	UY1N	18/7	OC45	10/-
6A7	10/6	6SG7GT	8/-	12Y4	10/6	DD	12/6	EC54	6/-	EM80	9/-	PCC85	9/6	TY86F	13/3	UY21	16/7	OC65	22/6
6A8	9/-	6SH7GT	8/-	14S7	27/10	AC6PEN	7/6	EC70	12/6	EM81	9/-	PCC88	18/-	U12/14	8/6	UY41	7/6	OC66	25/-
6AC7	4/-	6SJ7GT	8/-	19AQ5	10/6	AC/TP	33/2	EC92	13/3	EM84	10/6	PCC89	11/6	U16	10/6	UY85	7/-	OC70	6/6
6AG5	5/6	6SK7GT	6/-	19H1	10/-	ATP4	5/-	ECC32	5/6	EM85	17/3	PCF80	8/-	U18/20	8/6	VMP4G	15/-	OC71	6/6
6AG7	7/6	6SL7GT	6/6	20D1	15/3	AZ1	18/7	ECC33	8/6	EN31	53/-	PCF82	10/6	U19	36/-	VMS4B	15/-	OC72	8/-
6AK5	8/-	6SN7GT	5/6	20F2	26/6	AZ31	10/-	ECC34	24/7	EY51	9/-	PCF84	16/7	U22	8/-	VP2	12/6	OC73	16/-
6AL5	4/-	6SQ7GT	9/-	20L1	26/6	AZ41	13/11	ECC35	8/6	EY83	16/7	PCF86	15/-	U24	29/10	VP4	15/-	OC75	8/-
6AM6	4/6	6SS7GT	8/-	20P1	26/6	B36	15/-	ECC40	23/3	EY84	14/-	PCL82	10/-	U25	17/11	VP2B	14/6	OC77	15/-
6AQ5	7/6	6U4GT	12/6	20P3	23/3	BL63	7/6	ECC81	6/-	EY86	9/-	PCL83	10/6	U26	10/-	VP4B	23/3	OC78	8/-
6AT6	7/-	6U5G	7/6	20P4	26/6	C1	12/6	ECC82	6/6	EZ35	6/-	PCL84	12/6	U31	9/6	VP13C	7/-	OC81	8/-
6AU6	10/-	6U7G	8/6	20P5	23/3	C1C	12/6	ECC83	7/6	EZ40	7/-	PCL85	16/7	U33	26/6	VP23	6/6	OC170	13/6
6AV6	12/8	6V6G	7/-	25A6G	10/6	CBL1	26/6	ECC84	9/-	EZ41	7/-	PCL86	16/7	U35	26/6	VP41	6/-	OC171	14/6
6B8	5/-	6V6GTG	8/-	25L6GT	10/-	CBL31	23/3	ECC85	8/6	EZ80	7/-	PENA4	23/3	U37	26/6	VR105	8/-	OC200	16/6
6BA6	7/6	6X4	5/-	25Y5G	10/-	CCH35	23/3	ECC88	18/-	EZ81	7/-	PENB4	26/6	U43	9/-	VR150	7/6	OC203	24/-
6BE6	6/-	6X5GT	6/-	25Z4G	9/6	CK506	6/6	ECC91	5/6	FC4	15/-	PEN4DD		U45	9/-	VT61A	5/-	OCP71	29/6
6BG6G	23/3	6/30L2	10/-	25Z5	9/6	CL33	19/3	ECF80	10/6	FW4/500	8/6		26/6	U50	6/6	VT501	5/-	TJ1	40/-
6BH6	8/-	7A7	12/6	25Z6G	10/-	CV63	10/6	ECF82	10/6	FW4/800	8/6	PEN25	4/6	U52	6/6	W76	5/6	TJ2	45/-
6BJ6	6/-	7B6	21/3	27SU	19/11	CY1	18/7	ECF86	19/11	GU50	27/6	PEN40DD		U54	19/11	W81M	6/-	TJ3	50/-
6BQ7A	15/-	7B7	8/6	28D7	7/-	CY31	11/-	ECH3	26/6	GZ30	9/-		25/-	U76	6/-	W107	18/7	TP1	40/-
6BR7	12/6	7C5	8/-	30C1	8/-	D1	3/-	ECH21	23/3	GZ32	10/-	PEN44	26/6	U78	5/-	W729	19/11	TP2	40/-
6BS7	25/-	7C6	8/-	30F5	6/-	D15	10/6	ECH35	6/6	GZ33	19/11	PEN45	19/6	U107	16/7	X24M	24/7	TS1	10/-
6BW6	8/6	7H7	8/-	30FL1	40/-	D77	4/-	ECH42	9/-	GZ34	14/-	PEN46	7/6	U191	16/7	X41	15/-	TS2	12/6
6BW7	6/-	7R7	12/6	30L1	8/-	DAC32	10/6	ECH81	9/-	GZ37	19/11	PEN383	23/3	U201	16/7	X61(C)	12/6	TS3	15/-
6C4	5/-	7S7	9/6	30L15	11/6	DAF91	6/-	ECH83	13/11	H63	12/6	PEN453DD		U251	14/-	X63	9/-	TS4	24/-
6C5	6/6	7V7	8/6	30P4	12/-	DAF96	8/6	ECL80	9/-	HABC80			33/2	U281	19/11	X65	12/6	V30/10P	28/6
6C6	6/6	7Y4	7/6	30P12	7/6	DD41	13/11	ECL82	10/6		13/6	PEN/DD		U282	22/7	X66	12/6	XA101	23/-
6C9	13/6	8D2	3/6	30P19	12/-	DET25	7/6	ECL83	19/3	HL2	7/6	4020	33/2	U301	23/3	X76M	14/-	XA102	26/-
6C10	9/-	8D3	4/6	30PL1	10/6	DF33	10/6	ECL86	16/7	HL23	15/3	PL33	19/3	U329	14/-	X78	23/3	XA103	15/-
6CD6G	36/6	9BW6	15/3	30PL13	16/6	DF66	15/-	EF9	23/3	HL23DD	7/6	PL36	12/-	U339	16/7	X79	23/3	XA104	18/-
6CH6	9/-	9D2	4/-	35A5	21/3	DF91	3/6	EF22	14/-	HL41DD		PL38	26/6	U403	16/7	X109	17/3	XB102	10/-
6D6	6/6	10C1	13/-	35L6GT	9/6	DF96	8/6	EF36	4/-		19/3	PL81	10/6	U404	8/6	XD(1.5)	6/6	XB103	14/-
6E5	12/6	10C2	26/6	35W4	7/6	DF97	9/-	EF37A	8/-	HL42DD		PL82	7/6	U801	29/10	XFG1	18/-	XB104	10/-
6F1	26/6	10D2	12/-	35Z3	10/6	DH63	6/6	EF39	5/6		19/3	PL83	9/-	U4020	16/7	XFY12	9/6	XC101	16/-

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

VOLUME CONTROLS

All with Long Spindle and Double-pole 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	21/-	18RA 1-1-16-1	6/6
								(FC31)		(FC116)	
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	17/6	16RE 2-1-8-1	8/6	18RD 2-2-8-1	15/-
LW7	21/-	RM-4	14/-	14A124	28/-	(FC101)					
RM-0	7/11	RM-5	19/6	14A163	38/-	16RC 1-1-16-1	8/6	18RA 1-1-8-1	4/6	(FC124)	

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
- 16 x 8 x 8 mfd., 500 v. 4/-
- 32 x 32 mfd., 450 v. 5/9
- 64 x 120 mfd., 350 v. 8/3

- 60 x 250 mfd., 275 v. 9/6
- 100x400 mfd., 275 v. 12/6
- 100 mfd., 275 v. 3/-
- 200 mfd., 275 v. 4/-
- 100x200 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.

R.S.C. HI-FI TAPE RECORDER KIT

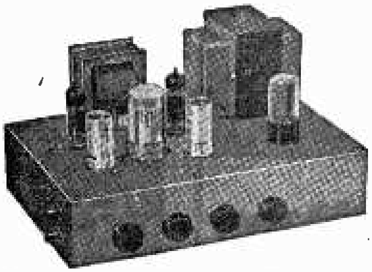
REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN HALF AN HOUR
The Recorder incorporates the Latest Collaro Studio Tape Transcriptor. The Linear LT45X High Quality Tape Amplifier listed £12.12.0 High Flux P.M. Speaker listed 30/-, empty Tape Spool, a Reel of Best quality Tape listed 22/6, and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 18 x 13 x 9in. high, listed £4.10.0, and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £30-£80 class. S.A.E for leaflet.

25½ GNS.
Carr. 17/6

H.P. TERMS. Deposit £5.7.6 and 12 monthly payments of 2 gns. Cash price if settled in 3 months.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

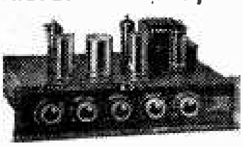
PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram, as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, 6Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc., OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/- (Or factory built 51/- extra).

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9, and 9 monthly payments of 24/9. Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones, etc., with cash and credit terms.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts, suitable for all crystal stereo heads. Ganged Bass and Treble Controls give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. Full constructional details and price list 2/6. **8 Gns.** Carr. 10/-

TELEVISION RECTIFIERS 250 v. 200 mA. small size. Only 6/9 each.

COLLARO CONQUEST 4-SPEED AUTO-CHANGER. with high fidelity Studio pick-up. Latest model. For 200-250 v. 50 c.p.s. A.C. mains. Our price £6.19.6. Carr. 5/6.

COLLARO RC 457 4 SPEED MIXER AUTO-CHANGERS. Turnover Studio Pick-up head. for 200-250 v. A.C. £7.19.6. Carr. 4/6.

THE SKYFOUR T.R.F. RECEIVER A design of a 3-valve long and Medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion detector. Valve line-up 6K7, SP61, 6V6G. Selectivity and quality excellent. Simple to construct. Point-to-Point wiring diagrams, instructions and parts list, 1/9, maximum building costs £4.19.6, inc. attractive Walnut veneered wood cabinet 12 x 6½ x 5½in.

D.C. SUPPLY KIT. 12 v. 1 a. consisting of a partially drilled metal case, mains trans., F.W. Bridge Rectifier, 2 fuseholders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable for Electric Trains. Limited number available at 33/9.

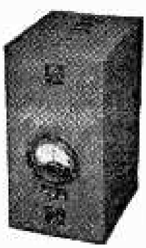
R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250v., 50 ccs. Guaranteed 12 months.

HEAVY DUTY CHARGER KIT 6/12 v. 6 amps. variable output. Consisting of Mains Transformer 0-200-230-250 v.; F.W. (Bridge) Selenium Rectifier: Ammeter, Variable Charge Rate Selector Panels, Plugs, Fuses, Fuseholder and circuit. 59/9. Carr. 4/6.

DEAF AID EARPIECES. Low Impedance with lead. 8/9. High Impedance Crystal 8/9.

MICROPHONE INSERTS. Crystal type 6/9.



Assembled 6 v. or 12 v. 4 amps.
Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finished. Fused and ready for use with mains and output leads. **69/6** Carr. 5/- Terms: Deposit 13/3 and 5 monthly payments 13/3.

ASSEMBLED CHARGER
6 v. or 12 v. 2 amps.
Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Ready for use With mains and output leads. Double Fused. Only **49/9** Carr. 3/9.

BATTERY CHARGER KITS Consisting of Mains Transformer. F.W. Bridge. Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders. Grommets, panels and circuit. Carr. 3/6 extra.
6 v. or 12 v. 1 amp. 24/9
As above, with Ammeter .. 32/9
6 v. 2 amps. 25/9
6 v. or 12 v. 2 amps. 31/6
6 v. or 12 v. 2 amps. inclusive of Ammeter 42/9
6 v. or 12 v. 4 amps. 53/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector 59/9

CHARGER AMMETERS. 0-1.5 a., 0-3 a., 0-4 a., 0-7 a., 0-25 a., 0-60 a. 8/9.

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

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

TOP SHROUDED DROP THROUGH
250-0-250 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a.. 17/9
350-0-350 v. 80 mA, 6.3 v. 2 a, 5 v. 2 a.. 18/9
250-0-250 v. 100 mA, 6.3 v. 2 a, 6.3 v. 1 a 19/9
250-0-250 v. 130 mA, 6.3 v. 3.5 a, C.T... 19/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 25/9
300-0-300 v. 130 mA, 6.3 v. 4 a, 6.3 v. 1 a for Mullard 510 Amplifier 29/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 26/9
350-0-350 v. 100 mA, 6.3 v. 4 v. 4 a, C.T. 0-4-5 v. 3 a.. .. .. 26/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a.. 29/9

FULLY SHROUDED UPRIGHT
250-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in. 17/11
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 27/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 27/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.. 27/6
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a.. 35/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T., 5 v. 3 a 49/9

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

OUTPUT TRANSFORMERS
Midget Battery Pentode 66:1 for 3S4, etc. 3/9
Small Pentode, 5000 Ω to 3 Ω 3/9
Small Pentode 7/8,000 Ω to 3 Ω .. 3/9
Standard Pentode 5,000 Ω to 3 Ω .. 5/6
Standard Pentode 7/8,000 Ω to 3 Ω .. 5/6
10,000 Ω to 3 Ω 5/6
Push-Pull 10-12 watts 6V6 to 3 Ω or 15 Ω 18/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω 19/9
Push-Pull EL84 to 3 or 15 Ω 18/9
Push-Pull 15-18 watts, 6L6, KT66 .. 22/9
Push-Pull for Mullard 510 Ultra Linear 29/9
Push-Pull 20 watts, sectionally wound 6L6, KT66 etc., to 3 to 15 Ω .. 49/9

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

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

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a, 11/9; 0-9-15 v. 2 a, 14/9; 0-9-15 v. 3 a, 16/9; 0-9-15 v. 5 a, 19/9; 0-9-15 v. 6a, 23/9; 0-9-15 v. 8 a, 28/9.

AUTO (Step up/Step down) TRANS.
0-110/120-230/250 v. 50-80 watts. 13/9; 1-110/120-200/230/250 v. 150 watts, 27/9.

MICROPHONE TRANSFORMERS
120:1 high grade, clamped, 6/9; 120:1 Potted. Mu-metal screened. 9/9.

R.S.C. (Manchester) Ltd. LIVERPOOL, LEEDS, BRADFORD, MANCHESTER

R.S.C. A12 STEREOPHONIC AMPLIFIER KIT

A complete set of parts to construct a 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. Only good quality components and latest high grade valves used. Exceptionally realistic reproduction can be obtained at ample volume for the home, as can be demonstrated in typical surroundings at our County Arcade premises. A really sensational offer.

4 Gns. Carr. and pkg. 5/-

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 35/9.

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 cover as for A11 can be supplied for 18/9. 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 paymentsof 33/9.

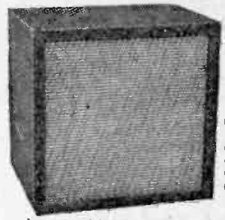
FULL RANGE OF LINEAR AMPLIFIERS ALWAYS IN STOCK.

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 LOUDSPEAKER 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

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. H.P. 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 18in. H.P. Terms. Deposit 34/9 and 9 monthly payments of 34/9. **15 Gns.** Both models for 200-250 v. A.C. mains. Carr. 10/-

Above model fitted Linear Tremolo Unit 5 gns. extra. Or Deposit 11/6 and 9 monthly payments 11/6.

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. £5.10.9. 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. B.S.R. Stereo-Monaural 39/11.

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

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 £4.15.9. 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 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types.

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

Type BM2. Size 8 x 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. 2/9 extra under £5. Open 9 to 6. Weds. until 1 p.m. Trade supplied S.A.E. with all enquiries.

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Short wave radio operates 24 hours a day. You can explore the world from the comfort of your own arm-chair and enjoy perfect relaxation from a day's work. Start now with this amazing little one-valver which gives really long distance reception at a minimum cost. Extra stage can be added later. Learn morse and listen in to shipping etc. 100/A kit with three matched coils covering 10 to 100 metres. PRICE £3.19.6, plus 1/- post. Send S.A.E. for leaflet.

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156 pages and giving characteristics of 4,800 valves, transistors, rectifiers and cathode ray tubes. Also base connections and equivalents. Latest issue and right up-to-date. Essential to all engineers. PRICE 6/-, post 9d.

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Enjoy crystal clear Hi-Fi reception with a JASON FM/VHF tuner unit. Still the best and most popular kits available. Full constructional data and prices 3/6, post 6d. Standard versions as illustrated FMT2 £11.7.6, with power supply. Other models including TV sound available.

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OC26 25/-, OC44 11/-, OC45 10/-, OC70 6/6, OC71 6/6, OC72 8/-, OC76 8/-, OC78 8/-, OC81 8/-, OC170 13/6, OC171 14/6. Matched pairs available. All available from stock.

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We now stock the full range of LAB type LX resistors, only ½in. long and 1/10in. dia. All preferred values 10% tolerance at 8d. each. Ideal for model control and transistor sets.

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A wonderful miniature iron for the constructor. Five different sizes of interchangeable bits are available, also practical bench stand and solder holder. All voltages from 6 to 240 in stock. Send for illustrated leaflet. Iron as shown 29/6 post paid. (Please state voltage).

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The W.B. Stentorian 'Clumber' 912C speaker and cabinet assembly mark a new advance in quality reproduction. Available from stock. PRICE 14 gns. (Plus 5/- part carriage). Leaflet on request.

MAKE YOUR OWN HIGH GRADE CERAMIC WAFER SWITCHES

Really compact high quality switches that you can assemble to your own particular requirements.

Complete shaft assembly 4/3
Separate wafers 4/- each
Spacers (if required) 9d. doz.

Wafers are available in the following combinations and up to eight can be assembled on to one shaft assembly. 1 pole 12 way, 2 pole 6 way, 3 pole 4 way, 4 pole 3 way, 6 pole 2 way. If desired D.P. mains on/off switch can be added to above 5/-.

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Constructional data and all parts in stock for these two sets. Price list on request. Complete set of guaranteed and specified parts for "Transistor 6" 9 gns. and "Roadfarer" £17.10.0.

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LOW PRICES ★ PICTORIAL STEP-BY-STEP PLANS ★ EASY AS A.B.C.

THE NEW "LISBON" TRANSISTOR SET 19/6

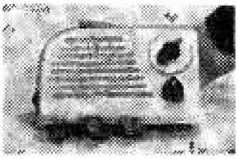
This is a pocket 2-stage transistor set not much larger than a matchbox. Excellent clear reception covering all medium waves, works for months off a tiny 1½ or 3 volt battery costing only 3½d. Easy to build and an excellent introduction to transistor circuitry. Everything can be supplied down to the last nut and bolt incl. **SIMPLE PICTORIAL STEP-BY-STEP PLANS FOR ONLY 19/6**, plus post and packing 1/6; (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.

THE NEW "FLORIDA" VALVE RADIO 27/6

This sensational "FLORIDA" model is one of our most sensitive valve radios. It is a highly compact, self-contained miniature push button base, valve pocket radio at absolutely rock bottom building cost. Covers all medium waves with very latest circuitry bringing in stations from all over Europe without fuss. Size only 4½ x 2¾ x 1½in. A fascinating pocket radio. We can supply all the parts including beautiful 2-tone case and **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**, screws, wire, etc. Can be built for the exceptionally **LOW PRICE OF 27/6**, plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.

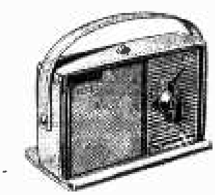
OUR NEW 4 STAGE "MINUETTE" 39/6

Build this newly-designed **"MINUETTE" 4-STAGE** transistor set in very strong ready drilled **ULTRA-MODERN CASE**, size only 6 x 3½ x 1in. Uses three transistors and diode and **SELF-CONTAINED LOUD SPEAKER**. Very sensitive, ideal for office, bedroom, holidays, etc. Months and months of listening off an 8d. battery. Can be built **FOR ONLY 39/6**, including **PROPER CASE**, miniature speaker, etc. **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS** etc., plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



THE NEW "SAN REMO" 27/6

This All Transistor Speaker Radio—The "San Remo"—covers all medium waves including "Home," "Light," etc. Reliable and lightweight—Slips easily into the Pocket or Handbag—size only 4½ x 2¾ x 1½in.! Works for Months off 8d. Battery! Ideal for holidays, Camping, Bedroom, etc. Anyone can assemble it in an hour or two with our simple-as-ABC PLAN! Complete set of parts including miniature speaker—everything—only 27/6, plus 2/6 P. & P. (C.O.D. 2/- extra.) Parts can be bought separately.



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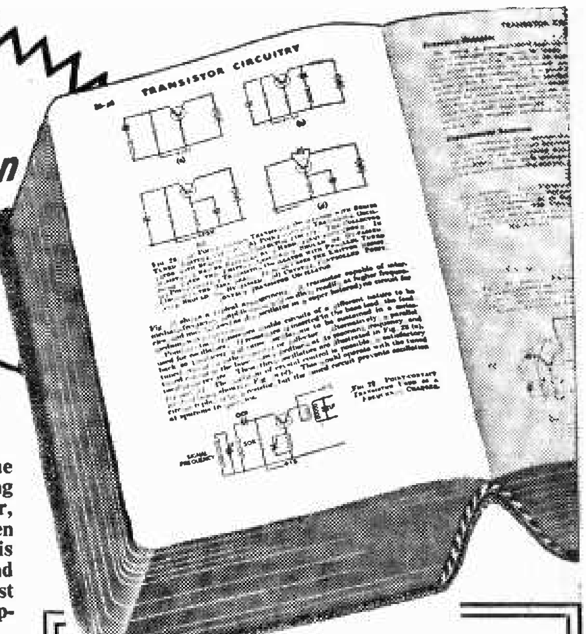

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11D5	5/9
12J7	9/6
12SA7	8/6
12SG7	7/-
12SK7	6/-
12SL7	6/9
12SR7	8/6
12ST7	8/6
18	17/9
19AQ5	10/6
19X3	10/6
20F2	19/9
20P1	19/9
25A6	10/6
25L6	10/-
25Y5	10/-
25Z4	9/6
35L6	9/6
35Z4	6/-
35Z5	9/-
41STH	11/-
45	10/-
43U1	10/-
77	8/-
807	7/6

SPECIAL OFFER 12—6K7G 35/-

MANY MORE VALVES THAN THE ABOVE IN STOCK, PLEASE ENQUIRE FOR TYPES NOT LISTED

100 ASSORTED TAG STRIPS
1 way up to—9 way
15/- per 100

WIRE WOUND POTS
12 Wire Wound Colvern Pots—all different values. P. & P. 9d. **10/9**

TECHNICAL TRAINING in radio television and electronics

Whether you plan to have your own business, to become an electronics engineer, to take up a career in industry, or to brush-up your knowledge and study new developments, transistors, etc., an I.C.S. Course will help you to success. You learn at home in your own time, under expert tuition. Moderate fees include all books.

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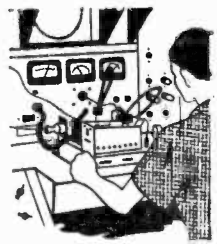

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OC19	48/-	OC72	8/-	OC78D	8/-
OC35	25/6	OC72pr	16/-	OC81	8/-
OC44	11/-	OC73	16/-	OC84	11/-
				OC170	13/6
OC45	10/-	OC75	8/-	OC171	14/6
OC70	6/6	OC77	10/-	OC201	12/6
OC71	6/6	OC78	8/-	OC202	36/-

A SPECIAL OFFER OF SIX MULLARD TRANSISTORS
1 OC44, 2 OC45, 1 OC81D, 2 OC81. Only 37/6 set.

EDISWAN TRANSISTORS
XA104 12/-, XA103 10/-, XB102 6/6 ea.

P.W. TRANSISTOR SIX PRINTED CIRCUIT VERSION

All components available from stock
Complete kit £9.15.0.

Full detailed shopping list, point to point wiring diagram, fully illustrated	1/6
Coil Set (Osc. and 3 I.F.T.s)	22/6
Driver Transformer	11/6
Output Transformer	10/6
Ferrite Rod Aerial	10/-
Printed Circuits	9/-
OO Gang Condensers	11/-
Volume Control V.C. 1545	10/6
Switch	3/6
Hardware Kit	4/6
Transistors (set of 6 plus crystal diode GD9)	70/-
Speaker	19/10
Case	7/6
Complete Kit of Condensers	15/-
Complete Set of Resistances	6/6
Trimmers (2)	2/8

All above components are brand new and are fully guaranteed.

TAPE DECKS

Collaro Studio Tape Transcriptor
3 motors, 3 speeds, 1⅞, 3¾, 7½ i.p.s., take 7in. spool. Push-button control. Price £12.12.0. Tape extra. Carr. & Ins. 5/6.

Latest B.S.R. "Monardeck" Single Speed
3¾ i.p.s. takes 5¾in. spools. Simple controls. £7.7.0. Tapes extra. Carr. and Ins. 5/6.

MICROPHONES

★ **Acos Mic., 39/1.** Crystal stick microphone for use as a hand, desk or floor stand unit. Listed at 3 gns. OUR PRICE 37/6. Table Stand 7/6 extra. Floor stand adaptor, 12/6 extra.

★ **Acos Mic. 40,** as supplied with modern tape recorders with a folding rest and 8ft. lead. Listed at £1.15.0. OUR PRICE 19/6.

★ **GBS Microphone,** pencil stick type fitted with muting switch, 42/-.

★ **T.S.L. Crystal "Stick" Microphone,** Model MX3, for general purpose use, complete with table stand, 45/-.

★ **T.S.L. Moving Coil Microphone,** for high or low impedance. Brown and cream plastic case with a fold-in table rest, 6ft. cable and a standard 3-way connecting continental plug, £4.4.0.

★ **Acos Mic. 45,** dual purpose, designed to fit into the hand, has built-in stand for desk use, die-cast case for a variety of applications from music to dictation, with lead, 25/- each.

TELEVISION TUBES RE-GUNNED

Super screen TV tubes with a 12 months' guarantee.
Tubes all types 12in. to 14in. ... £4.5.0 Tubes all types 15in. to 17in. ... £4.15.0
Carriage and insurance 10/- extra. Allowance against the return of old tube.

AUTOMATIC RECORD PLAYER UNITS

B.S.R. Monarch UA8, 4 speed unit, fitted the B.S.R. Full/Fi cartridge £6.15.0
B.S.R. Monarch UA8, as above but fitted with B.S.R. Full/Fi Stereo cartridge £6.19.6
B.S.R. Monarch UA14, 4 speed unit in two-tone grey £7.19.6
Garrard 210, 4 speed unit, arm wired for stereo, fitted with GC8 monaural cartridge £10.19.6
Garrard 209, 4 speed unit, fitted with GC8 cartridge £10.10.0
Garrard Laboratory Series Auto turntable type A, can be supplied with or without base, and cartridges to your specification, prices from......£21.1.5
Collaro, the latest Collaro Studio automatic record changer, 4-speed unit, finished in cream, fitted with turnover cartridge £7.19.6

VALVES BY RETURN POST

AZ1	10/-
AZ31	10/-
DAF96	8/-
DF96	8/-
DK96	8/-
DL96	8/-
EABC80	9/-
EAF42	9/6
EB91	4/6
EBC3	5/-
EBC33	6/9
EBC41	8/9
EBF80	9/9
EBF89	9/6
ECC81	8/-
ECC82	7/6
ECC83	9/-
ECC84	10/-
ECC85	9/6
ECF80	12/-
ECF82	10/6
ECH42	9/6
ECH81	9/-
ECL80	9/6
ECL82	10/6
ECL83	15/-
EF6	5/-
EF36	3/6
EF41	9/6
EF50	5/-
EF50SYL	7/-
EF80	7/-
EF85	7/-
EF86	12/6
EF89	8/9
EF91	5/9
EF91 (BVA)	7/6
EF92	6/-
EF183	15/-
EF184	15/-
EK32	7/-
EL32	4/6
EL33	10/-
EL41	9/-
EL84	9/-
EL91	4/6
EM34	9/6
EM80	9/6
EM81	10/6
EY51	9/6
EY86	10/-
EZ40	7/6
EZ41	7/6
EZ80	7/-
EZ81	7/-
FC13	5/-
FW4/500	10/-
GZ32	11/6
HL23DD	8/6
HL42DD	10/-
KT2	5/-
KT33C	6/-
KT61	10/-
KTW61	6/6
MX40	12/6
OZ4	4/6
PCC84	12/-
PCC85	8/6
PCF80	8/9
PCF82	11/6
PCL83	13/6
PL36	13/6
PL81	11/-
PL82	8/6
PL83	9/6
PX25	12/6
PY80	7/6
PY81	8/6
PY82	7/-
PY83	8/6
PEN4VA	10/-
PEN25	5/-
PEN45	8/-
SP4	5/-
TH30C	5/-
TP22	8/-
U10	9/6
U25	13/6
U26	10/-
U50	8/-
UABC80	9/-
UAF42	9/6
UBC41	8/6
UBC81	11/4
UBF80	9/-
UCC84	10/11
UCC85	9/6
UCH42	9/6
UCH81	9/6
UCL82	11/6
UCL83	13/6
UF85	9/-
UF89	9/-
UL41	9/-
UL84	9/-
UU6	19/3
UY1N	12/6
UY41	6/6
UY85	7/-
VP23	5/-
VR105/30	8/-
VR150/30	7/6
VU39 (MU 12/14)	8/9
Y63	7/6
1A7GT	13/6
1C2	11/6
1C5GT	12/6
1H5GT	9/-
1N5	10/6
1R5	7/6
1S5	6/6
1T4	5/6
3D6	5/-
3Q4	7/6
3Q5GT	9/6
3S4	7/6
3V4	8/-
4D1	3/-
5R4GY	9/6
5U4G	5/-
5V4	11/6
5Y3G	8/-
5Y3GT	7/6
5Z4G	9/-
6A7	10/-
6A8G	9/-
6AK5	5/-
6AL5	4/-
6AM5	7/6
6AM6	4/-
6AQ5	7/6
6AT6	8/6
6BA6	7/6
6BE6	7/6
6BH6	9/-
6BJ6	9/-
6BW6	9/-
6C4	4/6
6C5GT	6/6
6C6	5/-
6D6	5/-
6CH6	7/6
6F6G	7/-
6F6M	7/6
6J5GT	5/-
6J5M	6/6
6J6	4/-
6J7G	6/6
6K7G	3/6
6K7M	6/9
6K8G	6/6
6K7GT	5/9
6K8GT	10/-
6L6G	8/-
6L6M	9/6
6L18	11/6
6N7GT	7/6
6Q7G	7/6
6Q7GT	9/6
6SK7	6/-
6SL7GT	8/-
6SN7GT	7/6
6SQ7	9/3
6U4GT	12/-
6V6G	5/-
6V6GT	7/9
6X4	7/6
6X5G	7/-
6X5GT	7/-
6/30L2	12/6
7B6	10/6
7B7	8/6
7C5	8/-
7C6	8/-
7H7	8/-
7S7	9/6
7Y4	6/6
10F1	12/6
10P13	22/3
12A6	5/-
12AH8	12/-
12AT7	7/6
12AU7	8/-
12AX7	8/-
12BA6	9/-
12BE6	9/-
12C8	7/-
12J7GT	10/6
12K7GT	6/6
12K8GT	13/6
12K8M	13/-
12Q7GT	6/6
12SK7	6/-
12SL7	8/-
12SN7GT	10/-
15D2	7/9
25A6G	8/-
25L6GT	10/-
25Z4	9/6
25Z5	7/-
25Z6	10/-
30FL1	10/6
30L15	23/3
30P4	15/-
30P12	12/6
30PL1	12/6
35L6GT	10/-
25Y5	9/9
35Z4GT	8/-
42	8/-
35Z5GT	9/-
50L6GT	8/6
75	10/6
80	8/6
142BT	3/6
210DDT	4/6
210VPT	3/6

LOUDSPEAKER UNITS

All brand new

2½in. square Rola C25	26/10
2½in. square EMI	18/6
4in. square Elac Tweeter	12/6
5in. round Plessey with O.P.T.	16/6
6½in. round Celestion	17/6
8in. round Richard Allen	18/6
10in. round Elac	25/-
12in. round Plessey	29/6
6in. x 4in. Plessey	19/6
7in. x 4in. Plessey	19/6
8in. x 4in. Celestion and Richard Allen	19/11
10in. x 6in. Celestion and Plessey	21/6

RECORDING TAPE

Special Offer of Top quality recording tape, 3¼in. spool 200ft, 5/3, 5in. spool 600ft, 13/9, 5¾in. spool 850ft, 18/6, 7in. spool 1200ft, 23/-. Extra-play tape, 3¼in. spool 300ft. 7/-, 5in. spool 900ft, 21/-, 5¾in. spool 1275ft, 26/6, 7in. spool 1800ft, 37/6.
Empty spools, 3¼in., 1/6, 5in., 2/-, 7in., 3/-.

RECTIFIERS

RM1 5/3, RM2 6/9, RM3 7/6, RM4 13/6, RM5 19/6, 14A86 19/6, 14A97 19/6, 14A100 19/6, LW7 17/6, 18RA 1-1-16-1 6/-, FC31 (14RA 1-2-8-3) 22/6, FC101 (14RA 1-2-8-2) 16/6.

LIGHTWEIGHT SOLDERING IRON

Latest design, for use on 200/250 volts, with detachable handle, can be carried quite comfortably in pocket, 18/9 each.

HENLEY SOLON SOLDERING IRONS

65 watt, with oval bit, 29/- each; 65 watt, with pencil bit, 30/8 each; 25 watt, instrument model, 24/- each.
All spares available from stock.

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OUR 1962 CATALOGUE IS NOW AVAILABLE. PLEASE SEND 1/- IN STAMPS FOR YOUR COPY. TRADE CATALOGUE ALSO AVAILABLE, FOR WHICH PLEASE ATTACH YOUR BUSINESS LETTER HEADING.

ALPHA RADIO SUPPLY CO.

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LEEDS 7

TERMS: Cash with order or C.O.D. Postage and Packing charges extra; as follows: Orders value 10/- add 1/-; 20/- add 1/9; 40/- add 2/6; £5 add 3/6. Minimum C.O.D. fee & postage 3/-. For full terms of business see inside cover of our catalogue. Personal Shoppers 9 a.m. to 5 p.m. Mon. to Friday; Saturday 10 a.m. to 1 p.m.

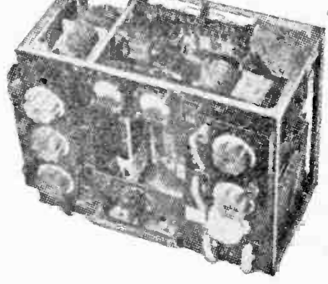
SUMMER SALE *Last Month!* SUMMER SALE

Most of the items advertised last month are still available and these, together with the new ones listed this month, may be purchased at the Special SUMMER SALE PRICE LIST until September 15th.

- **Transistor output transformer,** to match OC81 into 3 ohm, 4/6.
- **Small Bakelite cabinet,** suit table radio of any type 6/6, plus 2/- postage and insurance.
- **Potmeters long spindle,** no switch, following values available all 1/6. Each 25K ½ meg. 50K 1 meg. 100K 2 meg. Ditto with SP switch, 2/- each.
- **Crystals.** American make two pin plug-in type, 10/- doz. our assortment.
- **Fortiphone** transformer, type N23, for transistor circuits, 5/-.
- **3 valve amplifier** for portable record player, £2.10.0 complete.
- **Potmeters wire wound,** standard size, following values:—1K, 5K, 25K, 100 ohm, 220 ohm, 50 ohm, all 2/- each.
- **Rubber grommets,** our assortment, 5/- for 50.
- **Electrolytic condensers,** standard size. 1000 MFD 6 v. 3/3. 100 MFD 200 v. 2/6. 250 MFD 200 v. 2/6. 32 MFD 350 v. 1/10. 16 MFD 350 v. 1/6. 8 MFD 350 v. 1/3. 8 MFD 150 v. 1/-. 4 MFD 150 v. 1/-. 12 MFD 50 v. 9d. 50 MFD 6 v. 9d. 25 MFD 25 v. 9d. 100 + 200 MFD 250 v. 3/3. 8 + 16 MFD 350 v. 2/6. 32 + 32 MFD 375 v. 3/3.
- **Transistors, set of 6 all Mullard.** In maker's packs. OC44, OC45 (2) OC81D, OC81 matched pair £2.
- **Transistors,** 6 first grade unbranded, are replacements for the above Mullard range, 17/6.
- **Ferrite Aerial Rods.** 8 x ⅜in. diameter, 4/6. 8 x 5/16in. diameter, 2/6. 6 x ⅜in. diameter, 3/6. 4 x 5/16in. diameter, 2/3.
- **4½in. Ferrite Rod** complete with Long and Medium Wave coils and circuit diagram, 7/6.
- **Resistors,** 1½ watt 100 assorted comprise two each of 50 values covers good range up to 2 meg., 10/-.
- **TCC metal pack condensers,** 1 MFD 500 v. 3/-. .5 MFD 500 v. 2/-. .25 MFD 500 v. 1/9. .25 MFD 350 v. 1/6. .1 MFD 100 v. 1/9. .01 MFD 1000 v. 1/-. .005 MFD 1000 v. 1/3. .002 500 v. 1/-.
- **Indicators.** Solenoid operated winking eye type, 6/6 each.
- **Base with MU metal shield** for VCR 139 etc., 8/6.
- **Corner brackets** for mounting glass panels, 1/- set of four.
- **Carbon pile** regulators, 9/- each.
- **ES Lamp** holders, panel mounting 1/6 each.
- **Pyrex glass,** aerial insulators with metal fixing flange, 1/9.
- **Twin gang** Tuning condensers, .0004 pF, each section. 4/- each.
- **Toggle type** switch, 3 positions one permanently on, one permanently off the other spring return on/off, 3/6 each.
- **Knobs for** push buttons, 2/- per doz.
- **Rectifier** type, J50 high voltage, 5/- each.
- **Rectifier type,** 4 tubular type, 2/6 each.
- **Chrome handles** for instruments etc., size 7in., 6/- pair.
- **Thermal delay switch** 6.3 v. operated, 6/6 vacuum type, 2/9 open type.
- **Heater Transformer,** 6.3 v. 3/4 amps, unused but soiled, 6/- each.
- **Waterproof Heater wire,** 9/- per element or 7d. yd. 16 ohm per foot.
- **Cold Cathode Valve,** CV413 voltage regulator on trigger switch unused but ex-equipment, 2/- each.
- **Car Charger Rectifier,** for 6 or 12 volt at 5 amps, 10/- each plus 1/6 postage.

£100 WORTH OF EQUIPMENT 19/6

The famous R1154—unused but slightly soiled and not tested. Covers 200-500 kc/s, 3-5.5 Mc/s and 5.5-10 Mc/s. Has unique "click stop" mechanism (7 stops) and permits selected frequency, to be held, returned to, etc. Hartley oscillator, power amplifier, keying and speech. Wonderful breakdown value — meters, relays switches. Less valves—real bargain at 19/6, plus 10/- carriage.



- **B7G Valve Holder** with skirt for screening can, 6/- doz., less skirt 5/- doz.
- **Suppression Condensers,** stops drills etc., interfering with radio or TV. Simple instructions included, 1/3 each or 12/- doz.
- **Miniature Motor,** works off dry batteries, 3/6 each.
- **4 and 6 BA screws and nuts,** good assortment 288 for 3/6.
- **TV Cabinet 14in.,** modern design, must have cost at least £4 to make, the plywood is worth more than our give away price of 9/6 each, plus 4/6 carriage and insurance.
- **Wire wound resistor,** 1000 ohm adjustable slider 1/6 each. 15/- per doz.
- **8in. Ferrite Rod,** complete with Long and Medium Wave coils, plus car aerial coil and circuit, 8/6.
- **2K Heavy duty** wire wound pot meters, normally 15/-. Sale price 5/-.
- **TV Pattern eliminators,** 10/- each.
- **Complete Radio chassis by Beethoven,** few only £4.10.0. Each 5/6. Post and insurance.
- **Flat TRS cable** for electric wiring, 3/029 3 core, 1/-, 3/029 twin with earth, 9d., 3/029 twin, 8d., 3/029 single 4½d. 7/029 twin, 1/-, 7/029 3 core, 1/3 7/036 twin, 2/-, 7/036 3 core, 2/6, 7/044 2 core, 2/6. All prices are per yard.
- **Thermistors,** type No. not known, 6/- per doz.
- **Moving Coil Meter,** 2½in. flush 5 amp for battery charger etc., 15/-.
- **Wander plug connector** for extending leads, 6/- per doz.
- **Moving Coil Meter,** flush 2in. 0-350 RF, 6/6.
- **Set of coils** for Long and Medium Wave radio with circuit, 5/6.
- **¼in. spindle** connectors, metal with grub screws, 4/6 per doz.
- **Knobs Instrument** type, medium size 9d. each.
- **Slow Motion Drive,** epicyclic 1/6.
- **Midget coils,** double tuned with dust cores, frequency not known, useful for rewinding, 6/- per doz.
- **Bakelite** case for deaf aid, 3/6 each.
- **VCR 139 A,** cathode ray tube, 19/6 each. Plus 2/- post and insurance.
- **465 KC miniature I.F.** transformers, potted 5/- a pair.
- **Wander plugs** lockable types, 6/- per doz.
- **Spun Aluminium** lamp reflectors, 5½in. diameter 5in. deep, 3/3 each.
- **High to low** headphone adapters, 2/6 each.
- **Stand off insulator** porcelain with brass insets, threaded 2 BA, 1/6.
- **Cabinet safety switch,** cuts current when door opens, 6/- each.
- **Battery charger clips,** 25 amps 1/3 each.
- **Spring return** toggle switches, heavy duty, 2/6.
- **Set of Superhet coils,** LM & S, 6/6 each, with diagram.
- **High voltage tubular condensers,** .1 MFD 2500 v. Bakelite cased 2/6.
- **Ceiling Rose,** 2 Plate Bakelite, 9d. each.
- **Twin leads** as fitted to deaf aids 2/- each. 20/- per doz.
- **3 gang tuning condensers,** .0005 approx. 6/6 each. 2 gang ditto 5/6. 2 gang ditto with trimmers 6/6.
- **Midget 2 gang** tuning condensers fitted dust covers 370 pf each section, 7/6 each.
- **Double Trimmers,** 100 + 100, 250 + 250, 820 + 250, 1/3 each. 12/- per doz.
- **Electrolytics** small, but not miniature 50 v. 5 MFD, 15/- per doz.
- **Push Switches** for table lamps etc., 9d. each.
- **Pole switch** for lighting with screw-in type 30 amp fuses, 5/- each.
- **Rotary Switch by Arrow,** carry 15 amp. A.C. 4 positions hot, off, cold, off. Suitable hair drier, air-conditioning plant etc., 3/6, post 1/-.
- **Rotary Switch by Santon,** suitable 30 amp. A.C. single pole on/off. 3/6.
- **Silicon crystal diodes,** 6/- per doz.
- **Sapphire gramophone needles** miniature or standard 78 r.p.m. type, 12/- doz. 1/6 each.

Please include enough for postage and request "Summer sale list" for details of many other items.

"Dim and Full" Switch

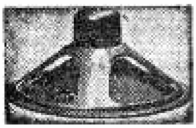
Particularly useful for controlling photoflood lamps which have only a short life at full brilliance. This switch has three positions: the first position puts two lamps in series at half brilliance for setting up, the second position is off and the third position full brilliance for the operation shots. 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.

A.C./D.C. Multimeter Kit

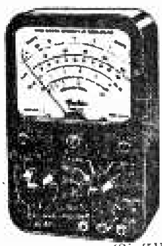
Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries, 0-500,000 with external batteries Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in.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

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.

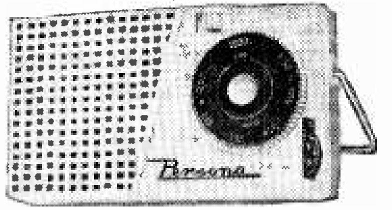
The Taylor Meter Model 127A



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.

NOW THE MARK IV

Pocket '4' 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.
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Mr. G. Bamford, Ramsgate.
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Mr. A. J. Simmonds, Welling, Kent.
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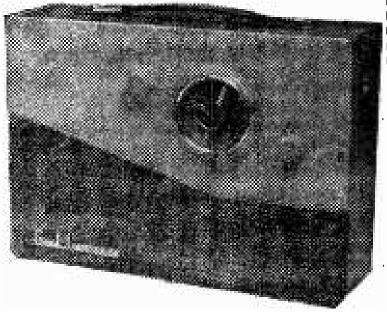

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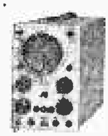
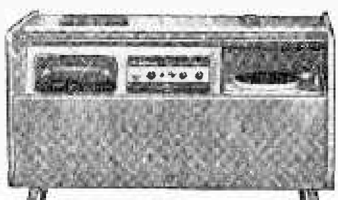

OS-1


SSU-1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Practical Wireless

VOL. XXXVII No. 655 SEPTEMBER, 1961

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Contents

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

MORE FREE BLUEPRINTS

INCLUDED with each copy of our next issue, will be a blueprint for our new receiver—the P.W. Tutor. As its name implies, it is designed essentially for the beginner, although it will also be found instructive for those who have not built a radio set for some time. The great success of our previous series for the beginner—The Beginner's Constructional Course and others—shows that there is a real need for this type of apparatus. Young people are continually leaving school and entering the radio field, and wish to add to any knowledge they may have gained at school, with practical work, which at the same time, will introduce them to new aspects of construction.

It is natural that the beginner will need to start from the very simplest point which means the crystal receiver, but the transistor must also be employed as this is becoming more and more to be accepted in place of the valve. Printed circuits are, of course, very widely used to-day, but it was felt that it would be rather too involved to try and use these in a receiver of the progressive kind, so the technique of utilising standard tag-boards has been adopted, and the receiver is built on these. The constructor goes from stage to stage, gradually adding parts and so advancing the design of each set.

NOVEMBER AND DECEMBER BLUEPRINTS

In the November and December issues, further free blueprints will enable more additions to be made to the preceding receivers. Included in the second and third blueprints will be a transistor battery superhet tuner together with its amplifier, which will also be suitable for a battery operated record player.

The blueprints will be such that the stages of construction are complete in themselves and each reader will be able to choose a design to suit his pocket and requirements.

INCREASED PRICE

The steadily increasing costs of production, paper, and other materials have made it necessary to increase the price of this magazine from the October issue—or to reduce it in size. We know that the latter procedure would not meet with approval and that most readers would rather pay an increased price than buy a smaller edition of PRACTICAL WIRELESS.

We shall, of course, keep up the same high standard of articles and endeavour to make each issue appeal to the widest possible circle of readers—catering both for the absolute beginner, as in the blueprint mentioned in the above paragraphs, as well as the advanced constructor and amateur transmitter. Blueprints in later issues will be designed for more experienced readers and we shall continue to provide the maximum service not only to individuals, but also to clubs and societies. From the October issue, therefore, the price of PRACTICAL WIRELESS will be increased to 2/-.

The October issue of PRACTICAL WIRELESS is published on September 7th—order your copy now and be sure of obtaining the first of the free blueprints.

Our next issue, dated October, will be published on September 7th.

Round the World of Wireless

POTENTIAL AND CURRENT NEWS

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of May, 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 Postal	687,207
Home Counties	649,332
Midland	469,160
North Eastern	511,084
North Western	439,846
South Western	388,260
Wales and Border Counties	227,571
Total England and Wales	3,372,460
Scotland	376,605
Northern Ireland	117,560
Grand Total	3,866,625

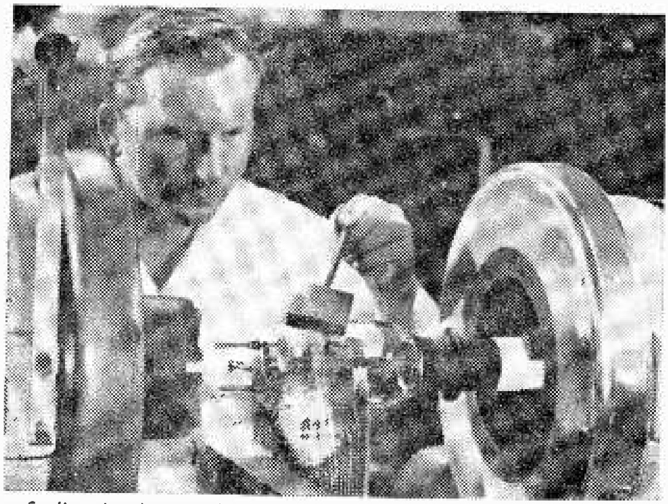
Tape Recorder Company Interests Change Hands

A WHOLLY-OWNED subsidiary of Multicore Solders Limited, Multimusic Limited, announces that it has disposed of all its interests in Reflectograph Tape Recorders to Pamphonic Reproducers Limited, a Pye Group Company. Pamphonic are now responsible for all service of Reflectograph recorders. Enquiries from the public concerning Reflectograph recorders should now be directed to Pamphonic Reproducers Limited at 17 Stratton Street, London, W.1.

Expansion at Valve and Capacitor Factory

A FURTHER expansion programme for the production and marketing of new and present types of valves and capacitors has recently been started by Standard Telephones and Cables Limited.

Manufacture of both these product lines is at the modern S.T.C. factory in Paignton, Devon. In the Valve Division plant, the principal products are valves for use in telecommunication systems, such as microwave radio links and transoceanic telephone cables.



Sealing the glass envelope of a water-cooled power triode, at the S.T.C. factory at Paignton, Devon.

Expansion is envisaged in the production and application of many types of valve.

Capacitors, like valves, have been key products of S.T.C. for many years and were formerly made mainly at North Woolwich, London, with a satellite plant at Treforest in Wales. The success of the Valve Division operations led to the building of a second factory for the manufacture of capacitors.

Multi-channel Radio Telephone System for British Railways

AS part of the British Railways modernisation programme, its north-eastern region is to be equipped with a high-frequency multi-channel radio telephone system between York and Newcastle, via Darlington—a distance of 78 miles. This will be the first such installation to be used by British Railways.

The radio equipment is to be supplied and installed by Marconi's Wireless Telegraph Co. Ltd., and the carrier equipment by Automatic Telephone and Electric Co. Ltd. The system is designed for a maximum capacity of 300 telephone channels, but initially 180 will be in operation. It will handle the telephone traffic between the regional centres, with full facilities for through subscriber trunk dialling.

The installation is duplicated to operate on a main-standby basis, with automatic changeover in the event of failure. In this connection, particular features of the equipment are the relatively low number of valves used and the simplicity of the R.F. transmission circuits, which employ one microwave klystron per unit equipment, both factors which greatly reduce the probability of equipment failure. The telephone channelling equipment is of the latest design, using transistors throughout and printed wiring cards for mounting all components.

Radio and Television Exhibition

THE Radio and Television Exhibition of France will be held this year from September 14th to 26th in Paris—Porte de Versailles. It will be situated in the Parc des Expositions—Halls 101 to 110. This exhibition is undertaken by the Radiodiffusion Télévision Française and by the Fédération Nationale des Industries Electroniques.

The exhibition, which covers all fields of radio and television, is open to all foreign visitors but is for French exhibitors only. The utilization of the "Palais des Sports" enables the organizers to receive the largest audience in conditions of comfort. A studio with 1,000 seats for broadcasting lyrical and dramatic programmes, and high fidelity demonstrations will be included in the exhibition.

Minicabs Radiotelephone System

WITH the opening of the London minicab scheme, Pye Telecommunications put into operation, for Welbeck Motors, a radiotelephone system which operates 200 radiotaxis initially, expanding to 800 by the end of the year.

The system with six-channel radiotelephone equipment is installed under the dashboard of each car and gives communication over a radius of 20 to 25 miles of Piccadilly Circus. A special control room has a conveyor-belt message system designed to handle calls at the rate of one every two seconds.

V.H.F. Unit for Lifeboat

THE President of the Dieppe Lifeboat Committee has been presented with a Pye International marine radiotelephone by the French National Railway.

This is the first French national lifeboat to be equipped with V.H.F. radio. It will work into the Dieppe railway radio station and the local public correspondence scheme. The lifeboat will thus be able to communicate with cross-channel steamers, with local fishing boats, which have the requisite equipment, and with the Boulogne Sur Mer Radio Station.

Mobile Microwave System

THE United States Government has recently placed a contract with Marconi's Wireless Telegraph Co. Ltd., for the supply of a mobile microwave telephone and telegraph communication system to link many of the United States Air Force bases in the U.K. Marconi's and the Automatic Telephone and Electric Co. Ltd., who are also involved in the contract, are currently fulfilling this three-and-a-half million dollar agreement.

The Marconi radio equipment and the Automatic Telephone and Electric telephone carrier equipment is housed in semi-trailer air-conditioned vehicles. Inside these large vehicles the transmitter, receiver and supervisory equipment are each contained in racks arranged for easy accessibility by the operators.

Naval Plotting System

MOST of the Western nations were represented at a recent demonstration of a new naval automatic plotting system—developed by E.M.I. Electronics Ltd.—given on board H.M.S. Rhyl, one of Britain's latest anti-submarine frigates. The system constitutes a big advance in plotting the positions of other craft in the vicinity, and is of particular use when hunting fast submarines. It is also of great value for coastal navigation.

In ships fitted with this system, the former method of manual plotting and the reporting of bearings and ranges over an intercom network has been replaced by E.M.I.'s electronic equipment, which produces much quicker and more accurate results.

Radio Paging System

PHILLIP W. HOLLAND, M.P. for Acton Constituency, visited the Ultra Electronics factory at Western Avenue, Acton, recently to inspect their radio paging system.

He became interested in this equipment when he saw it at the Crime Prevention Exhibition organised recently at Acton Town Hall, by the local police authorities.

Mr. Holland has a question tabled to the Secretary of State regarding the use of such equipment by the policeman on the beat.

Moscow Exhibition

THE Council of the Scientific Instrument Manufacturers' Association of Great Britain states that its 19 members who took part in the combined stand at the recent British Industries Fair in Moscow are very well pleased with the results.

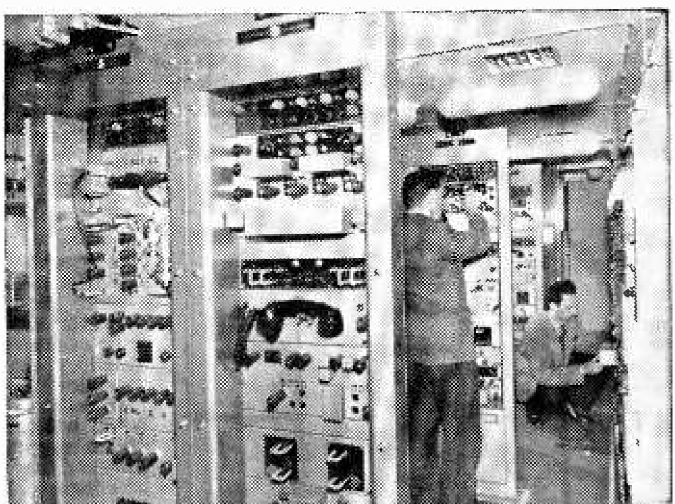
Firm contracts have been signed for 75 per cent. of their exhibits. Preliminary contracts for a considerable additional quantity of equipment to be exported immediately or in the near future have also been placed.

Cable Across The Thames

A £100,000 contract from the South Eastern Electricity Board to reinforce the electricity distribution system between sub-stations at West Weybridge in Surrey, and Laleham in Middlesex, has been awarded to Associated Electrical Industries Limited.

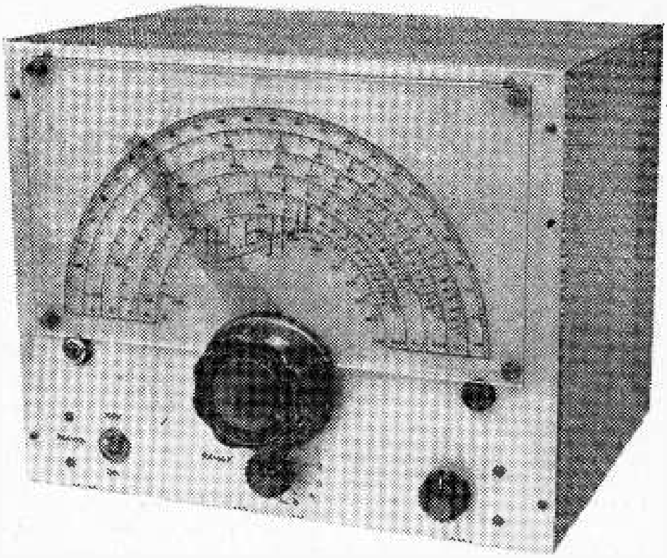
The project will involve laying four miles of 33kV oil-filled cable and associated pilot cables. They will be taken across the River Thames in buried pipes. Two canal crossings are also involved.

The work will be carried out by AEI Construction (Cables and Lines) Division and will begin in July. The cable will be of AEI manufacture, from AEI Cable Division's Gravesend factory.



The interior of one of the vehicles which Marconi are supplying to the U.S. Air Force. The rack on the extreme left houses the transmitter, the middle rack the receiver, and the right-hand rack contains the supervisory equipment.

20c/s TO 200kc/s ON FUNDAMENTALS WITH LOW DISTORTION AND STABLE OUTPUT LEVEL



WIDE-RANGE AUDIO OSCILLATOR

By R. C. Englefield

THERE are four problems involved in the design of a variable low frequency signal generator: stability, waveform, frequency range, and output level characteristics. Of the three main audio oscillator circuits, the beat-frequency oscillator is suitable for general purpose applications, especially where a wide frequency range is required with a single tuning control. It has, however, several serious drawbacks, including lack of stability, bad waveform at low frequencies, and R.F. in the output. These disadvantages may all be overcome by careful design, but the resulting instrument is very large and very expensive.

The conventional L-C oscillator is ideal for single frequency operation but requires an impossibly large tuning capacitor to produce the lowest ranges of a variable oscillator. In addition to this, it is difficult to obtain a frequency coverage greater than 3 : 1 in each band, which means that 7 ranges are necessary to cover the audio spectrum of 20-20,000c/s.

The R-C oscillator, however, easily achieves a coverage of 10 : 1, reducing the number of ranges to three. It has the further advantage that the basic circuit satisfies the four design problems set out above. The R-C circuit has therefore been chosen for this design.

The R-C circuit

The basic circuit is shown in Fig. 1. It consists of an amplifier back-coupled through a Wein bridge. The bridge is made up of the resistors R1-R4 and the capacitors C1-C2, with the input and output of the amplifier connected to the diagonal points. By this means, both positive and negative feedback are applied to the amplifier. The circuit oscillates at the balance frequency of the bridge. The negative feedback, through R1C1 and R2C2 determines the frequency, given by

$$f = \frac{1}{2\pi \sqrt{(C1.\ C2.\ R1.\ R2.)}}$$

The positive feedback, through R3 and R4, stabilises the level of the oscillation.

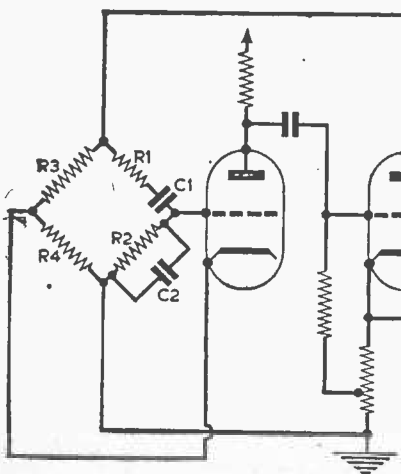


Fig. 1. The basic circuit.

Since the input and output impedances of the amplifier are not directly connected across the arms of the frequency discriminating network, the amplifier characteristics have no effect on the oscillator frequency.

In order to stabilise the amplitude of the oscillation with change of frequency, the attenuation of the negative feedback network must be kept constant, that is, the ratios R1/R2 and C1/C2 must be constant. The frequency of the oscillation may be adjusted by alteration of either pair of these components, and in this design, continuous frequency variation is achieved by varying the capacitances, different ranges being selected by variation of the resistances. A much higher degree

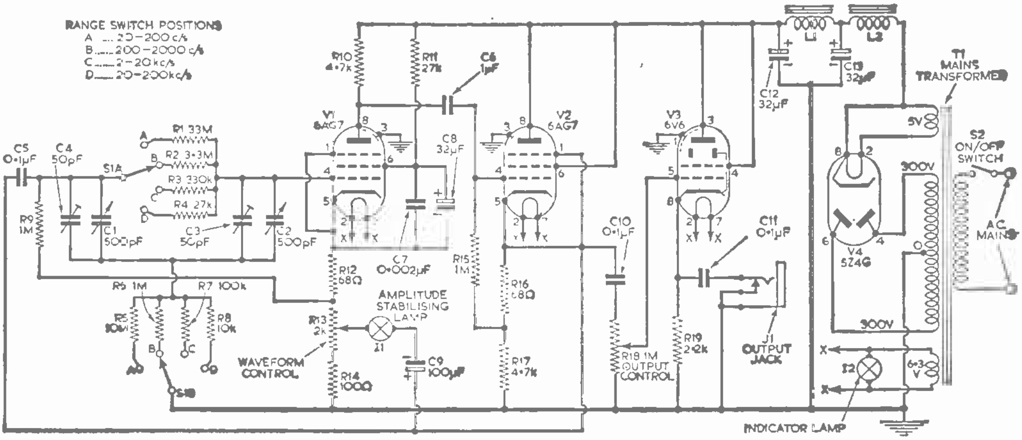


Fig. 2.—The complete practical circuit diagram.

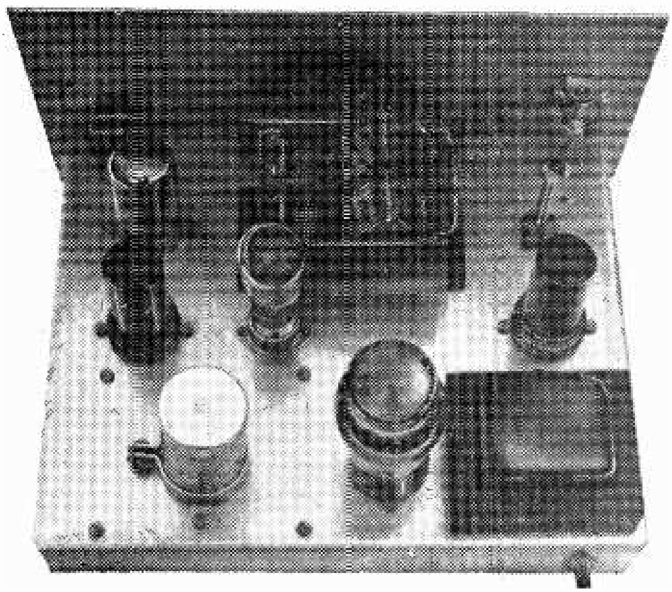
of amplitude stability can be obtained by substituting a metal filament lamp for the resistor R3. Thus when the amplitude of the oscillation falls, the positive feedback current decreases, so reducing the resistance of the lamp—this in turn increases the positive feedback and compensates for the original drop in amplitude.

The practical circuit

A complete bridge-stabilised circuit is shown in Fig. 2. The first two stages are based on the circuit of Fig. 1, with the addition of the 15W 240V lamp, I1, and range switching. The tuning capacitor is a standard two-gang capacitor with trimmers, and the resistors R1-R8 are low temperature-coefficient types, though ordinary resistors should prove satisfactory in use. The range resistors are best mounted on a ceramic switch.

The output of the oscillator is fed to the grid of a cathode follower, and the output from the unit is taken from a shorting-type microphone jack. If the oscillator is required to work into load impedances lower than 20k, it will be necessary to substitute a 25μF capacitor in place of C11, if excessive loss of voltage is to be avoided at very low frequencies.

The power section is a conventional full-wave circuit, and generous smoothing arrangements are used, with the result that the hum level of the output is less than 0·2per cent of the maximum output voltage. Screened wire should be used for the wiring of the heaters and panel lamp.



Rear view of the oscillator.

Construction

Construction is simple and straightforward. The tuning capacitor is insulated from the chassis with a sheet of Paxolin, and carries the pointer; slow motion tuning is employed, a simple frictional drive being easy to make and perfectly satisfactory. The range switch is mounted beneath the tuning control, and selects the following ranges: 20 to 200c/s (A) 200 to 2000c/s (B) 2 to 20kc/s (C) 20 to 200kc/s (D). The range can be extended up to 1Mc/s if necessary by using a 2·2k resistor and a 680Ω resistor, mounted on a fifth pole of the range switch. A continuously variable output control, the output socket, the main switch, and the indicator lamp complete the panel items.

The scale is made from Perspex sheet, mounted in front of the pointer; the calibrations are drawn in Indian ink on the back of the Perspex this type of scale being very durable, and has the advantage that errors can be corrected without trace by removing the ink with

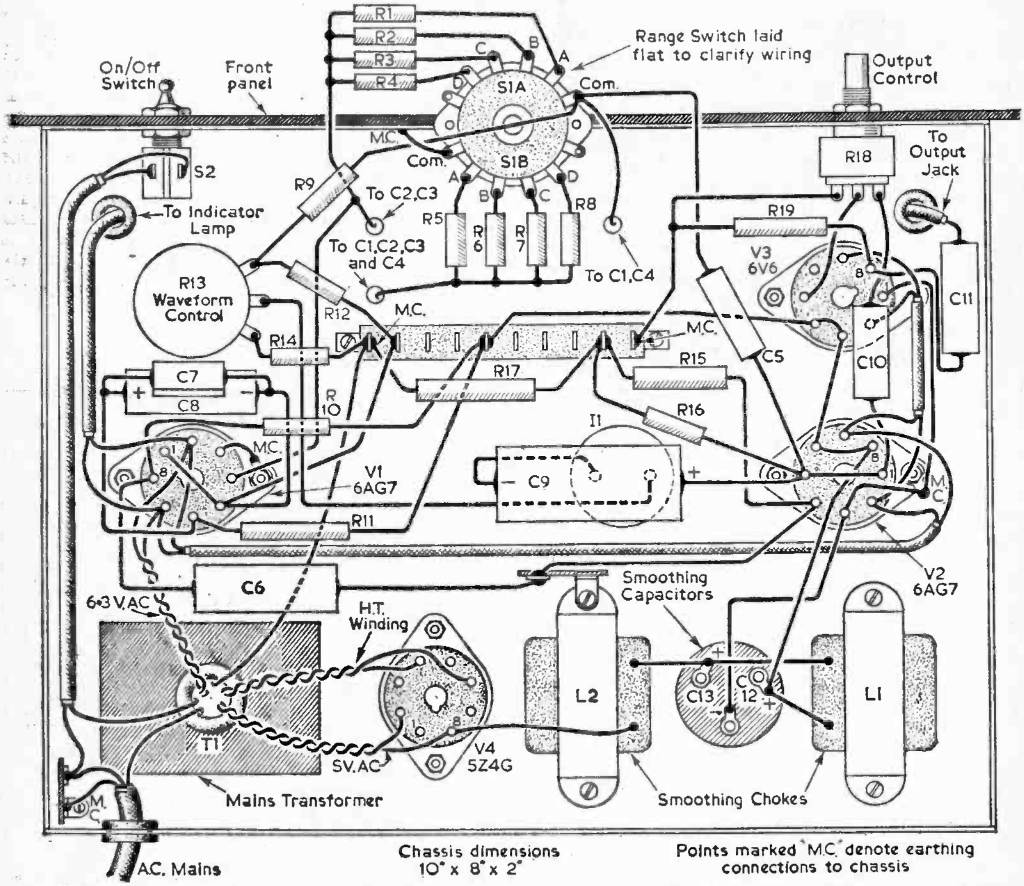


Fig. 3.—The under-chassis wiring diagram.

the finger-nail. The whole unit is contained in a case made from perforated zinc.

Calibration

An oscilloscope is essential for the accurate calibration of the instrument. Two preliminary adjustments are necessary: first, feed the output of the oscillator into the 'scope, and adjust R13 until a good sine-wave is obtained —this circuit gives an exceptionally low distortion, less than 0·5per cent at all frequencies. Second, set the trimmers C3 and C4 to maximum capacity, and find the 200c/s point in range A, using the 50c/s mains supply as standard; then adjust the trimmers a

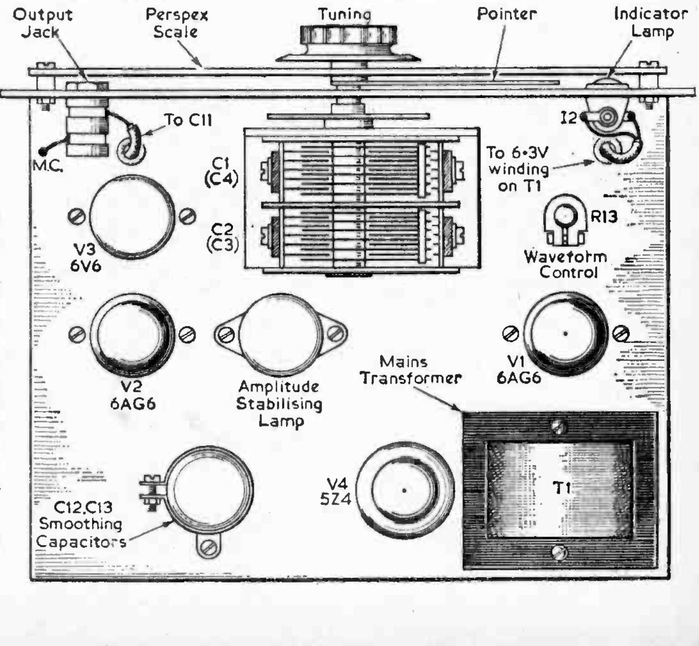
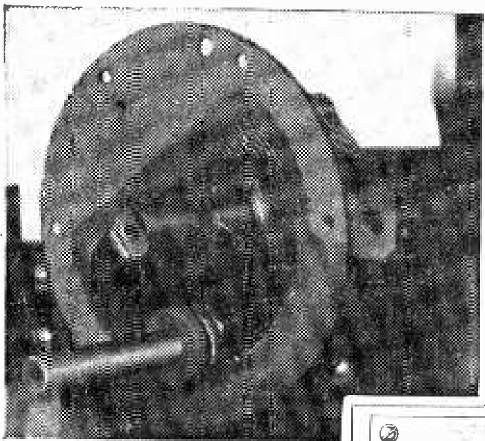


Fig. 4.—The above-chassis layout.



little at a time, keeping their capacities about equal, until the 200c/s point is just at the end of the range. This sets the high end of all four ranges.

Before commencing the calibration proper, remove the Perspex dial and construct a logging scale on the surface nearest to the pointer: this scale should have as large a radius as the length of the pointer will allow. A large protractor will simplify the division of the circumference into 180 parts, but if this is not available, then a scale of divisions (say 256) may be constructed by continuous bisection of a 360°—this is best drawn out on paper first, and then transferred to the Perspex.

By connecting the 'scope to display Lissajous figures, using 50c/s mains as standard, ranges A and B can now be calibrated: points should be logged every 5c/s in range A, and every 50c/s in range B. To calibrate range C, set the internal timebase of the 'scope to 500c/s, again using the mains as standard, and log points every 500c/s throughout the range—it is recommended that the sweep frequency be checked directly after each calibration is taken. Lissajous figures may again be used to calibrate range D if a 100kc/s quartz crystal standard or other ultra-stable oscillator is available, but if not, points can be accurately obtained by beating the harmonics of the oscil-

The tuning drive mechanism.

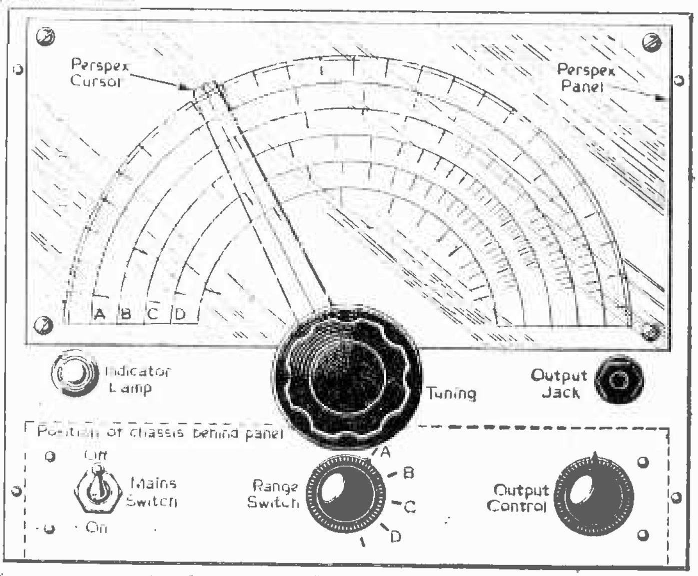
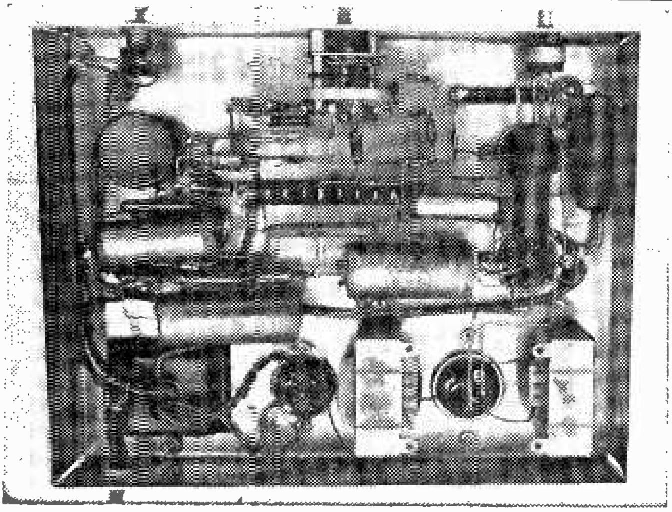


Fig. 5.—The front panel.



lator against the carrier waves of broadcasting stations, especially in the Long-wave band.

The scale may now be removed, and the dial calibrated directly in terms of frequency; further points may be obtained if necessary by graphical means; if any marks are misplaced, they can easily be corrected as explained.

The overall performance of this instrument is more than adequate for ordinary testing: the output is inherently stable in frequency and level, and the hum level and distortion are especially low. These advantages more than offset the slight disadvantage that range-switching is necessary to cover the audio spectrum. ■

An underchassis view.

THE P.W. SIGNAL GENERATOR

BUILDING CHASSIS No. 4—THE CRYSTAL CHECK OSCILLATOR

(Continued from page 306 of the August issue)

By E. V. King

MANY amateurs have made up an R.F. generator and then found that the greatest difficulty, often insuperable, has been accurate calibration.

Details will be given of methods of calibration using broadcast stations as standards, but it is so simple to build a standard crystal oscillator that it is proposed to deal with the construction of a *simple* unit as part of this instrument.

The author housed the crystal check unit in the same case as the other chassis, but it could be kept separate and only plugged in or connected when required. Valves from the variable audio oscillator could be "borrowed" for this, but it is better to have two kept for use in the unit alone.

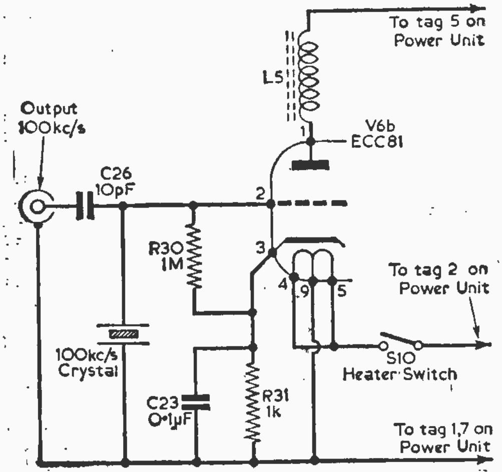


Fig. 27.—The crystal oscillator circuit.

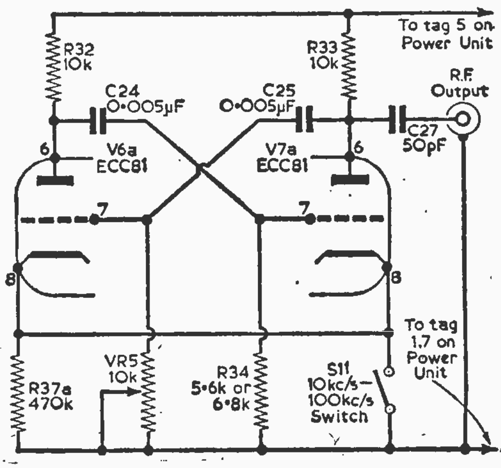


Fig. 28.—The circuit of the multivibrator.

How it works

The valve oscillator V6b (Fig. 27) functions on a frequency of 100kc/s owing to the inductance and self capacitance of L5 and the quartz crystal. This latter is not "tuned", but will be accurate enough at all temperatures for this purpose.

Valves V6a and V7a (Fig. 28) function as another oscillator, a multi-vibrator (working at 10kc/s), but the frequency is very unstable and therefore a synchronising signal is fed from the crystal controlled oscillator.

The actual frequency of 10kc/s is set by using the pre-set variable resistance VR5 which corrects for slight variations in component values. Switch S11 is used to control this 10kc/s oscillator—when S11 is "open", the oscillator is switched off. The resistor R37a, which is wired across the switch, is to ensure that some H.T. current is always passing through the valves V6a and V6b—if the valves were operated for long periods without H.T., the cathodes would become "poisoned" and the circuit would no longer operate.

Switch S10 is used to switch on or off the complete crystal check oscillator—Chassis 4. When S10 is on, the 100kc/s oscillator will function.

The signals obtained are fed to V7b, a harmonic-producing amplifier (Fig. 30); the diode helps in this respect, too. If S11 is on, 10kc/s signals and harmonics are thus fed to the output socket. When S11 is off, the 100kc/s signal from V6b goes through C26, C25 and C27 and is thus amplified in the same way. The 100kc/s signal will thus be fed through to V7b in addition to the 10kc/s signal from the multivibrator (V6a and V7a).

Mounting the Components

There is plenty of room in the chassis and the layout is in no way critical. Fig. 29 shows the wiring for the 100kc/s crystal oscillator.

Rotary toggle switches are used so that the fact that Chassis 4 is a check unit is apparent from the front, all other switches being of the lever toggle type. Likewise the output socket is at the back so that it cannot be used in error for the R.F. or audio socket.

Make sure the tag strip does not short to earth and that the valveholders are correctly positioned as in Fig. 29.

Inductance L5

This has an inductance (measured) of 11.5mH, but is not critical.

A length of ferrite rod (see the Components List and Fig. 29) is covered with a layer of Sellotape and then 400 turns of 32s.w.g. enamelled copper wire are wound on approximately to the dimensions of Fig. 29 where distances "a" are $\frac{3}{8}$in. and "b" are $\frac{3}{4}$in. Windings are pile-wound and *must* all be in the *same* direction. Balsa cement may be used to keep the windings in place. Check that the windings do not short to earth when mounted.

The rod may be mounted in any convenient manner. The author preferred to insulate it from the chassis at the ends, but it worked quite satisfactorily uninsulated.

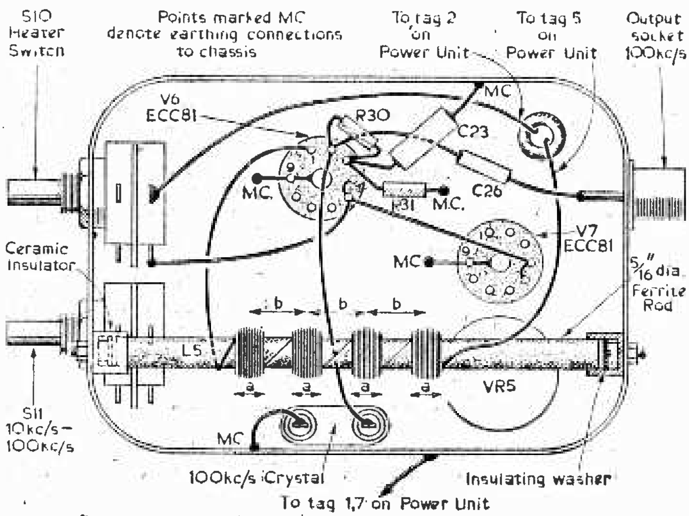


Fig. 29.—The underchassis wiring of the crystal oscillator.

Wiring the Crystal Oscillator (V6b)

The circuit is shown in Fig. 27 and the layout and wiring in Fig. 29. Proceed as follows: take pin 1 and the centre spigot of each valve to earth. Join pins 4 and 5 of each valve and wire them via S10 to a tag (2) of the tag strip which is on top of the chassis. This tag strip is fixed in a similar position to the strips on the other three chassis—see Fig. 23 last month for example. Connect the unit to the power pack tags 1 (or 2) and 7. Plug in the valves and observe that all heaters light correctly.

Now take one end of the coil to pin 1 of V6 and the other end to a tag (5) of the tag strip. Note that tag 5 of the power unit is also used for the audio oscillator, but this does not matter as the two units will not be used at the same time.

Take one side of the crystal to earth and the other side to pin 2 of V6. Join pin 2 to pin 3 via R30 and connect C26 from pin 2 to the output socket (temporarily only). From pin 3 take R31 to earth and C23 also to earth. Note there are now three wires on pin 3.

Testing the Crystal Oscillator

Connect it to the power unit. Put a milliammeter in the H.T. lead to tag 5. The current taken will be about 2mA if the unit is oscillating and 8mA if it is not oscillating.

While the unit is connected, withdraw the crystal and the H.T. current should alter from the approximate value of 2mA to about 8mA. If difficulty is experienced and wiring is correct, try another valve or suspect the wrong inductance for L5—try putting small condensers across it, starting with 100pF. If the crystal recommended is used there will be no trouble.

Now put the oscillator near the long wave crystal transistor or another receiver (page 27, May issue). A high pitched whistle or hiss (which may be hum-modulated) should be heard. It should also be possible to tune it slightly. If necessary, join the output terminal to the receiver's aerial terminal through a small condenser (say, 50pF).

If a good mains receiver is available for long waves put the crystal oscillator near to it, with 6in. of wire connected to the output socket. On tuning the long waves, a whistle, hiss,

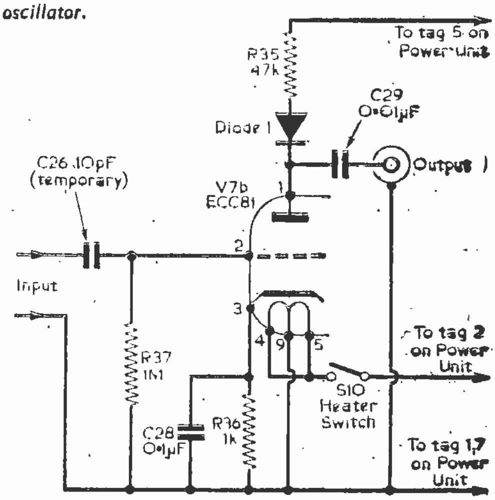


Fig. 30.—The distorter amplifier or harmonic producer.

or hum, should be heard at the 200kc/s mark (Light Programme) and also at 300kc/s and 400kc/s. If the receiver will tune to 100kc/s, a stronger signal will be heard there. If the output is connected via a condenser to the aerial terminal, strong signals will be heard as the receiver is tuned through the 100kc/s, 200kc/s, 300kc/s and 400kc/s points.

The 100kc/s point is the fundamental. It is now proposed to increase the number of strong harmonics so that the receiver may pick them up even on 25Mc/s. As it is now, the crystal oscillator will check receiver calibrations on the Long Wave band and part of the Medium Wave band.

The Harmonic-producing Amplifier

The circuit is shown in Fig. 30 and the layout and wiring in Fig. 31.

Proceed as follows: remove C26 from the output socket and solder it to pin 2 of the other valve (V7), and then wire pin 2 to earth via R37. From pin 3 of this valve take R36 and C28 to earth. To pin 1 connect the diode (do not shorten the leads too much or allow them to become hot), and wire the other end of the diode through R35 to tag 5 on the tag strip (for H.T. from the power unit). Note that the red (+) end of the diode is connected to pin 1 of V7b and the black (−) end to R35. From pin 1 take C29 to the output socket. From the H.T. end of R35, wire R32 to pin 6 of V6.

Testing the Amplifier

Connect 'phones to the output socket. Remove V6 from its holder, plug in, switch on, etc., and touch pin 2 of V7. A humming should be heard in the 'phones. Replace V6 and repeat the previously described tests with receivers. Calibration points will be found every 100kc/s up to at least 25Mc/s (i.e., even on the 16m band which is considered adequate for this instrument). Note that most ordinary receivers are only approximately aligned to the scale on the short-wave bands.

COMPONENTS LIST FOR CRYSTAL CHECK UNIT

Baking Tin (as for the other chassis)

Resistors:

R30	1M $\frac{1}{4}$W	R35	47k $\frac{1}{4}$W
R31	1k $\frac{1}{4}$W	R36	1k $\frac{1}{4}$W
R32 and R33	10k $\frac{1}{4}$W	R37	1M $\frac{1}{4}$W
R34	5·6k or 6·8k $\frac{1}{4}$W	R37a	470k $\frac{1}{4}$W

Condensers:

C23 0·1 μF 200VW
C24 and C25 0·005 μF (5000pF) Mica (No other value is suitable—parallel wiring of say 1000pF and 4000pF condensers will give the required value)
C26 10pF, mica or ceramic
C27 50pF, mica or ceramic
C28 0·1 μF 200VW
C29 0·01 μF 350VW

Valve V6 and V7 Mullard ECC81
Switch S11 Rotary toggle type
Switch S10 Rotary toggle type
Diode Any germanium or silicon diode (surplus)
Inductance L5 About 1oz of 32s.w.g. enamelled copper wire and a $\frac{5}{16}$in. diameter ferrite rod $5\frac{1}{4}$ or $5\frac{1}{2}$in. long is required
Quartz Crystal Any 100kc/s crystal will suit, the prototype uses a rather large surplus type available from Henry's Radio. A holder is available also
Output Socket Normal co-axial type
4 or 4-way tag strip—two tags being earthed by fixing
Variable Resistor VR5 10k, any type will suit. A surplus locking ring is useful to prevent this control from moving once it is set
Nuts, bolts, grommets, etc

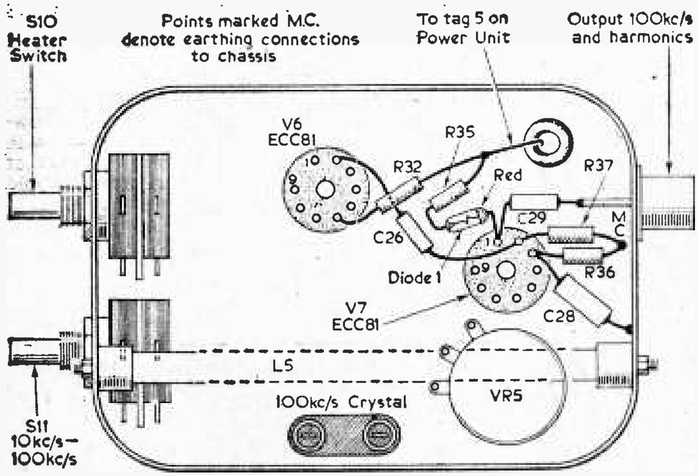


Fig. 31.—The wiring of the harmonic-producing amplifier.

Building the 10kc/s Multivibrator

The valve heaters for this part of the circuit are already wired and tested. The circuit can be seen in Fig. 28 and the wiring, which has to be added to that already carried out (Figs. 29 and 31), can be seen in Fig. 32.

Unsolder C26 from its temporary connection on pin 2 of V7. Join pins 8 of both valves together. Connect pin 8 of V6 to one side of S11 and the other side of S11 to earth. Take pin 8 of V6 temporarily direct to earth. Take pin 7 of V6 to one outer tag of VR5 and also through C25 (which must be of the correct value) to pin 6 of V7. Take pin 7 of V7 to earth via R34 (this must also be of the correct value). It will probably be easiest to earth pin 7 of V7 to the centre spigot or to pin 9. Join pin 7 of V7 also to pin 6 of V6 via C24 (again, this must be of the correct value). From pin 6 of V6, join R32 (positioned upright) to a similar resistor R33 (also upright) and the junction of these two (R32 and R33) is joined to R35 where it leads off to tag 5 (H.T.). The wire joining the three resistors is left "in the air". The other end of R33 is connected to pin 6 of V7.

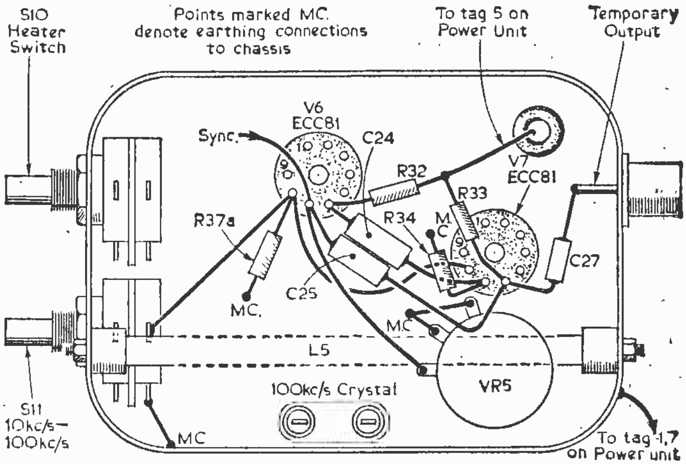


Fig. 32.—The wiring of the multivibrator.

Testing the Multivibrator

Connect up to the power pack with a milliammeter in the H.T. lead to tag 5. The current should be about 10 to 12mA with both the amplifier and crystal oscillator working.

Connect to the aerial socket of a receiver via a small condenser (10pF) (and via C27) to pin 6 of V7. Loud and numerous "swishes" will be heard in many places on any waveband, the number of swishes being controlled partly by VR5 which must not be turned to the completely "off" (i.e., shorting) position.

Synchronising the Multivibrator

Condenser C26 has already been connected to pin 2 of V6 and is now not connected at the other end; solder this end to pin 7 of V6. The 100kc/s signal will now synchronise the multivibrator.

Connect up as before to a receiver set to long waves. Notice exactly where the 100kc/s points were (they will be the loudest "whistles" or "swishes") and verify that "swishes", previously non-existent, are now heard in between the 100kc/s points. Verify that the number can be altered by means of VR5.

Setting the Multivibrator on 10kc/s

Connect the unconnected end of C27 to pin 2 of V7. Disconnect the earth lead from pin 8 of V6. The circuit is now as shown in Fig. 28.

It is vital that VR5 control is correctly set—guess-work is not good enough. Place the unit near to a selective receiver, and connect it to the aerial socket via a low value condenser (only if it proves necessary). Disconnect the normal aerial. Switch to Long waves and tune in the Light Programme.. Switch S10 on and S11 off. Note very carefully (a piece of gummed paper on the dial will help) the crystal calibrator point at 200kc/s and tune in the next one at 300kc/s and mark it accurately. Now switch on S11 so that the multi-vibrator functions. Count very carefully the "swishes" between the two points already marked. There should be nine (i.e. eleven counting the two main points). If the number is not correct, move VR5 slowly until you hear it lock to another frequency (in the receiver, or, if your hearing is good, from the vibrating valve electrodes in the vibrator). Repeat this until you are sure. Near the actual 100kc/s points, the hiss or whistle may be so loud that it spreads over some of the dial and masks what might be another "swish" or "whistle".

The remedy is to move the generator farther away from the receiver so that the "swishes" are not so loud.

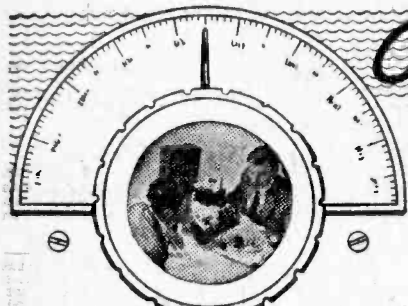
Finally, when VR5 has been correctly set, there should be nine smaller "swishes" between the two larger "swishes". If the receiver used is not sufficiently selective, then only seven smaller "swishes" may be heard. The two which are nearest the two larger "swishes" may be hidden by them. However, it should be obvious that two are being hidden because the spacing between the seven smaller "swishes" will be regular, while the spacing between the final smaller "swishes" and the two larger "swishes' will be noticeably greater: it will be obvious that there is space for the two "swishes" which are masked.

When VR5 is correctly set it is sealed; sealing wax is suitable.

Checking Receiver Dials

The receiver dial may now be checked; approximately, using the 100kc/s points (these are, however, exactly accurate), and then in detail with the 10kc/s points throughout the whole range of most ordinary receivers. The beginner should experiment in this direction to gain experience.

(To be continued)



On Your Wavelength

BY THERMION

Those Portables

SOME time ago I mentioned the annoyance which was being caused by the transistor type of portable and suggested that perhaps legislation would have to be introduced to limit the use of this latest weapon. Since then, I was very relieved to see that a number of authorities have taken steps to preserve the rights of the majority of us who prefer quiet and peace. At Lord's cricket ground the use of the portable has been banned, as well as on the sun-deck of the pier at Southend. At least one other seaside resort has a bye-law preventing the playing of radio in the streets after a certain hour and one visitor who was walking along with his radio playing was fined.

These little sets are wonderful, if properly used, but now one sees them, in my view, being abused. On an underground train recently, one gentleman was tinkering with one and when he got out at my local station (which was above ground) he slipped it in a small cloth shopping bag, still playing, and his taste in music was inflicted on all the passengers, and presumably also on the pedestrians in every street through which he passed. The recent spate of cricket and tennis relays has brought untold misery to many and I do feel very strongly about these receivers, and think that the type with a plug-in earpiece deserves wider use, as then others do not have to listen. It is surely a very selfish attitude to use these loudspeaker portables in such a way that others can hear them, and I feel sure that their continued use to the annoyance of others will cause so many complaints that eventually they will be banned from public places, or at least a limit will be put on the volume of sound which may be used. This, of course, brings in the problem of our old friend the decibel. When a standard such as this is adopted, some measuring device must be employed and users of road breaking apparatus and others who may fall foul of the law may plead that the volume was not excessive whilst those who object contradict this, so without a reliable yardstick, legal actions will not be possible. Perhaps the Noise Abatement people will produce some instrument which may be legalised as a measurer of noise, and receive police sanction, so that those who wish to complain will be able to do so with every chance of being upheld in their complaint.

Speed Detectors

The talk of noise measurers, brings to mind the speeding car detector, and it seems that our lives are being rather filled with modern scientific apparatus to the exclusion of our own senses and abilities. The modern calculating machine, the instant photo copier and similar devices are now commonplace, and whilst there is little doubt that they do improve efficiency by speeding up the result, the human endeavour is ousted and I wonder whether this is all to the good. We shall not need the clever mathematician in future years, as the calculator will take his place, and the efficient typist will be pushed out by the electrical typewriter, complete with automatic gadgets, whilst the skilled photographer who is now called upon to make accurate copies of documents, etc., will be replaced by the "copier".

Amateur Satisfaction

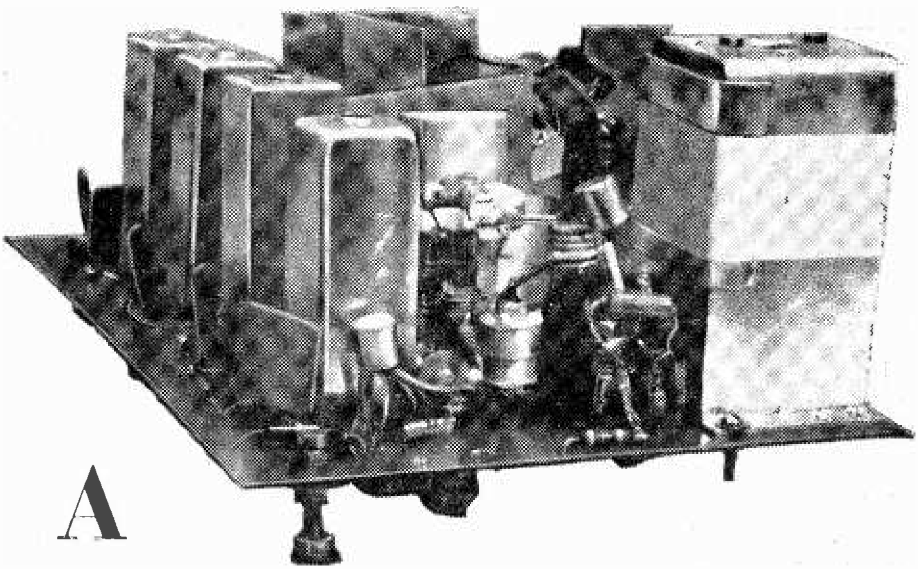
My postbag contains letters on a multitude of subjects, but it is surprising how many deal with the radio of earlier days. As one who saw radio commence its entry into the world, I do agree with a correspondent who wonders whether the modern amateur gets as much satisfaction from modern equipment. He sends me a neat pile of leaflets which he found amongst some gear at home and sends them for my inspection. He says

"From my point of view, the list of the Northampton Plating Co. was of particular interest, as I remember that it was one of those sources of components at a price low enough for me to afford, being a schoolboy at that time. Their S.L.F. variable condensers at 3s 11d were well made and smooth in use, one of them was surviving until some ten years ago when it was passed on to some local Scouts with other items for further use. It was still quite free of wear or shake. Incidentally S.L.F. type single condensers do not seem to be very easily obtainable nowadays, which is a pity in view of the number of circuits appearing for small receivers and alignment oscillators in amateur publications. Most condensers offered at "popular" prices seem to be either S.L.C. or law types, and twin gang at that.

"The dull emitter valves advertised by the Plating Co. were also quite good for their time, although the two I purchased had a greater tendency to microphony than the Mullard and Cossor products.

"Still, one sometimes wonders whether the present day schoolboy, with a range of components available at relatively low price, gets quite the same gratification as my generation did at receiving Schenectady on a crystal and catswhisker."

Yes, I wonder whether the same degree of satisfaction is experienced, especially by those who received tuition in radio at school and therefore regard it not so much as a mystery but as an accepted thing—like the essential services to be found in the home?



A Transistorised VHF Superhet

AN ALL TRANSISTOR PORTABLE RECEIVER

Designed by D. R. Bowman

THE design of the receiver described here is admittedly a by-product in the development of a fully-transistorised television receiver. Before the latter can be presented, a number of serious problems remain to be solved; but the radio-frequency and intermediate-frequency stages proved very amenable to normal transistor design procedure, and it was therefore decided to make the few necessary modifications to offer a fully transistorised VHF receiver. Work with this will afford valuable experience to the constructor, as it did to the writer.

It was realised from the outset that the production of a receiver of the too-usual miniature type would result in the also too-usual "tinny" reception, and this would do far less than justice both to the excellent and interference-free VHF transmissions and to the present-day high quality transistors. Provision has therefore been made for class AB audio output up to 1W, and for reasonable reproduction of bass frequencies, a minimum size of cabinet had to be specified. The receiver is certainly quite portable, as it weighs only a few pounds, but is not in the vest-pocket class.

Sensitivity is of the same order as the usual kind of domestic F.M. mains-operated receiver. An aerial signal of 5μV gives a power output of 50mW with the prototype receiver. The normal spread of transistor parameters may cause this to vary appreciably—perhaps from 3 to 20μV—but this will be found quite adequate in practice. Signals of 200mV can be handled, but where such a strong signal is obtainable, a very sketchy aerial can be used, and doubtless will be used, by many constructors. An outside aerial, 20ft high, consisting of a plain dipole, will ensure reception at distances of 100 miles or more from the transmitter.

In the prototype receiver, printed-circuit construction has been employed. The circuit will be found readily adaptable however for those who wish to use a normal chassis, but the use of copper-clad laminate is recommended for its ease of working and its good electrical properties—no difficulty will be experienced in the etching process.

Fig. 1 shows the circuit diagram. This, it will be seen, denotes a "line-up" of nine transistors; an R.F. amplifying stage, self-oscillating frequency-changer, three I.F. stages, ratio detector, audio pre-amplifier, driver and push-pull output stages.

The R.F. Stage

The R.F. stage consists of a Mullard OC171, operating in the grounded-base configuration. The real part of the emitter input impedance under the conditions of the circuit, is about 120Ω. The aerial is therefore connected direct to the emitter through the usual coaxial cable of nominal impedance 80Ω This provides a very reasonable match. If, however, a length of wire is used for portable operation, best results are obtained by plugging a 42in. length into the centre connection of the coaxial input socket. It will be remembered that a single 33in. length will present an impedance of about 40Ω to the emitter, and the extra length is required for a better match.

The input is of course not aperiodic, as might be supposed: the input tuned circuit is in fact the aerial. As long as its Q is about 12 or less, the sensitivity drop at the edges of the VHF band will be less than 6dB. The aerial should therefore ideally consist of a dipole using copper or aluminium tubing of ½in. diameter. However, the writer uses a picture-rail aerial consisting of two 33in. lengths of 14s.w.g. copper wire, with good reception of the "local" station (56 miles away).

The R.F. OC171 operates at a collector current of about 1·4mA. A higher current gives negligible increase of gain and a noticeable rise in noise-level. A capacitor connected between emitter and base, of value 20pF, may require some comment. The purpose of this is to bring the collector feed-back current more into phase with the aerial current, and results in a measure of positive feedback, increasing R.F. gain by 3 to 4dB. It may be possible to increase this capacitor to a value of 25pF, but in the prototype receiver such an increase caused the R.F. stage to oscillate when the collector circuit was tuned to 95Mc/s or higher frequency. By the same token, with certain transistors, it may be necessary to reduce its value to 15pF or even 10pF.

The collector circuit is tuned partly by a fixed capacitance of negative temperature coefficient and partly by a variable capacitor in series with another capacitor of negative temperature coefficient. The collector transformer is so designed that the secondary winding matches the input impedance of the frequency-changer transistor.

The Frequency-Changer

The frequency-changer, another OC171, is also operated in the grounded-base configuration, current from the R.F. stage being introduced by including the secondary of the inter-stage transformer in the emitter circuit. As this is a self-oscillating frequency-changer, and feedback from the collector is arranged by capacitive coupling, it is necessary to include a resistor of about 100Ω in the emitter circuit also. This causes some reduction in the signal injected, but the effect is small. The oscillating circuit is tuned partly by a pre-set capacitor, and partly by a variable capacitor ganged with the R.F. inter-stage tuning capacitor. Both are in series with a fixed capactor of negative temperature coefficient which also does duty as the fixed capacitor of the I.F. transformer in the collector circuit.

The use of negative temperature coefficient capacitors in the R.F. and F.C. circuits is not—as with valve operated equipment—to correct for warming-up drift. In the transistor receiver their function is to correct for changes in ambient temperature. and conditions are much less critical. If the user does not object to re-tuning as the room temperature changes, silver-mica capacitors can be used instead.

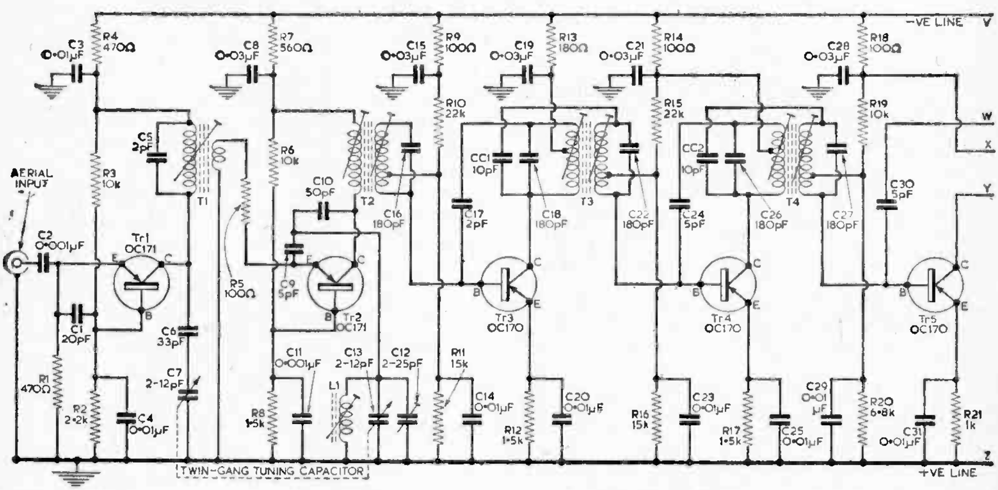


Fig. 1a.—The input and I.F. stages of the circuit.

The Intermediate-Frequency Amplifier

It was realised that many constructors would be unwilling to undertake the construction of a receiver in which the setting-up and alignment would require a valve voltmeter or oscilloscope. In this circuit, adjustable coupling has been avoided wherever possible, and the I.F. transformers have been arranged for fixed capacitive coupling between primary and secondary, with non-critical spacing between windings. The only variable coupling is in the collector circuit of the last I.F. stage, where a simple drill enables the precise conditions to be reached, using a meter, or "near-enough" conditions by ear.

Mullard transistors, type OC170, are employed in the I.F. stages. Two pairs of coupled circuits are used between the first and second I.F. stages and between the second and third. Coupling is "critical", and the dynamic impedance of primary and secondary have been calculated to give the bandwidth needed. For exact bandwidth the transformers should be tuned by 160pF capacitors; but 180 pF capacitors are here specified because the inevitable slight inaccuracies in practical alignment, result in a very slightly "stagger-tuned" amplifier, which still has the correct bandwidth.

The last I.F. stage, which drives the ratio detector, requires tighter coupling than critical, and coupling of approximately 1·5 critical is used. The intermediate frequency is 10·7Mc/s nominally, though the constructor may prefer to vary this a little one way or the other to avoid a powerful local short-wave transmitter.

The Ratio Detector

The use of a ratio detector was decided upon because of its simplicity and its ability to deal with small signals effectively. Because of this latter consideration, AGC has not been provided and its absence has not been acutely felt. The ratio detector is of conventional design. Diodes supplied in a matched pair (OA79) avoid the need for adjustable resistances in series. Amplitude limiting is improved by the stabilisation of only about 90per cent of the developed voltage, and this is arrived at by the inclusion of small fixed resistors in series with the diodes. The normal de-emphasis (in this case, 45μsec) is provided.

Neutralisation

As the transistor may be regarded for some purposes as a triode with the grid operated in the positive region, it will be understood that at the intermediate frequency concerned, 10·7Mc/s, neutralisation of the collector-base feedback will be needed. By suitable design of the I.F. transformers, fixed non-critical capacitive neutralisation can be achieved. In fact, this circuit possesses very slight over-neutralisation, and with certain transistors the 5pF neutralising capacitors may need reduction to 3·3pF if I.F. instability is experienced. If desired, the addition of small resistors (about 47Ω) in series with the neutralising capacitors will improve stability and gain. This process, known as unilateralisation, enables wanted and unwanted feedback to cancel each other out exactly in magnitude and phase. However, this is a refinement found not to be necessary in practice,—although the purist may prefer to include it in his receiver.

The Audio Amplifier

No claim is made that the audio amplifier is original. In fact it is almost identical with the Mullard 1W amplifier, described in "Reference Manual of Transistor Circuits" (first edition, 1960). There seemed to be no point in gilding the lily. However, with the transformers specified, cross-over distortion at low signal levels was more noticeable than might be desired, and a slight increase in output quiescent current has been arranged to overcome this.

Very thorough decoupling has been found essential in the audio section of the receiver. This is hardly surprising, since approximately 70dB audio gain is obtained. Layout however is not critical. The inevitable increase in battery resistance during discharge causes no instability, and as much as 300Ω has been put in series with the battery without causing trouble.

(To be continued)

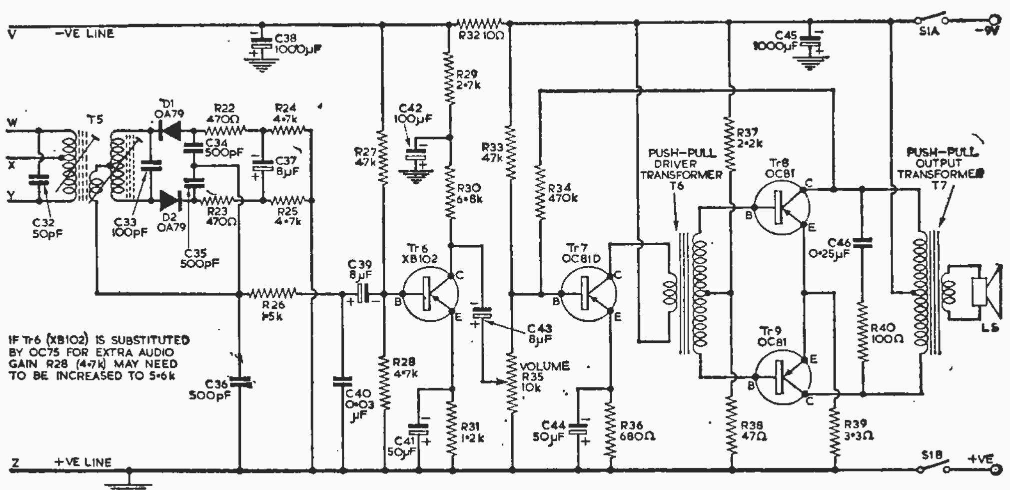


Fig. 1b.—The detector and audio stages of the circuit.

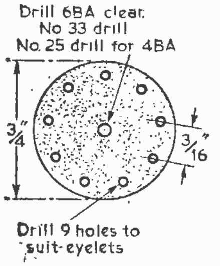
A Pre-wired Valveholder Extension

A SPACE SAVING MODIFICATION

By D. J. Gill

A READER'S letter in the February issue, on the subject "Extension of Valveholders," tempts me to submit this simple and effective solution, which I adopted some years ago.

This simple method not only eliminates the cumbersome tagboard, thus enabling the amateur to reduce the overall size of the unit under construction, or take advantage of the space saved to accommodate better his other components, but it has the added advantage of allowing each valveholder and its associated components to be wired and checked as a separate sub-unit *before* the valveholders are mounted on the chassis, as will be seen. Added to this is the advantage of being able to wire all valveholders while they are on a clear bench with every component readily accessible, as opposed to having to probe into



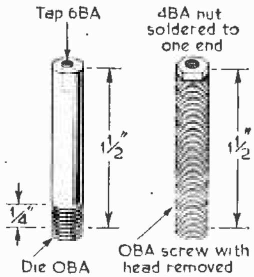


Fig. 1. (left)—The dimensions of the Paxolin disc.

Fig. 2. (right)—Two suitable extension pillars.

hidden corners with a soldering iron, sometimes at the expense of wiring, or other components, only to finish up with a doubtful connection.

Reference to the diagrams will show that the only tools required are a couple of taps and dies, but even these are not absolutely necessary. Fig. 1 shows the type of disc used by the writer, but the shape is optional, and end cheeks from discarded coil formers, or any other thin Paxolin or Bakelite will serve equally well. The dimensions for Fig. 1 can also be left to the reader, though those shown have been found to be more than adequate to accommodate all the components associated with any valve. When the size and shape has been decided, they can be drilled in batches of about six at a time as shown.

The extension pillar, Fig. 2, can be made from brass, dural, or one of the many thin rods or tubing easily obtained. For those whose kit does not include taps or dies, this pillar can be made equally well from a 0B.A. 1½in. long screw, in the case of a nine pin valveholder. For a seven pin valveholder, the procedure is the same but the screw is 2B.A.

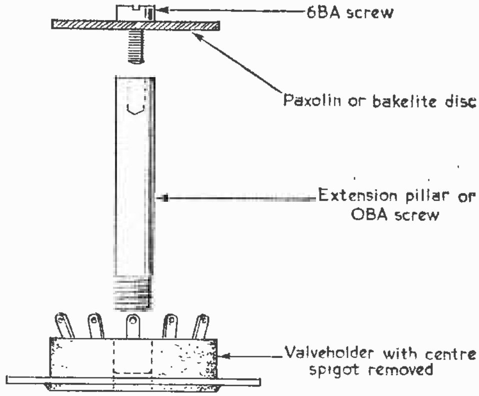


Fig. 3.—The simple construction of the extension.

The head of the screw is removed and a 6B.A. or 4B.A. nut soldered on one end of the screw. The thread is then filed off about a ¼in. at the other end. This will leave the screw a tight push-fit into the centre of the valveholder.

Fig. 3 shows the unit ready for assembly, and needs no explanation further than to say that the

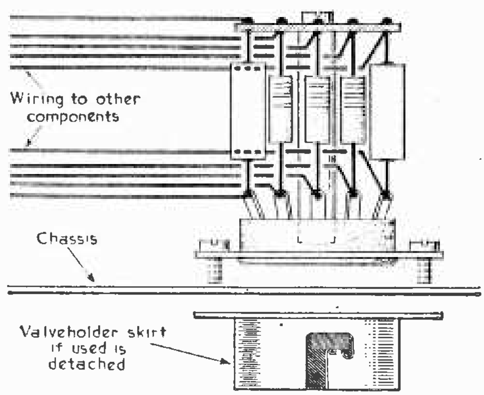


Fig. 4.—The valveholder extension in use.

top disc can be left off until all the components have been soldered to the valveholder pins.

When all components have been soldered to the valveholders, the free ends are slipped through the eyelets and the outgoing leads with them, the disc having been screwed in position. The reason for putting the outgoing wires in at this stage is that it is easier to put two or three wires if necessary through an eyelet before soldering, although there is nothing against making small loops in the component wires after they have been passed through the eyelets, and taking the wiring from these. ■

Record-player and Radiogram Faults

CAUSES AND CURES OF NOISE DISTORTION, WRONG SPEED, ETC.

By
L. E. Higgs

RADIOGRAMS can suffer from a number of troubles in addition to the usual radio receiver faults with symptoms peculiar to themselves. These defects are generally either pick-up faults or turntable faults.

Pick-up Faults—Hum

Hum is more pronounced on radiograms, when present because of the larger speakers fitted and the extra attention given to the audio circuit by the designer to increase bass response. The larger baffle area for the speaker also accentuates this. Never attempt to clear hum troubles on a gram chassis without the accompanying speaker connected and fitted in its cabinet. If this is not possible, then make sure that the bench speaker used is well baffled, because a low-level hum which is tolerable on a small speaker turns out to be overpowering when the chassis is fitted back in its cabinet.

Hum that occurs when the gram is switched to records, and is unaffected by the volume control, is residual and is introduced in the circuit after the volume control. Deteriorating smoothing capacitors and partial heater to cathode leaks in following audio valves are the most likely reasons.

Variation in hum level when the pick-up or motor board are handled denotes incorrect earthing. Check the earth connections under the board but do not add extra earths to chassis in the case of A.C./D.C. grams or the motor board might become live to mains. Some A.C./D.C. grams give less hum with the mains plug a certain way round in the supply socket (taking the chassis to neutral).

Pick-up Faults (Fig. 1)

Distortion on gram only, can be caused by the stylus or by the pick-up crystal itself. The stylus can be checked on rotating cartridges by reversing to the other stylus; if this gives undistorted results (on the correct speed record), then the other stylus is proved defective. In any case, it pays to replace worn styli before evidence of wear is audible. See that the stylus is properly located on the crystal transmission pad. Too often, through mishandling and heavy set-down on auto-changers, the stylus becomes dislodged and is found jammed between the cartridge side and pad (see Fig. 1). Debris picked up as dust should be cleaned periodically from the stylus.

Cracked Crystals

Good reproduction on radio but weak distorted sound from records is often due to a cracked crystal. This can be checked by unplugging the pick-up plugs from the chassis and fitting a crystal microphone or a substitute crystal pick-up from a portable record player. Good results from any of these shows the original crystal to be at fault. Crystal cartridges are fragile and can be fractured by careless handling—it is not generally known however that they are prone to failure with high temperature and portable mains radiograms with upper vents discharging heat into the space under

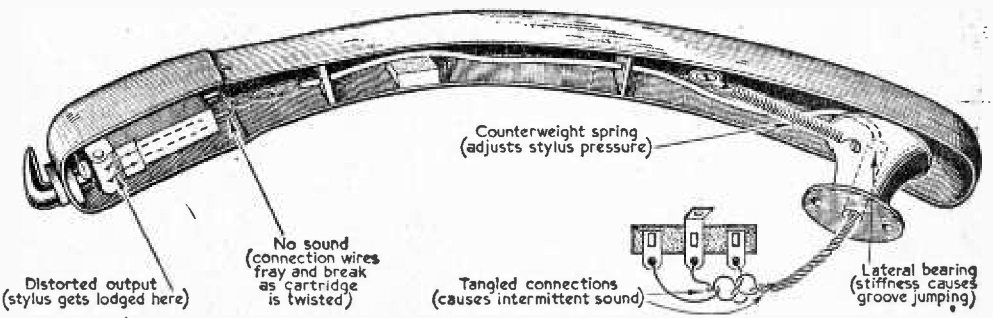


Fig. 1.—Typical faults which may develop in the pick-up arm.

Hum which reduces with the volume control setting on "gram" only nearly always originates from the pick-up. This can be checked by unplugging the pick-up leads from the chassis when the hum drops to a tolerable level. Check that the pick-up leads are not reversed—the screen should be earthed or connected to the chassis—this is a common trouble as many grams are not provided with polarised sockets and the plugs can be fitted the wrong way round by a novice without affecting the sound but causing hum.

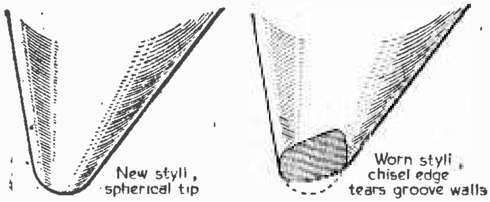
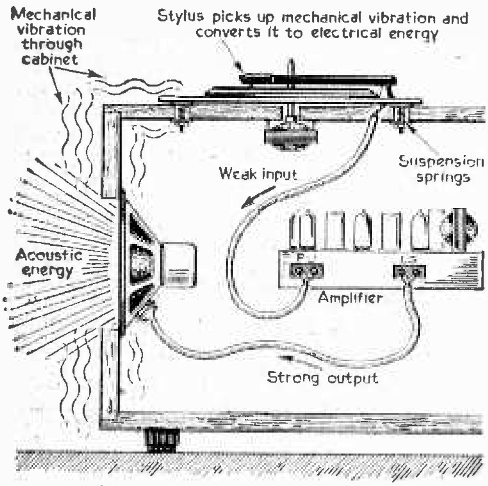


Fig. 2 (above).—The styli may become worn if the balance of the arm is maladjusted.

Fig. 3 (below).—Howling is caused by mechanical vibration being picked up and circulated by the acoustic feedback loop.



Microphony

Howling which commences when the volume is increased above a certain minimum (similar to amplifier acoustic feedback in a hall) is due to the cabinet conducting vibrations from the loudspeaker to the turntable and record where they are picked up by the stylus, amplified, and sent round the feedback loop again (see Fig. 3). This is usually a fault with home constructed equipment where the motor board is unsprung or badly fitted. A rigid cabinet with baffle bracing reduces mechanical vibration and raises volume at which the threshold of howl is reached. On manufacturers equipment this trouble is more often due to tight, unslackened, turntable transit screws.

Turntable Speed

The usual fault causing wow, slurring, and slowing of the record is not the turntable at all but the record slipping and skidding on its label with the one in contact with it (Fig. 4). This loss of friction can cause a warbling noticed on sustained high notes or severe slowing and at times stopping of the top record while the underside pile continue to rotate normally. The upper record when examined will be found to be saucer-shaped or to possess a small eruption on the label lifting the upper record clear of the main friction plane. A greasy or polished rim on the jockey wheel can cause the same effects but this time the turntable will be found to be turning slowly (Fig. 5). Check the pressure spring pulling the jockey wheel on to the pulley for reduced tension.

Permanent steady slow speed is most usually caused by engagement of the wrong pulley. The pulley bush can slip down the motor spindle if the grub screws loosen accidentally and with little flywheel momentum, wow or flutter may be present to iron it out.

(Continued on page 407)

the lid "cook" pick-ups if the gram is operated for an hour or two with the lid down.

One of the commonest troubles with turnover pick-up cartridges is the breaking off of the fine wire leads at the terminals on the cartridge due to the constant flexing with rotation. *Do not solder direct to the terminals* but remove the clips first and solder to them otherwise the heat may damage the crystal. This trouble is sometimes intermittent if the broken lead makes and breaks with vibration.

Insufficient pick-up weight can also cause cutting out of the sound owing to the stylus tip being held clear of the bottom of the groove. An adjustable lowering stop at the base of the pick-up can allow the stylus to drop lower, or if the arm is almost weightless, the counter balance spring also situated under the arm at the base can be slackened off one hole. Too much weight however causes excessive wear of records and styli (see Fig. 2).

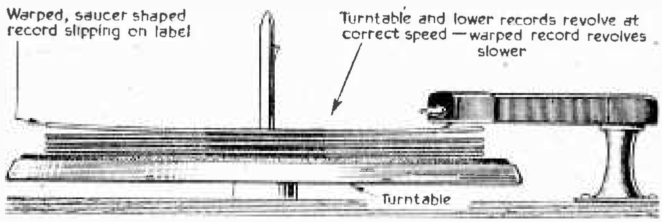
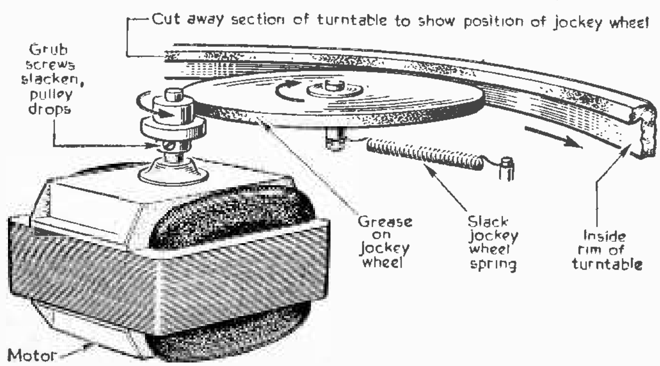


Fig. 4 (above).—Slow speed, slurring and wow, is usually caused by a warped record.

Fig. 5 (below).—Some of the causes of permanent slow speed.

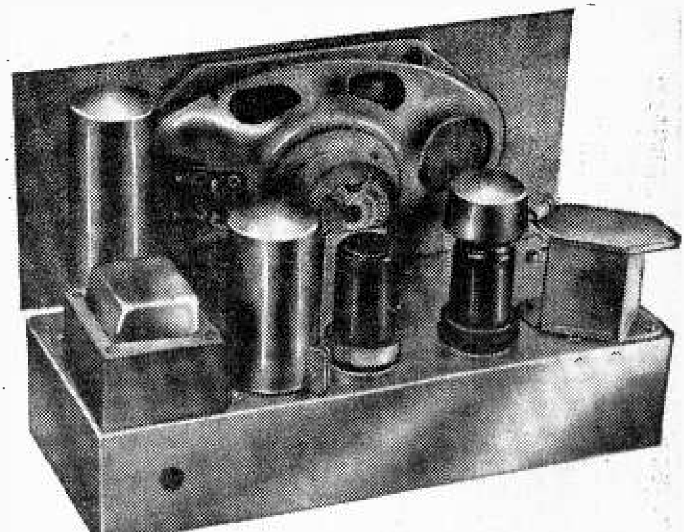


An Intercom Amplifier

By V. E. Holley

THIS AMPLIFIER WILL GIVE RELIABLE SERVICE AS A GENERAL COMMUNICATIONS UNIT.

THIS amplifier is designed for the reproduction of speech and it will give long and reliable service as an intercom, baby alarm, etc. Power consumption and heat generation are both very low and it is therefore especially suitable for continuous duty over long periods. The prototype has been in service for more than 3000 hours without valve replacement or deterioration in performance.



A rear view of the Amplifier

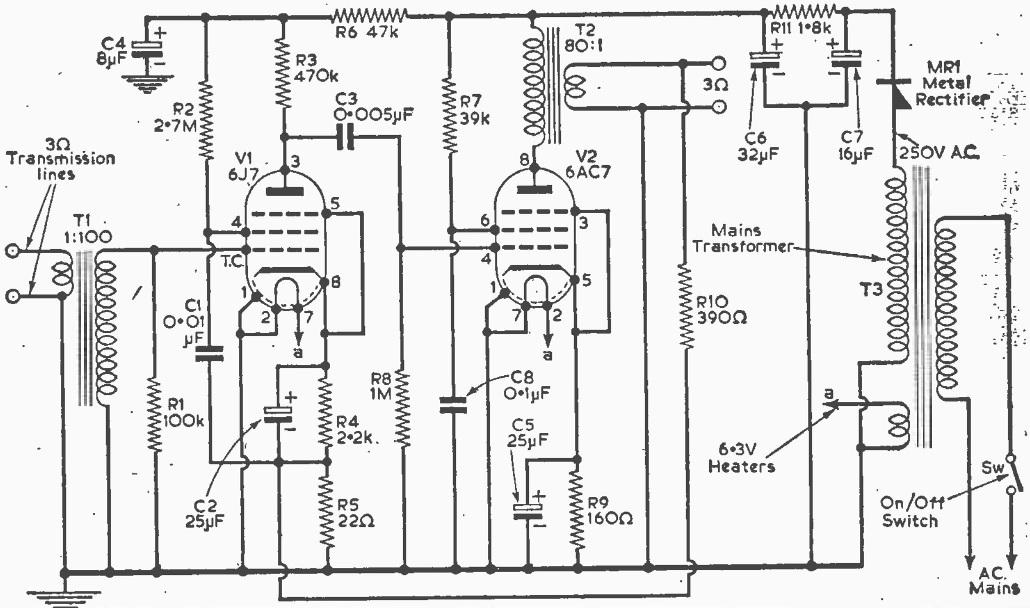


Fig. 1. The circuit diagram.

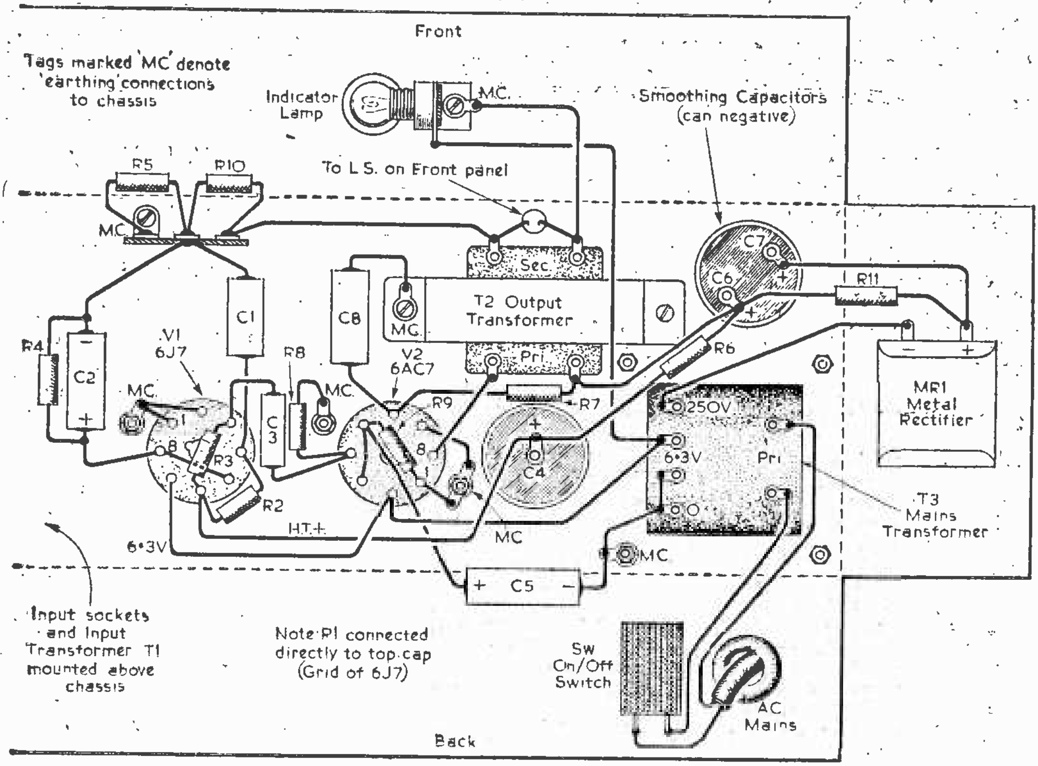


Fig. 2.—Details of the underchassis wiring.

Output Stage

This stage uses a high gain pentode, 6AC7, in the circuit given in Fig. 1. Though not properly an output valve, the 6AC7 performs that function very well, with an output approaching one watt for a signal of about 2V peak on the grid. The output transformer in the anode circuit should have a ratio of 80 or 90:1 for a 3Ω loudspeaker. Both cathode and screen resistors are bypassed for maximum gain.

Voltage Amplifier

The signal required by the output stage is derived from the anode circuit of V1, a resistance coupled A.F. pentode (6J7). The coupling capacitor, C3 is given a value of 0·005μF to introduce some attenuation of the lower audio frequencies which is desirable for clean crisp speech. With anode and screen loads of 470k and 2·7M respectively, and a cathode bias resistor of 2·2k the gain of the stage is 180 and the upper frequency limit is around 5000c/s. In the grid circuit is a microphone transformer, T1, having a step-up ratio of 1:100. so that the external lines can be at low impedance and therefore less susceptible to hum pick-up. The screen of V1 is decoupled to the junction of R4 and R5. This avoids degeneration and loss of gain which R5 would introduce if the decoupling were to chassis.

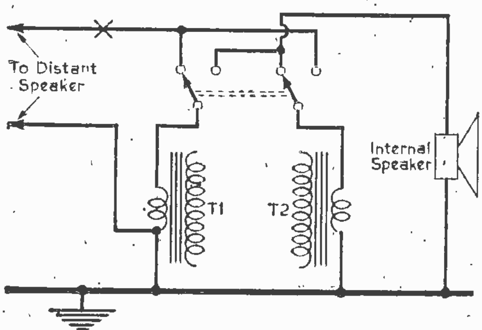


Fig. 3.—The "talk-listen" switch circuit.

Negative Feedback

The overall gain of the two stages is more than is required and is reduced by negative feedback taken from the output transformer secondary to the junction of R4 and R5 in the cathode circuit of V1. The feedback, and, therefore, the gain, can be adjusted as necessary by varying the value of R10 in the range 220 to 1000Ω and if the gain cannot be reduced to the desired working level, a further reduction can be effected by removing C5

With equipment of this sort it is found that if the gain is fixed and constant, the user rapidly becomes accustomed to it so that the results are always consistent; it might be compared in this respect with a telephone. No external gain control is therefore provided.

Power Supply

The H.T. required is 14mA at 250-300V and the total heater current including the indicator lamp, is is a little less than 1A. A miniature mains transformer of the instrument of television convertor type is used, together with a half-wave, contact-cooled, rectifier. The power consumption from 240V mains is less than 15W.

The resistor R11, and the capacitors C6 and C7, provide the main smoothing, supplemented by R6 and C4 for the supply to V1. It must be mentioned that the elimination of hum requires rather special attention. A background hum which would pass unnoticed in a domestic radio receiver can be prominent and objectionable in apparatus where the sound output is normally zero, especially in quiet surroundings. In this amplifier, adequate smoothing and negative feedback give a silent background.

Construction

Fig. 4 gives a plan of the chassis on which the prototype was built. It is not essential to adhere to this, but, whatever layout is adopted, it must be arranged that there is a distance of not less than about 6in. between the mains and input transformers and that the magnetic axes of the mains and output transformers are at right angles. The output transformer also must not be less than about 4in. from the input transformer and the latter should not be bolted to the chassis until after it has been wired up and orientated to the position of minimum hum pick-up—this position is usually quite critical. A wiring diagram is given in Fig. 2. It is convenient to omit the connection between the output transformer and R10 until the test stage is reached.

The speaker in the prototype is a 7in. x 4in. elliptical unit mounted on a piece of hardboard 10in. x 6½in. in which a suitable aperture has been cut. The board is bolted to the chassis runner in two places and the speaker is supported at the rear by a light aluminium bracket.

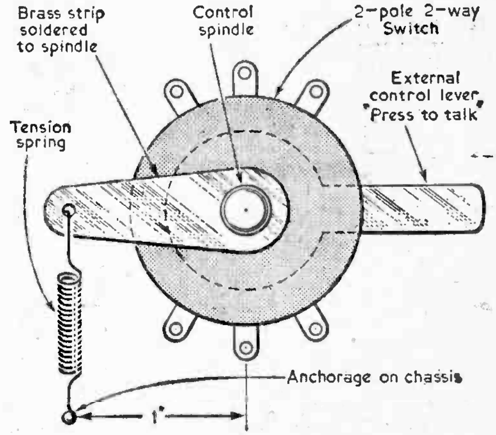


Fig. 5.—The construction of the "talk-listen" switch.

Components

All the capacitors except C2 and C5 should be 350VW as they have to withstand the full H.T. voltage from the rectifier while the valve cathodes are warming up. The resistors can all be ½W except R11, which should be 1W. R9, which has a non-standard value of 160Ω is easily found by measurement from a batch of 150Ω components of usual tolerance. V1 may be a 6J7, 6K7, 6SJ7, 6SK7, or any direct equivalent, without alteration of component values and with very little difference in performance, though the use of a valve with a top grid cap and a metal body is recommended.

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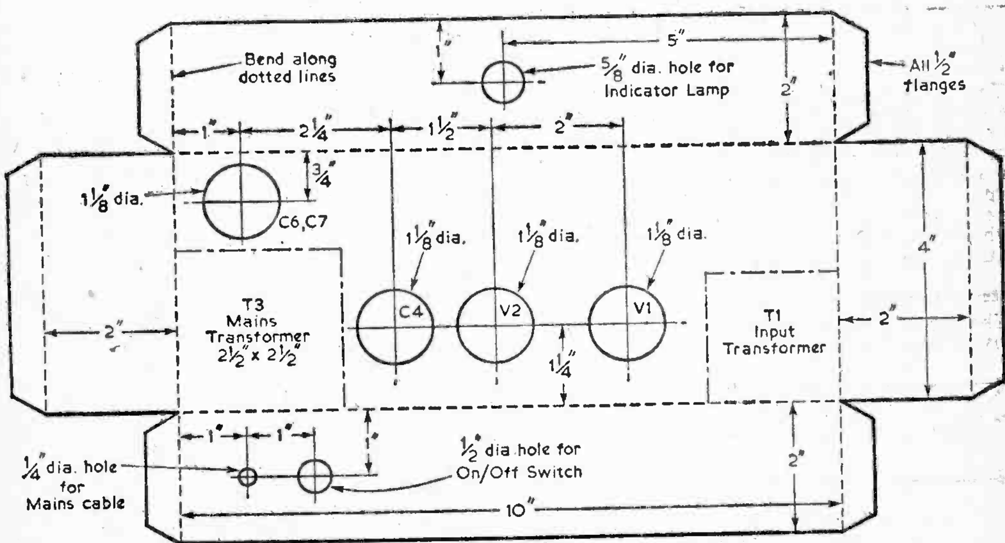


Fig. 4.—The drilling dimensions for the chassis.

Ferrite Rod Aerial Conversion

By C. Fletcher

CONVERTING A TRF SET TO A RECEIVER USING A FERRITE AERIAL AND ONE STAGE OF TUNING

THIS article describes a method of converting a simple TRF receiver using a tuned R.F. stage with air-cored coils, to a receiver with a ferrite rod aerial and only one stage of tuning.

The conversion was carried out on a miniature three valve mains receiver during the course of a complete overhaul, the valve line-up being three Z77's used as the R.F. stage, the A.F. amplifier and the output valves (plus a crystal diode detector). The main advantage of the conversion was the elimination of the inconvenience of having to provide even a short length of aerial wire when the set was transported from room to room. A further, although not so obvious, advantage was the elimination of the anode tuning of the R.F. stage. This meant a very simple alignment procedure. This second advantage was gained because of the extremely high unloaded "Q" of the Ferrite rod aerial.

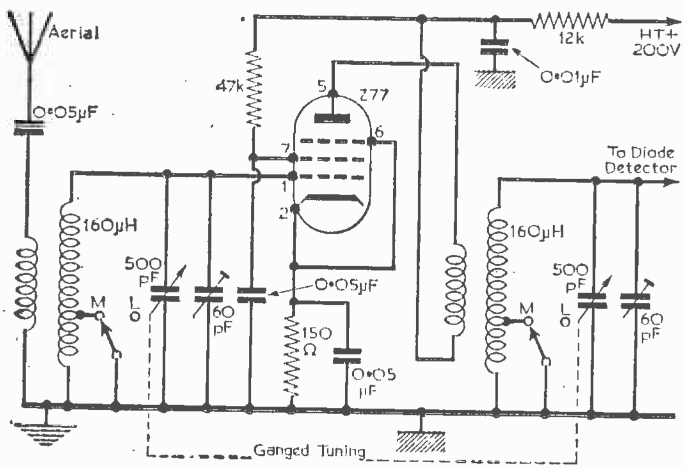


Fig. 1.—The R.F. stage of the receiver.

The circuit of the R.F. stage of the receiver was as shown in Fig. 1. The circuit was quite conventional and the valve drew an anode current of about 9mA. The values of inductance against the secondaries of the coils refer to the medium-wave sections of the windings only.

Choice of New Circuit

On looking at Fig. 1 it might be thought that the simplest thing to do would be to wind a coil on a ferrite rod, with inductances the same as for the air-cored secondaries, and wire it in the grid circuit; leaving the rest of the circuit unaltered. However, such a solution is neither necessary nor practical. It is not necessary since with two similar cascaded tuned circuits, as are present in Fig. 1, the effective Q of the combination is approximately double that of the Q of one circuit considered separately; hence with a Q of 60 for each circuit the overall Q is about 120. With a ferrite rod aerial it is quite easy to construct a coil with a medium wave Q of several hundreds — in fact the aerial constructed by the writer had a measured Q of 300 at 1·5Mc/s. Hence, it is

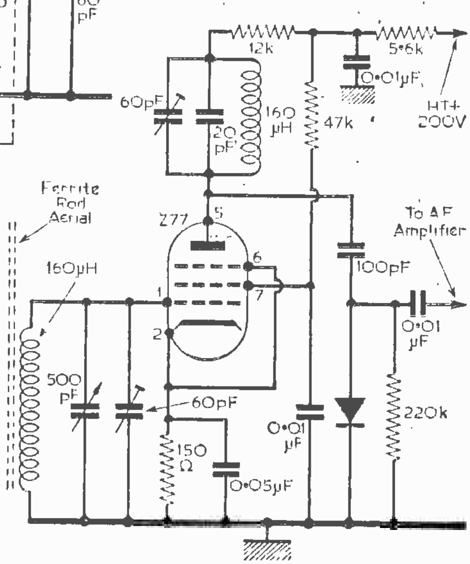
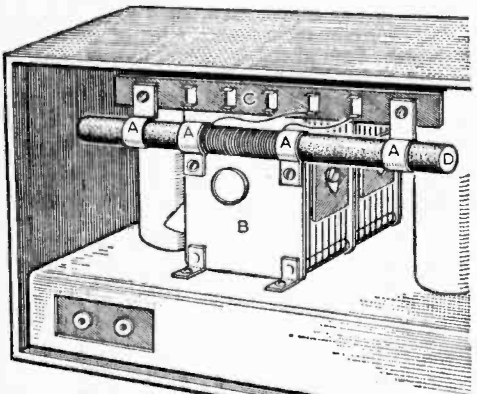


Fig. 2.—The circuit of Fig. 1 with the alterations necessary for the use of a ferrite aerial; the resistor previously used for anode decoupling is now employed as the anode load.

unnecessary to increase the effective Q of the R.F. stage by employing anode tuning.

It is not practical to tune the anode of the R.F. stage since, with most double-tuned TRF receivers, the anode and grid coils are not separately screened, but merely screened from one another by being placed one above and one below the chassis. With a high Q grid coil it is extremely difficult, without special precautions in layout and screening, to ensure that positive, uncontrolled, feedback does not take place. Since this was a conversion, the layout had been already fixed and the slight increase in selectivity which would be obtained did not justify extensive modifications to the existing layout.

The circuit so far described is an R.F. stage with grid tuning only. A further simplification made in the writer's set was to restrict the tuning to medium-waves only. This was decided since the set was mainly intended for domestic listening and the only station normally required on long waves was the BBC Light Programme. Since this is easily obtainable, in the writer's location, on medium waves, the inclusion of long waves was not considered justified. In order to use all the control positions of the set, the hole previously used by the wave-change switch was used for the "on-off" switch and a volume control without a switch was employed.



A.....Plastic clips
B.....Tuning Condenser
C.....Tag strip D.....Ferrite Rod Aerial

Fig. 3.—A suitable method of mounting the aerial.

A difficulty which arises on medium waves (without a tuned anode circuit), particularly at the high frequency end of the band, is due to the stray capacities appearing across the anode load of the R.F. stage. The effect of such capacities is to shunt the anode load and so reduce the gain of the stage. This is unfortunate, particularly if it is required to receive Radio Luxembourg since this station is fairly elusive anyway. However, the difficulty can be easily overcome by employing the anode coil (previously tuned by the variable condenser) in series with a resistive anode load, and peaking this coil on about 1·5Mc/s by means of its trimmer. Hence, instead of the gain falling at the H.F. end of the band, it can be made to rise and then fall away sharply. No difficulty was experienced with unwanted feedback since the fixed anode tuned circuit is quite isolated from the variable grid tuned circuit, and no long grid and anode leads need to be adjacent. With a coil inductance of 160μH, to tune to 1·5Mc/s, the preset tuning condenser must have a value of at least 60pF; this assumes a stray capacity of 10pF. In order to be sure of satisfying this condition a fixed condenser of 20pF was added in parallel with the 60pF trimmer already available. The circuit arrived at from the above considerations is shown at Fig. 2. It can be seen that the resistor previously used for anode decoupling is now employed as the anode load.

The aerial coil was wound on a piece of ⅜in. x 6½in. ferrite rod, 52 turns being required for an inductance of 160μH. In order to achieve the high Q necessary the coil was wound with Litz wire. A suggested method of mounting the aerial is indicated by Fig. 3.

Since the coil was wound with Litz wire, care had to be taken to be certain that each strand of wire was soldered on to the tags. An extremely satisfactory way of cleaning the ends of the Litz wire is given as follows. A small tin lid is filled with "meths" and the "meths" is ignited: the end of the Litz wire is first placed in the blue flame. The wire is held here for a few seconds allowing the cotton to burn off, and the copper to become red hot. The wire is then plunged into the "meths" and then immediately withdrawn over the side of the tin lid. If the method has been carried out correctly, each strand of the Litz wire will be perfectly clean and show the characteristic pink colour of unoxidised copper. As soon as the wire has been withdrawn from the "meths" it should be tinned.

The receiver should first be tuned to a station at the L.F. end of the dial, and the aerial trimmer and tuning condenser adjusted until the station coincides with its marked position on the dial. The set is then tuned to the required H.F. station at which the anode tuned circuit is to be peaked (e.g. Radio Luxembourg) and the anode trimmer adjusted for maximum volume. ■

Record-player and Radiogram Faults

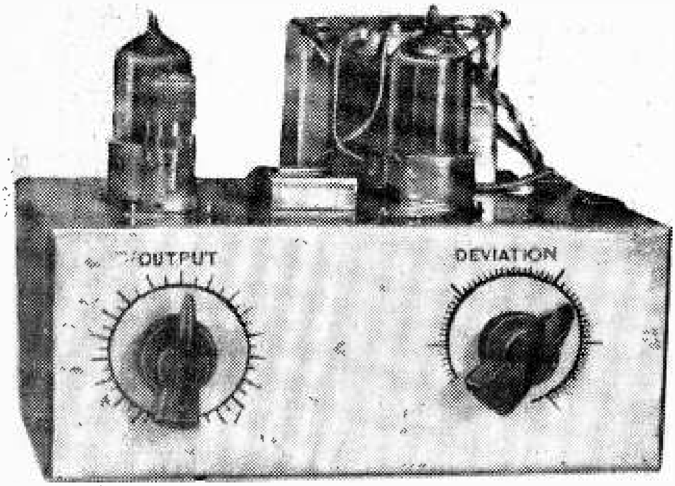
(Continued from page 400)

Generally quiet passages or sustained notes show up this effect which is heard as a flutter or gnawing sound. It may be due to a fault in the rotor causing uneven pull, or to a flat on the drive pulley.

Groove Jumping

Microgroove records in good condition that exhibit this trouble at any random place across the record point to excessive lateral stiffness of the pick-up arm. See that the pick-up screened wire is flexing freely without resistance and that the central bearing holding the arm is lightly lubricated.

Groove jumping that takes place always near the end of the record is often caused by the trip mechanism becoming stiff. When examining this small, lightly riveted pawl, under the turntable *do not oil it*. Clean it and exercise it with a few twists with the fingers to clear any chemical corrosion that can increase friction but to oil it will only attract the dirt and dust and cause the same trouble later.



A WOB

for

Of course, the characteristic of an I.F. amplifier may be plotted on graph paper by using an accurately calibrated signal generator in conjunction with a meter. Unmodulated signals are fed into the I.F. amplifier at various frequencies, and the output voltages are noted for each. A curve may then be drawn showing output voltage against frequency; a similar procedure may be adopted with the discriminator. However, should the curves have the wrong shape, then when steps have been taken to correct them, another set of curves must be drawn. This alignment procedure is obviously not one to be recommended for the amateur.

What is needed is a visual display of the various characteristics without the necessity of drawing graphs. The instrument for this display is the oscilloscope—as in the graphs which may be drawn, the x-axis is used to represent frequency and the y-axis to represent the output voltages. In

RECEIVERS for the BBC's F.M. service have always presented difficulties of alignment for the amateur. The usual methods employ an A.M. signal generator and a sensitive voltmeter. In such a method, the generator is connected between the chassis and the input of the receiver's I.F. amplifier, and the meter between the chassis and the grid of the limiter valve. The cores of the I.F. transformers are adjusted for maximum readings on the meter. The meter is then moved to the discriminator stage and the alignment completed.

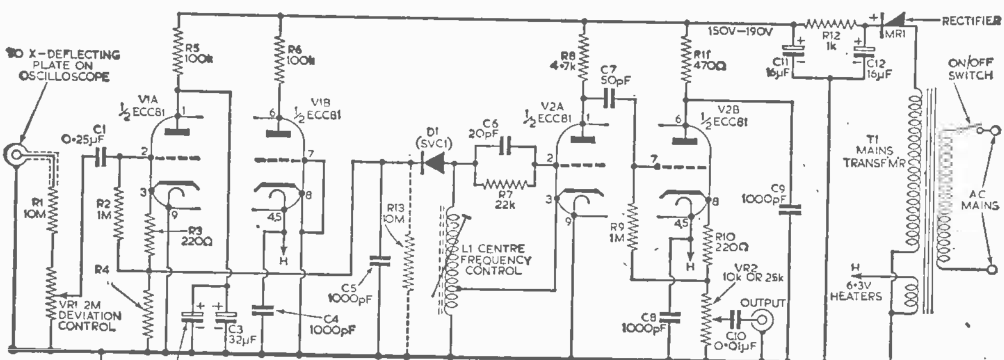


Fig. 1.—The circuit of the wobbulator. Note: the value of the resistor R4 is 6·8k.

Whilst this procedure is satisfactory for approximate alignment, it is not always good enough, as I.F. amplifiers in F.M. receivers need to have a certain bandwidth if the signal from the transmitter is to retain its high fidelity. The discriminator especially needs to be aligned accurately so that its characteristic is linear if distortion is not to be heard in the output of the receiver.

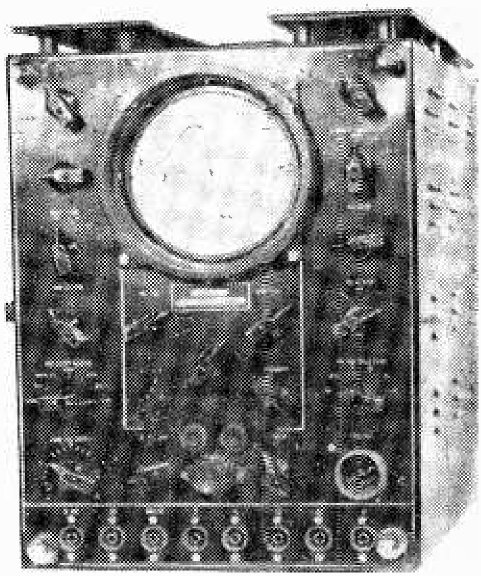
use, a frequency-modulated signal is applied to the I.F. amplifier and the output of the amplifier is fed to the Y-plates of the oscilloscope to deflect the spot vertically. Horizontal deflection of the spot is obtained in the usual way by using the internal timebase of the oscilloscope. If the frequency modulation of the input signal is synchronised with the timebase of the oscilloscope, then a trace will

BULATOR

.M. I.F. Alignment

VISUAL DISPLAY OF I.F. AMPLIFIER AND DISCRIMINATOR CHARACTERISTICS

By R. E. F. Street



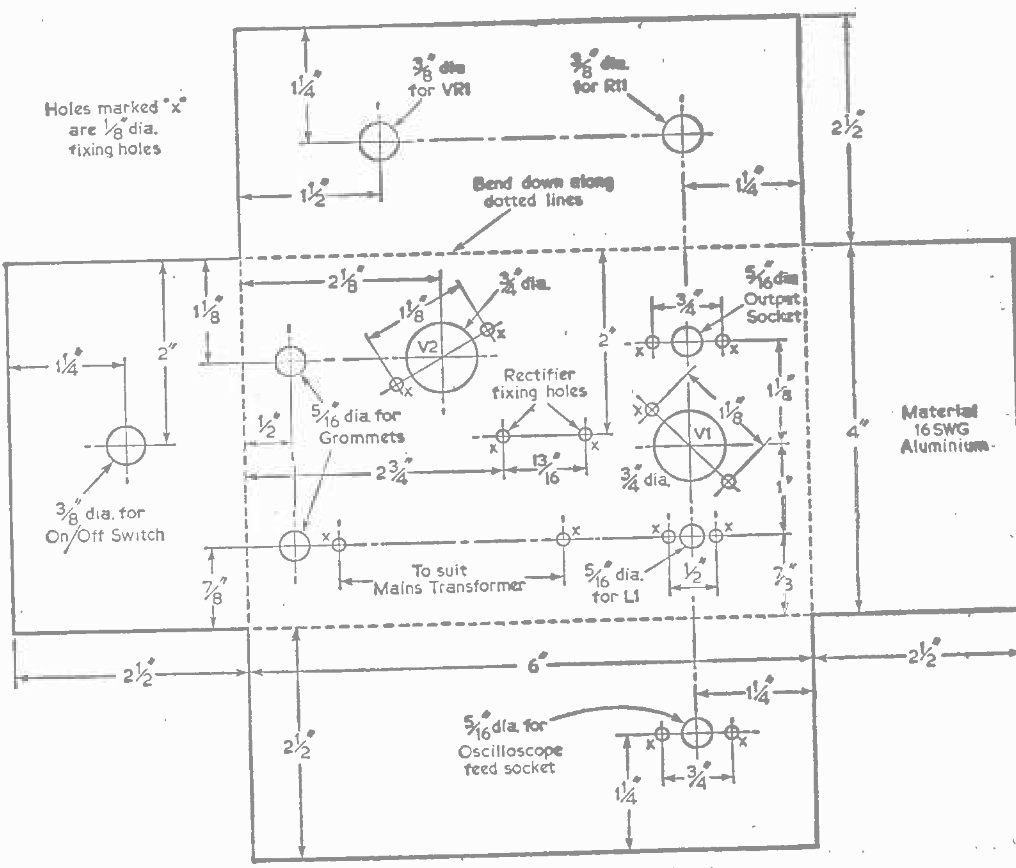


Fig. 2.—The drilling dimensions of the chassis.

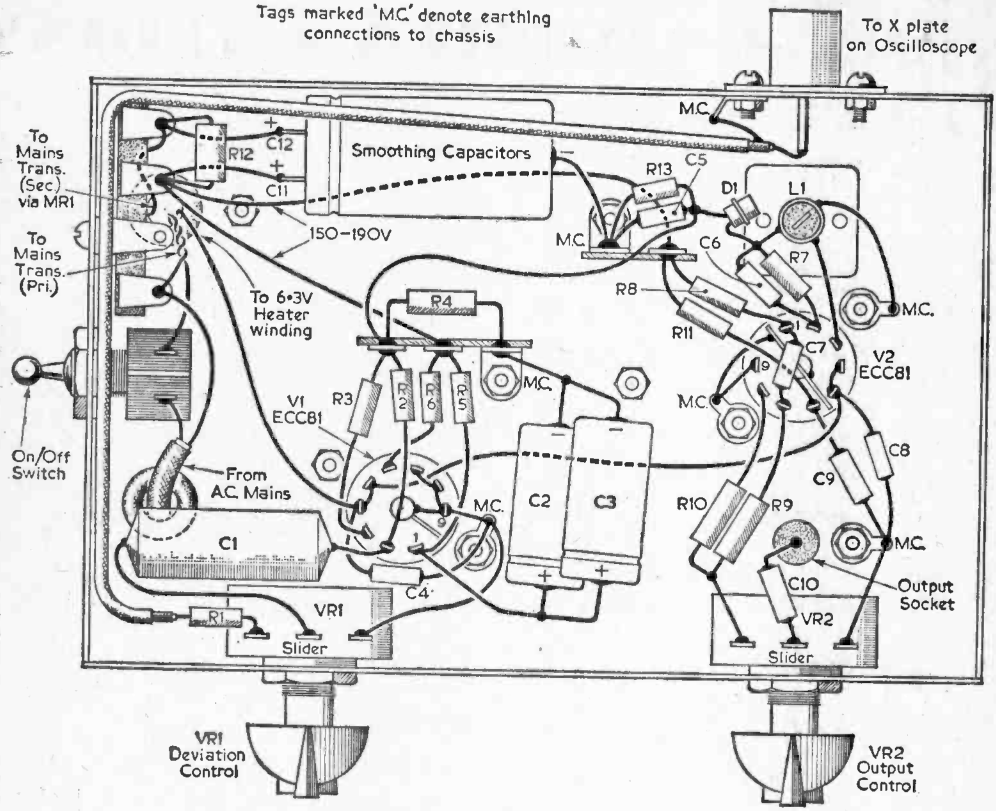
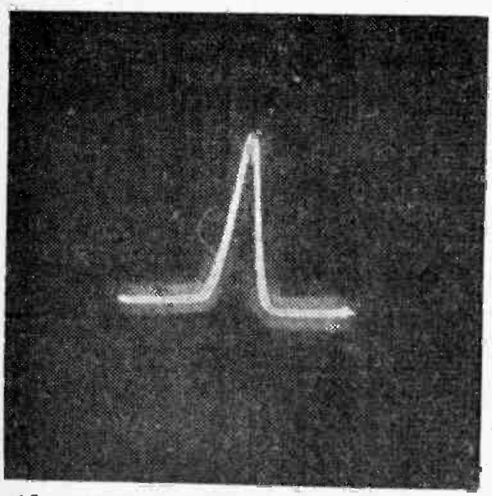


Fig. 3.—The underchassis wiring and component layout.

be formed on the face of the tube which represents the amplifier characteristic.



I.F. response of an F.M. receiver at limiter grid.

The Principle of Operation

In this instrument, a signal is generated at a frequency of 10·7Mc/s—the optimum F.M. I.F.—and this signal is frequency-modulated by a signal derived from the timebase of the oscilloscope. Early methods of obtaining frequency-modulation employed variation of the inductance of the oscillator producing the 10·7Mc/s signal, or the use of a reactance valve circuit, which acted as a voltage-dependent capacitor across the tuned circuit of the oscillator. However, the circuit used in this unit employs a silicon-junction diode as a voltage-dependent capacitor. When such a diode is biased in its reverse direction, a "depletion" layer is formed which acts as a dielectric of a capacitor formed by the two halves of the diode. The width of this layer, and thus the capacity of the junction, may be varied by altering the reverse bias across the diode. This is the principle of operation of the unit described.

It might be thought that the use of the 50c/s mains voltage as a modulating source would make for a simple instrument, but using such a high sweep frequency would give a misleading set of curves—the tuned circuits would not have time to respond to the rapidly changing frequency of the input signal.

(Continued on page 430)

ADDING COMMUNICATIONS FEATURES

CHOICE OF VALVES AND STAGES

(Continued from page 342 of the August issue)

By F. G. Rayer

GOOD results can be obtained with the older type of valve, such as those with octal bases, and many highly valued communications receivers have such valves. But when a receiver is being modified, or stages are to be added, it may be worth while using modern miniature valves, which will save space, and in some cases may give improved results.

Value of Modifications

If octal valves are to hand, or already fitted, it will not be worth while to replace these by miniature valves, in some stages. This particularly applies to audio amplifiers. Even in earlier stages, an anticipated improvement from substituting an old type valve by one with higher gain may scarcely be realised. This is because gain will almost always be reduced to some extent by the AVC circuit, so that the extra gain of the newer valve is not used.

It is in the early stage or stages in particular (e.g., R.F. amplifiers, and mixer or frequency changer) that modern valves with a lower noise level can best be used. Even here, it must be remembered that the noise level referred to is that generated inside the set, and not that picked up by the aerial from external sources, which will often predominate.

The valve types favoured in commercially built communications receivers are a good guide to those which may be used when adapting or building a receiver. Many reputable communications receivers of older type, still in use, employ valves such as the 6K7 (or equivalents CV1941, CV1943, EF39, OM6, W63 etc.) in R.F. and I.F. stages. That such receivers are still in regular use indicates that these valves can give good results. With them will often be found the 6K8, 6Q7, 6H6, 6V6, and similar octal valves.

Receivers of later design tend to use more modern valves, such as the 6SG7, 6BA6, UAF42, 6BJ6, etc., in R.F. and I.F. stages. Frequency-changers, converters, mixers and oscillators are also of more modern type, such as 6U8, UCH42, 6AJ8, 6AH6, 6C4, etc.

In later stages, miniature valves are also generally used, but some of these are equivalents of octal types, and are only fitted to save space and give uniformity. For example, a 6BW6 may be used instead of a 6V6, and except for being a miniature, is identical, for audio purposes.

To obtain best results with the modern valve types, some resistor values may require changing. The circuits given here, and in other articles in this series, may be used with either octal or miniature valves. When adapting and improving a receiver, it should be remembered that a double valve can often be introduced, to perform more than one function. For example, a twin triode may act as A.F. amplifier and BFO. Or such a valve could be used for a 100kc/s crystal marker, and audio or other purposes.

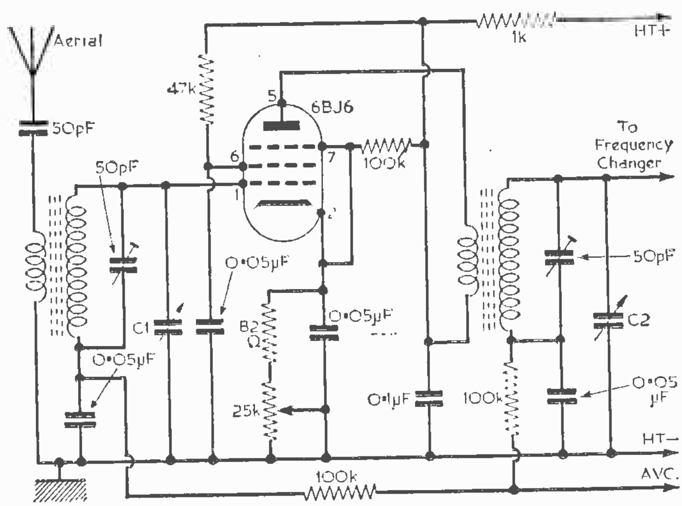


Fig. 13.—This circuit shows a 6BJ6 R.F. stage.

R.F. Stage

Suitable valves for a 6BJ6 are shown in Fig. 1. C1 and C2 are sections of the usual gang tuning condenser. This valve is economical, and can give very good results. A 6K7 may be used if the bias resistor is changed to about 220Ω. The high slope 6BA6 is also employed in this stage in high quality receivers, and should have a 33k screen grid resistor, and 68Ω bias resistor. Its heater current is twice that of the 6BJ6, but its gain is higher.

The usual popular type of superhet has no R.F. gain control, and one should certainly be introduced when improving the receiver. One method of doing this is shown in Fig. 13, where the 25k potentiometer is panel mounted, and acts as R.F. gain control. The most suitable value depends to some extent on the value and H.T. voltage, and may be from about 5k to 50k. If the value is too small volume will be too great, even at minimum setting. But a very large value will give abrupt control of volume. A value of about 20k can thus often be fitted. The fixed resistor from cathode to H.T. positive (100k in Fig. 13) helps to give more uniform control.

If a receiver of fairly simple type is in view, quite good results are possible on the lower

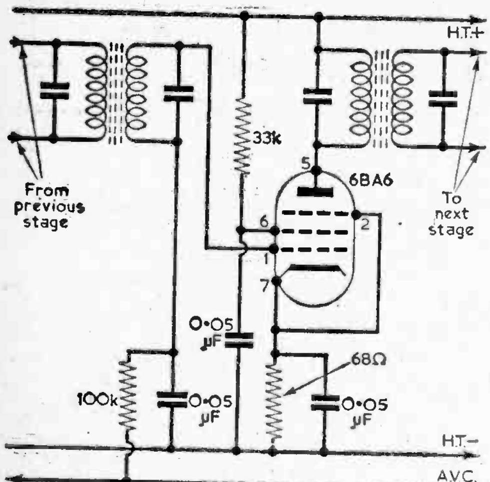


Fig. 14 (above).—A 6BA6 valve in an I.F. stage.

Fig. 15 (right).—An E6F82 mixer-oscillator stage.

frequency amateur and S.W. bands, without the use of an R.F. stage. It is usual, however, to have at least one R.F. stage, as this reduces second channel interference, and improves sensitivity and signal-to-noise ratio.

I.F. Stages

When an ordinary type of superhet is being improved, it is usually fairly easy to add an I.F. stage. This will give considerable increase in selectivity and sensitivity. Such a stage is particularly easy to add in a receiver originally having only one I.F. stage. If the receiver already has two intermediate frequency stages, much more care is necessary to avoid instability. Complete screening, and decoupling of AVC and H.T. feed circuits, will be required.

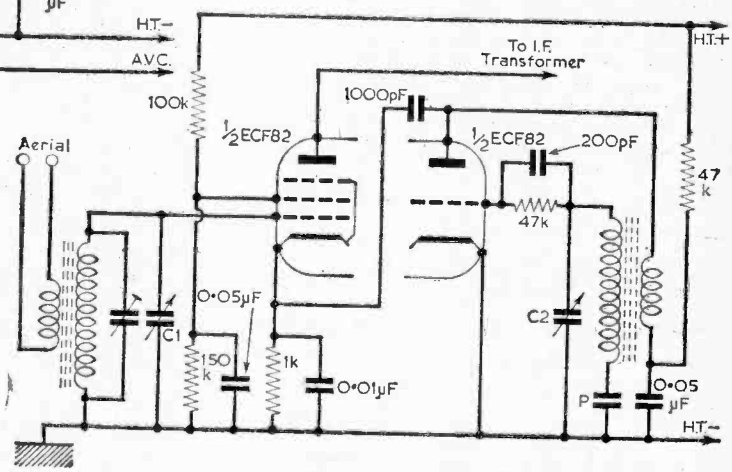
A typical I.F. stage is shown in Fig. 14, using a high slope valve. Valves such as the 6K7 may be used, with a 220Ω bias resistor. and 47k screen grid resistor. The additional I.F. transformer must, of course, be for the same frequency as those already fitted.

If the I.F. amplifier has more than one valve it is useful to fit an I.F. gain control, which can be arranged in a similar manner to that in Fig. 13.

A crystal filter may be incorporated in an I.F. stage, and this will be dealt with later. A simple way of securing additional selectivity is to use two I.F. transformers in the coupling between I.F. stages. The secondary of the first transformer is connected to the primary of the second transformer through a *very small* capacity.

Frequency-Changer or Mixer

Many popular sets have a triode-hexode frequency changer, such as an octal 6K8, or miniature 12AH8. Older communcations receivers often have a valve such as the 6K8 operating as mixer only, with a separate oscillator valve. These methods can work well in general coverage receivers.



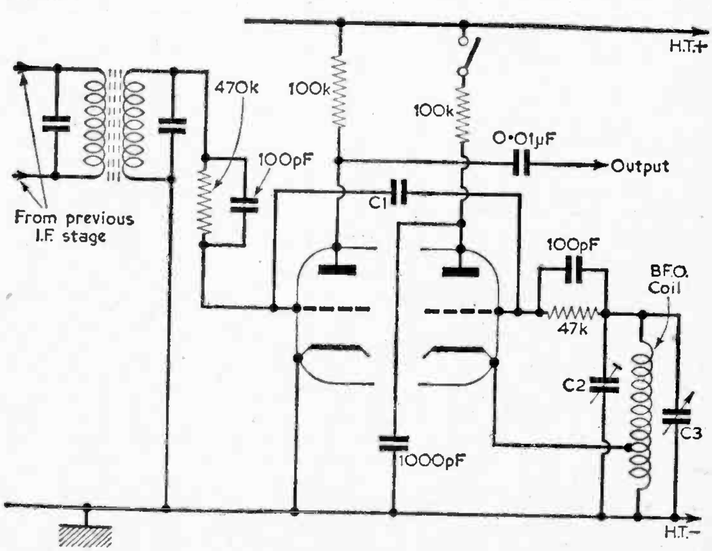


Fig. 16.—A double triode used in a detector and BFO circuit.

A mixer-oscillator stage using an ECF82 is shown in Fig. 15. A similar circuit may be used with a separate oscillator valve, and a 6C5, 6C4, 6AM6, or similar valve may then be used as oscillator.

Fig. 15 also shows connections for a dipole aerial—the coil primary is not earthed, but twin sockets or terminals are provided, for the twin feeder. Such an aerial will usually give better results, especially in reducing untunable background noise from external sources.

Good results can be achieved by using the ECF82 as the first stage, and this has the merit of simplicity. In a larger or more ambitious receiver, a 6BA6 R.F. stage, followed by the ECF82 stage, will allow of a very good performance.

C1 and C2 are sections of the usual gang condenser. The padder condenser P should be of the correct value for the band in use. Several wavebands will normally be provided, as already explained.

Combined Valves

When high sensitivity is required from a superhet with few stages, a grid detector may be used, instead of the more usual diode. Such a detector may be easily overloaded, but can give a very good output with weak signals.

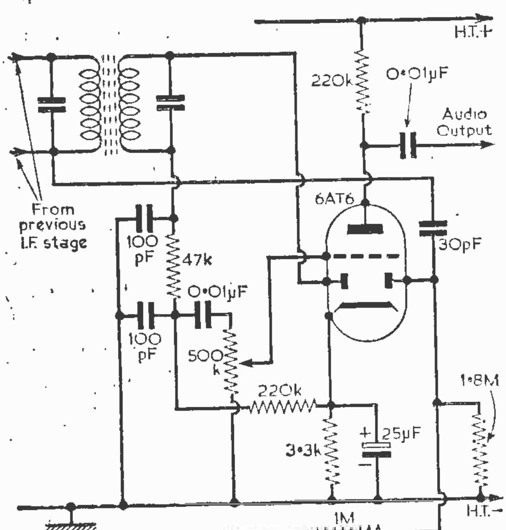
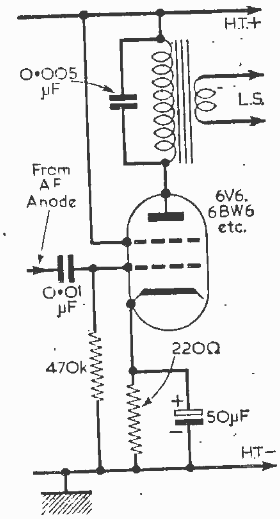


Fig. 17.—An AVC, detection and audio amplification circuit using a 6AT6.

A detector of this kind is shown in Fig. 16. Here, a double-triode has been used, and the second triode section is employed as BFO. The coupling condenser C1 is of very small capacity, such as can be made from twisting together insulated connecting wire for a short distance. Octal valves such as the 6SL7 or 6SN7 may be usefully employed. Full details of BFO oscillators have been given. The BFO circuit is tunable 1kc/s or so either side the intermediate frequency, C3 being used for adjustment. It renders CW morse audible, and is switched off for voice reception. Miniature valves, such as the 12AT7, are equally suitable.

Fig. 18.—This output stage could use any of a number of valves; 6V6, 6BW6, 6AQ5, etc,



If a BFO is not wanted, or is already available, a twin triode may be used as grid detector and A.F. amplifier. Alternatively, one triode section can furnish a 100kc/s marker signal, as previously explained in an earlier article. Some receivers employ a twin triode for BFO and audio amplifier.

Fig. 17 shows suitable values for a 6AT6, employed for detection, A.F. amplification, and automatic volume control. If a miniature valve is not wanted, a 6Q7 octal type may be used instead. An AVC in/out switch may be wired from the AVC line to chassis, to permit manual control in R.F. and I.F. stages, and prevent the automatic volume control circuit trying to follow morse. A double-diode-triode stage of this kind is very popular indeed. The H.T. positive feed may be decoupled by means of a 33k resistor and 8µF or similar condenser. This will slightly reduce hum, if H.T. smoothing is a little inadequate, and is generally worth while.

When phone reception is in view, the output of the triode will often be adequate. Alternatively, a second small triode can be used. Or a 6H6 or other double-diode may be fitted, for detection and AVC and a double-triode to provide two stages of A.F. amplification.

Output and Rectifier

Very many communications receivers, including modern sets of high quality, employ a single beam tetrode or similar valve, such as the 6BW6 or 6AQ5. These are miniatures, and similar, except that the 6AQ5 is intended for up to 250V only, and has a miniature 7-pin base, compared with the 9-pin of the 6BW6. If octal valves are preferred, a 6V6 may be employed, with no change in values or performance. Suitable values for any of these valves are shown in Fig. 18. Other valves may, of course, be used instead. If so, the bias resistor should be chosen to suit.

The existing power supply circuit of the receiver can probably remain unchanged, especially if transformer and rectifier are of fairly generous rating. If the H.T. rating of the transformer is rather small, it may be necessary to replace the output valve by a more economical type, for example, a 6BW6 might be replaced by a 6AM5, and this would save roughly 30mA of H.T. current, which would be available for extra I.F. or other stages. The 6AM5 requires a 680Ω bias resistor.

Club News

REPORTS OF CURRENT ACTIVITIES

BRADFORD RADIO SOCIETY
Hon. Sec.: M. T. Powell, G3NNO, 28 Gledhow Avenue, Roundhay, Leeds 8.

At the Annual General Meeting it was decided to change the name of the society from "Bradford Amateur Radio Society" to "Bradford Radio Society". On May 23rd members visited the Granada TV studios in Manchester, and on June 6th they visited the Leeds and Bradford Airport. G3LZW gave a talk on "Audio Amplifier Design and Construction" on July 25th.

All meetings commence at 7.30 p.m. Slow Morse classes, if previously arranged, are held before meetings.

Future Event:
September 12th—The first meeting of the new session.

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

The Society's Golden Jubilee Year celebrations are continuing, and on July 2nd the second Two Metre Field Day was held. A Surplus Sale was held on July 5th and on the 12th a Direction Finding Practice Run.

Future Events:
August 5th.—"Fifty Years of Radio"—an exhibition at the Derby Art Gallery—will be held for three weeks until August 26th.
August 13th—A Mobile Rally at Rykneld School.

LICHFIELD AMATEUR RADIO SOCIETY
Hon. Sec.: T. L. Painter, G3NEO, Lyndhurst, 98 Gaia Lane, Lichfield.

The Society meets on the first Monday and third Tuesday of every month, at the King's Head, Lichfield.

LLANELLY AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: H. J. Hughes, 4 Pen-y-morfa, New Dock, Llanelly.

Lectures for the RAE were continued each Thursday up to the end of May. A highly successful "Ladies' Night" was held on May 18th.

During Technical Training Week, commencing May 30th, a club transmitter, under the call sign GW3LL U/A, was set up at the Drill Hall, Llanelly.

LUTON AND DISTRICT RADIO SOCIETY
Hon. Sec.: D. Bavister, 70 Crawley Green Road, Luton, Bedfordshire.

The Society is organising a Mobile Rally for August 20th at Stockwood Park, Luton.

Meetings are still held at Surrey Street School every Monday night at 8 p.m.

MITCHAM AND DISTRICT RADIO SOCIETY
Hon. Sec.: M. Pharaoh, G3LCH, 1 Madeira Road, Mitcham.

Recent meetings included one where various members brought along a piece of equipment and gave a short descriptive talk about it. On Friday, June 30th, there was a discussion on Club affairs and outside activities.

On July 22nd members operated an exhibition station at the Mitcham Horticultural Show. The Society operated a similar station at the Show last year.

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

On July 26th the Society held an informal meeting.
Future Event:
August 9th—A discussion on the Scout-Jamboree-On-The-Air.

NORTHERN MOBILE RADIO RALLY
Hon. Sec.: J. Charlesworth, G3IJC, 23 Craven Lane, Gomersal, Leeds.

The Rally was held in fine weather and attracted approximately 900 visitors of which 80 were mobiles, which with 160 non-mobiles, made a total of 240 cars. The majority operated on 160m, although a few 2m and All-band operators were present.

PADDINGTON AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: N. A. Lambert, G3LVK, Beauchamp Lodge Settlement, 2 Warwick Crescent, London, W.2.

The Society continues to meet on Wednesday evenings at 7.30. Recent activities have included a sale of surplus equipment and talks by Mr. Alban (G3JEA), and Mr. Legge (G3KNL). Mr. Kippin, G8PL, brought along a large number of pre-war QSL cards and certificates to show the members.

On June 24th the Society was active on G3PAD and also had an exhibition of home-made equipment.

SHEFFIELD AMATEUR RADIO CLUB
Hon. Sec.: D. R. A. Hill, 16 Tylney Road, Sheffield 2.

The two technical lectures will be held during October and December at the Dog and Partridge Hotel, Trippett Lane, Sheffield 1. They are to be held on the second Wednesday of each month.

The October lecture will be on High Power Transmitters and will be given by Dr. Kaiser Department of Physics, Sheffield University; and the December lecture will be given by Mr. Lyon, and is entitled "New Receiver".

SOUTH YORKSHIRE AMATEUR RADIO SOCIETY
Hon. Sec.: E. Brailsford, G3PAF, 15 Ayrsome Walk, Cantley 4, Doncaster.

The Society continues to increase its membership, and is now on the air as G30WK. Members recently saw two Mullard films at the Club room.

An Intercom Amplifier

(Continued from page 405)

Pin 1 on each valve base should be earthed to chassis.

Testing

When construction is complete and the wiring has been checked against the diagram, test with a meter between C7 and chassis that there are no shorts in the H.T. circuits. If all is well, apply power and check that the proper voltages appear at the valve electrodes. R10 can then be connected to the output transformer and if this causes oscillation, the connections to either the primary or secondary of the output transformer should be reversed to make the feedback negative. Orientate T1 to the position of minimum hum and bolt it to the chassis; hum should then be inaudible 6in. from the speaker when the primary of the input transformer is short circuited.

Operation

The external lines should be unshielded and if an earth connection is used, and it is not essential, it should be to the amplifier chassis only. In this way, interference which may be present is picked up on both transmission lines equally and is cancelled out in the primary of T1. Ordinary lighting flex is very satisfactory for distances up to about 50ft but for longer runs, a cable of lower D.C. resistance is desirable. The signal source may be a moving coil microphone but a small moving coil speaker is equally satisfactory and much cheaper.

Talk-back Facilities

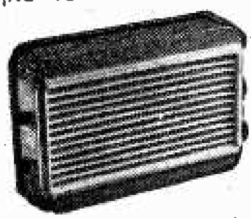
For intercom service, talk-back facilities will be required and may be arranged quite simply with the circuit of Fig. 3. The switch should be a double-pole change-over component preferably of the key type, but, if this is not obtainable, an ordinary rotary switch can be modified by removal of the locating device and the addition of a spring-loaded arm as shown in Fig. 5, so that it will automatically return to the "Listen" position after use. Communication to any number of distant points can of course be established by including a multi-way switch in the transmission line at point X in Fig. 3. ■

PORTABLE RADIO OR CAR RADIO

PUSH-PULL SIX

(6 Ediswan Transistors plus 2 Diodes)

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. Miniature 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.

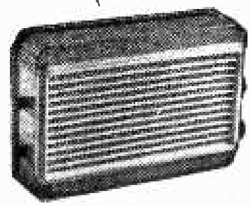
Total building cost **£6.19.6** P.P. 2/6. Size 6¼ x 4¼ x 1½in.

"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.

ALL PARTS SOLD SEPARATELY

NEW PUSH-PULL FIVE

(MW/LW and TRAWLER BAND)
(5 Ediswan Transistors)



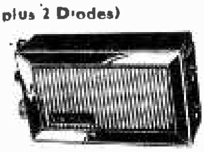
Now greatly improved. Sensitive FERRITE ROD AERIAL. Pale blue polystyrene case with speaker grilles in red. Volume/sensitivity control. Miniature push-pull transformers. 350 Mw XC101's in push-pull. Sensitivity R.F. stage for station selection.

Total building cost **£5.7.6** P.P. 2/6

ALL PARTS SOLD SEPARATELY

TRANSONA-4

(4 Ediswan Transistors, plus 2 Diodes)

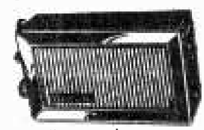


Miniature speaker. **FERRITE ROD AERIAL.** MW/LW and Trawler Band coverage down to 80 metres On test tuned in many stations. This sensational new radio is simple to build with our easy-build plans. Handsome pocket case.

May be built for **65/-** P.P. 2/6

Push-Pull Pocket Six

MEDIUM AND LONG WAVES AND 400 TO 750 METRES 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.**

All parts cost **£5.19.6** P.P. 2/6

ALL PARTS SOLD SEPARATELY

NEW ! POCKET RADIO

(5 Ediswan Transistors and 2 Diodes)

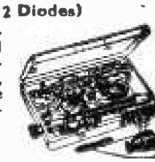
MEDIUM, LONG WAVE AND TRAWLER BAND TO 80 METRES. Designed round super sensitive ferrite rod aerial and 3in. speaker. Home and Continental stations at your finger tips. Attractive 2-tone pocket size case in gleaming polystyrene. No aerial required. Many stations listed test receiver. Easy-build plans for beginners. Powered by 4½ volt battery.

Total cost of parts required. **£4.19.6** P.P. 2/6

ALL PARTS SOLD SEPARATELY

New ! Easy Build Three Radio

(3 Ediswan Transistors plus 2 Diodes)



Easy to build, easy to operate. This transistor radio operates over the M.W. and L.W. extending down to 80 metres without coil changing. Ferrite rod aerial, volume-sensitivity control. Sonotone high fidelity miniature earpiece or miniature speaker.

May be built for **49/6** P.P. 2/6

Ferrite Rod Aerial, M/L wave (7in.)	8/6
Ferrite Rod Aerial, M/W (4in.)	5/-
Transformers: 300 ohms primary, 5 ohms secondary Brand new boxed	3/6
High Fidelity Headphones with miniature earpieces and transformer with lead and jack plug for high or low impedance, matching. Brand new. Boxed	25/-
Sensitive balanced Armature Headphones. Boxed, brand new	pair 9/-
Sensitive 2½in. Speakers. Only ⅞in. deep, 3 ohm	16/6

DATA SHEETS AND PARTS PRICE LIST FOR THE ABOVE 1/3 EACH

ALL PARTS SOLD SEPARATELY

AFTER SALES SERVICE

RADIO EXCHANGE COMPANY

27 HARPUR STREET, BEDFORD

(Opposite Co-op)

PHONE 2367

CLOSE 1 p.m. SAT.

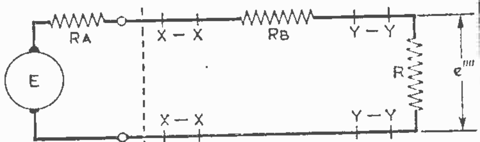
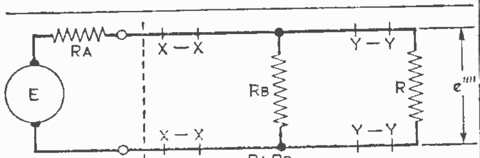
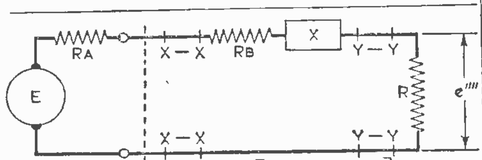
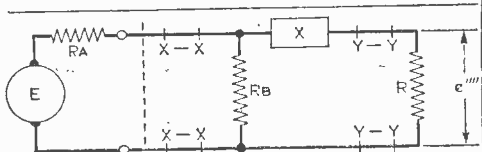
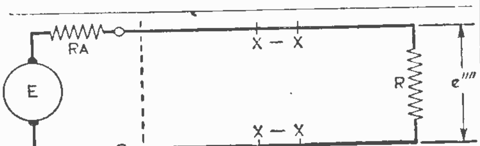
SIGNAL GENERATOR OUTPUTS

(Continued from page 315 of the August issue)

By R. Brown

THE output impedance of a signal generator can be changed, quite easily, with the aid of external impedances.

Supposing the required output impedance is greater than the actual signal generator impedance, the signal generator output impedance can be increased to the new value by connecting a resistance R_B in series with the output lead. R_B must have a value such that $R_B + R_A$ is equal to the required output impedance. Under these

Output Connections	Required Output Impedance Ro or Zo	Value of Extra Resistor R_B	New Source EMF	Voltage Developed Across Load R
 $R_O = R_A + R_B$	Resistive $R_O > R_A$	$R_O - R_A$	E	$\frac{R}{R_A+R_B+R}.E$
 $R_O = \frac{R_A R_B}{R_A + R_B}$	Resistive $R_O < R_A$	$\frac{R_O . R_A}{R_A - R_O}$	$\frac{R_B}{R_A+R_B}.E$	$\frac{R.R_B}{R.R_B+R_A.R_B+R.R_A}.E$
 $R_O = R_A + R_B$ $Z_O = \sqrt{[(R_A+R_B)^2 + X^2]}$	Resistive and reactive ($R_O + jX$) $R_O > R_A$	$R_O - R_A$	E	$\frac{R}{\sqrt{\{(R_A+R_B+R)^2+X^2\}}}.E$
 $R_O = \frac{R_A.R_B}{R_A+R_B}$ $Z_O = \sqrt{\left[\left(\frac{R_A.R_B}{R_A+R_B}\right)^2 + X^2\right]}$	Resistive and reactive ($R_O + jX$) $R_O < R_A$	$\frac{R_O . R_A}{R_A - R_O}$	$\frac{R_B}{R_A+R_B}.E$	$\frac{R}{\sqrt{\left\{\left(R+\frac{R_A.R_B}{R_A+R_B}\right)^2+X^2\right\}}}.E$
 $R_O = R_A$	Resistive $R_O = R_A$	—	E	$\frac{R}{R_A+R}.E$

The connecting cable X-X should have a characteristic impedance equal to R_A. Y-Y should have a characteristic impedance equal to R_O. (or Z_O).

Fig. 4.—Altering the signal generator output impedance. For convenience X may be connected at load end of Y-Y, which should then have a characteristic impedance equal to R_O.

conditions the source EMF will have the same value, E, as before: but the voltage developed across a load, R, will now equal:

$$\frac{ER}{R_A + R_B + R} \qquad (1)$$

A reduction in the signal generator output impedance can be achieved by connecting a suitable value resistor, R_B, directly across the signal generator output. The value of R_B is chosen so that the parallel combination of R, and R_A,

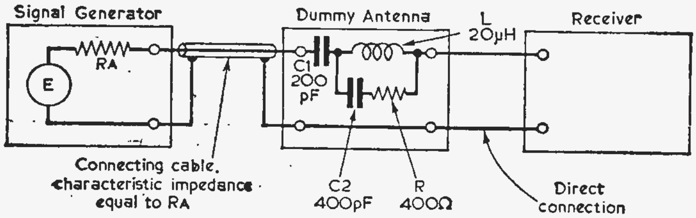


Fig. 5.—Connecting a signal generator to a broadcast band receiver.

$R = R_B.R_A/(R_B + R_A)$ is equal to the desired output impedance. The source EMF is now given by:

$$E = \frac{R_B}{R_B + R_A} . E \qquad (2)$$

The voltage developed across a load, R, will be given by:

$$e = \frac{R_B.R}{R_B + R} \times \left(\frac{R_B + R}{R_B.R} + R\right) \times E$$

or

$$e = \frac{R.R_B}{R.R_B + R_A.R_B + R.R_A} . E \qquad (3)$$

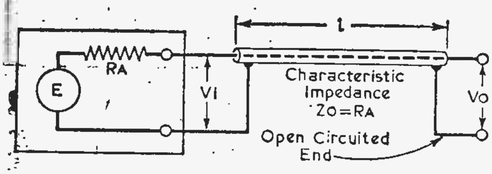


Fig. 6.—The effect of connecting cable. Here the cable has a characteristic impedance equal to R_A, and its far end is open circuited (see text).

If the required output impedance is to be reactive and resistive then a suitable reactive component may be connected in series with the output. These results are summarised in the chart Fig. 4. The connections marked X—X and Y—Y are usually coaxial cables, and the correct value for their characteristic impedance will be discussed later.

Connecting the Signal Generator to Low Frequency Receivers

As has already been mentioned, low frequency receivers usually operate from non-resonant aerials; aerials which present an impedance which has a resistive and a reactive component. This type of aerial can be effectively simulated by connecting the signal generator to the receiver via a network which has an impedance equivalent to the aerial impedance. A standard network, called a dummy aerial, is shown in Fig. 5. This, with the output impedance of the signal generator, effectively simulates a broadcast band aerial.

The Connecting Cable

The signal generator is usually connected to the receiver with a length of coaxial cable. This cable does not need to be terminated in a resistance equal to its characteristic impedance. It must, however, have a characteristic impedance equal to the signal generator output impedance.

That this is so can perhaps best be seen with the aid of Fig. 6. This shows a signal generator, to the output of which is connected a length 'l' of coaxial cable. The far end of this cable is open circuited. It has a characteristic impedance equal to R_A. Now, it can be shown, that if such a cable is "loss-less", then the voltage Vi developed across the input end will be given by:

$$Vi = E \cos\beta l \qquad (5)$$

where β is the phase constant ($2\pi l\lambda$) of the cable.

It can also be shown that the voltage Vo at the end of such an open-circuited line is given by:

$$Vo = Vi/\cos\beta l$$
$$= E\cos\beta l/\cos\beta l$$
$$\text{Therefore, } Vo = E \qquad (6)$$

In other words the source EMF is still E volts even though the cable is unterminated.

If we now look back along the cable from the far end we see a line of characteristic impedance Zo terminated in a resistance R_A. But R_A=Zo. So we are looking at a cable which is correctly terminated. The impedance we see looking back from the far end of the cable is therefore R_A.

Thus provided the cable does have the correct characteristic impedance, the receiver, or other

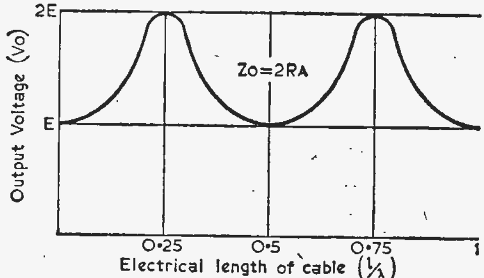


Fig. 7.—The cable output voltage for an open circuited cable which has a characteristic impedance equal to $2R_A$.

equipment, to which the signal generator is connected will still see a generator of E volts in series with a resistance R_A.

(Continued on page 422)

RECORDING FROM THE RADIO

By J. B. Dance

AVOIDING HUM AND DISTORTION

TAPE recorders do not normally have built-in radio receivers. When one wishes to record a radio programme, it is, therefore, necessary to feed a signal from a receiver into the input of the tape recorder through a length of cable which may have to be fairly long. It is preferable to use coaxial cable.

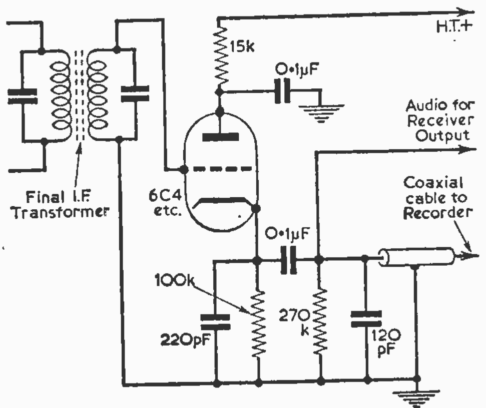


Fig. 1.—The cathode follower detector.

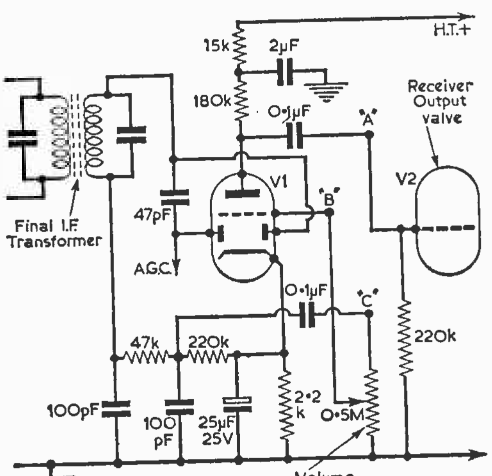
Signal Supply Point

It is common practice to take the signal from the external speaker terminals of the radio receiver or (if no such terminals are fitted) the signal may be taken from the output side of the speaker transformer. Although a low impedance output is conveniently obtained by this method, it necessarily means that any distortion in the receiver output valve or in the speaker transformer will be present in the recording. Most radio receiver distortion usually occurs in the output stage unless the receiver is an expensive one.

On the other hand, it is not wise to connect a length of coaxial cable to the detector output or to the anode of an audio amplifier which is in the radio receiver (via a D.C. blocking condenser), because the capacity of the cable will severely affect the high frequency response.

Cathode Follower Detector

If a radio receiver is being constructed so that it can be used to feed a tape recorder, a cathode follower detector may conveniently be used. This circuit, which is shown in Fig. 1, has a low output impedance and can be used to feed a tape recorder through a long length of coaxial cable without high audio frequency attentuation. The circuit



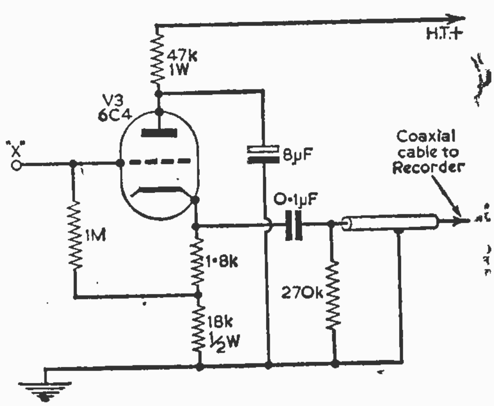


Fig. 2.—The circuit on the right is a cathode follower audio stage which may be added to a receiver the existing circuit of which is shown in the left-hand diagram. Point "X" should be connected to one of the points "A", "B" or "C".

has the additional advantages that it does not appreciably load the previous tuned circuit and maximum selectivity and gain are therefore obtained. The distortion given by the cathode follower detector is very low. Almost any small triode or triode connected pentode, e.g. the 6C4 triode, can be used as the detector valve in the Fig. 1 circuit.

Cathode Follower Stage

If it is required to feed a tape recorder from an existing receiver, the substitution of a cathode follower detector for the common diode detector would involve re-alignment of the receiver. This can be avoided by the use of an additional cathode follower audio stage in the receiver.

Assuming a diode detector is used in the usual double diode triode circuit shown in Fig. 2, the audio output may be taken from one of the points marked A, B and C in the circuit and fed into the point marked X. The component values shown in the left-hand circuit of Fig. 2 are typical, but will vary slightly from receiver to receiver.

If the point X is connected to the point A, considerably more amplification will be obtained than if it is connected to the point B or point C. The receiver volume control will affect the tape recorder input if the connection is made to point A or B, but it is probably more convenient to connect point X to point C so that the receiver volume control does not affect the recording level.

Double Triode Circuit

Those readers wishing to use the double triode ECC82 (or the 6SN7 or 12AU7) may find the Fig. 3 circuit convenient. The first triode is an ordinary amplifying stage which is directly coupled to the grid of the second stage. The positive voltage applied to this grid (about 100) is counteracted by a slightly greater positive voltage on the cathode owing to the flow of the anode current through the large cathode resistor. The difference

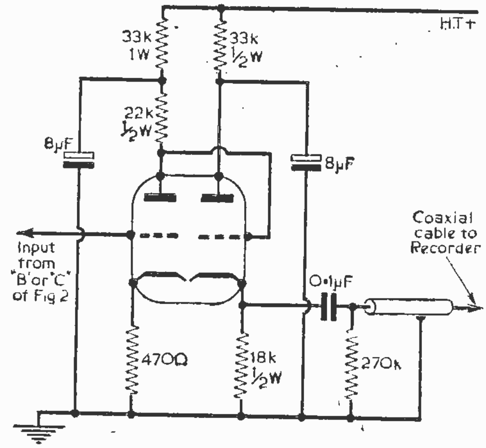


Fig. 3.—A double triode as amplifier and cathode follower.

between these voltages provides the bias for the second triode. The input can be taken from points B or C of Fig. 2. The audio voltage at point A is too large for connection to the input of the Fig. 3 circuit.

With the circuits shown, the signal can be fed into a very long length of coaxial cable, and hence to the recorder, without the high frequency response being noticeably affected. The circuits must be placed in the radio receiver and not in the tape recorder. When the circuit of Fig. 2 or Fig. 3 is used, the lead from the audio take-off point (A, B or C) to the additional valve circuit should not be more than about three inches long—shorter if possible. Care should be taken to ensure that there is only one earth connection between the receiver and recorder; this is the outer connection of the coaxial cable. ■

SIGNAL GENERATOR OUTPUTS

(Continued from page 418)

There will, of course, be standing waves on the cable (except when the load equals R_A), but provided the cable introduces negligible losses, this will not cause any error. The cable will not normally introduce losses, for the signal generator will be close to the equipment under test, and the cable will be very short.

Incorrect Cable Impedance

The incorrect reading of the signal generator attenuator, and an incorrect connection to the equipment under test can certainly result in errors in measurements. The cause of these errors is often difficult to find. A graph is shown in Fig. 7 giving the variations in the cable output voltage with length, when the cable has a characteristic impedance equal to $2R_A$. The output impedance seen by the equipment under test will also be wrong with this condition, and it does not need much imagination to picture the completely incorrect and probably baffling results which could be achieved. Provided reasonable care is taken, however, one can usually be sure what output voltage the signal generator is giving, and what its output impedance is. ■

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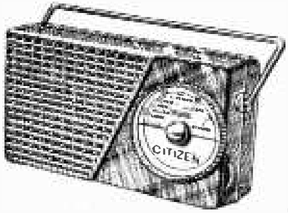

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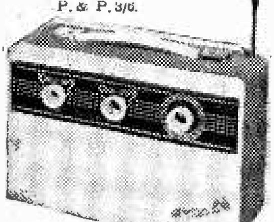

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Converting the TRF Transistor Four to L.W. Tuning

By D. SAULL

A SIMPLE MODIFICATION TO THIS P.W. SET TO ALLOW RECEPTION ON THE LONG WAVE BAND.

THE four transistor TRF receiver featured in the June 1960 issue of PRACTICAL WIRELESS was described as simple to construct and therefore particularly suitable to the newcomer to transisitor circuits. For simplicity, medium waveband tuning only was included, and this arrangement is entirely satisfactory for readers living equidistant from the transmitters covering the Light and the Home programmes on the medium waveband. However, in areas where it is the usual practice to receive the Light programme on the long waveband, medium waveband tuning only restricts the usefulness of the receiver, and details are given here of how best to modify the original design, in order to accommodate both wavebands. The modification necessitates introducing a four-pole, two-way, switch into the circuit, which may be the circular type (1¼in. in diameter) and also an additional L.W. R.F. transformer.

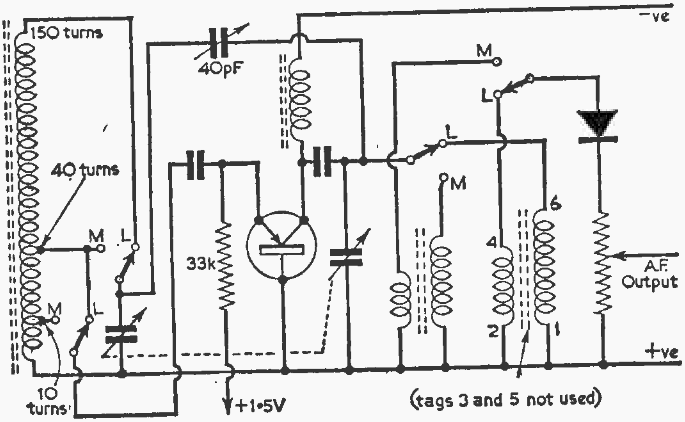

Fig. 1.—The arrangement of the second tuned circuit. The L.W. Coil used is a Teletron HLX.

The Construction of the Aerial Coils

There are three methods of constructing the aerial coils: winding the coils for both wavebands on the same ferrite rod; winding the medium-wave coil on the ferrite rod and winding a separate frame aerial to cover the long-wave tuning; or winding the long-wave coil on the ferrite rod and winding a separate frame aerial to cover medium-wave tuning. If either of the last two methods is used, the choice between them is determined by the weakest signal strength in a particular area—a frame aerial has greater sensitivity to weaker signal strengths.

In the first method, where both coils are wound on the same ferrite rod, the medium-wave coil forms parts of the winding of the long-wave coil. When the wave-change switch is turned to the medium-wave position, the long-wave section of the coil is left floating. This section of the coil has an inductance of about 2·2mH and requires only a 10pF parallel capacitance to resonate at 1·2Mc/s, which is the wavelength of the Light programme on the medium waveband. Should this section of the coil, when not in circuit, so resonate—being tightly coupled through the ferrite rod to the medium-wave tuning section of the coil—it will result in heavily loading the medium-wave coil and will render the 1·2Mc/s tuning section inoperative. The self capacity of the wave-change switch will be about 3pF, and the single-layer wound aerial coil will also possess a little self capacity—hence the stray capacity of the wiring in the circuit must be kept to an absolute minimum if trouble is to be avoided. This may be achieved by keeping the connecting lead from the top end of the long-wave coil to the switch as short as possible. To achieve this, the wave-change switch should be mounted directly beneath the ferrite rod—the switch control spindle may then extend to the rear of the receiver cabinet.

The Method of Winding the M.W. and L.W. Coils on the same Ferrite Rod

The dual-wave coil consists of 150 turns of 34s.w.g. double silk covered wire, close wound in a single layer on the former that should be a sliding fit on the two ferrite rods; the coil is tapped as shown in Fig. 2. The former is made by winding a strip of thick paper, two inches wide, three times round the ferrite rods, adhesive having first been applied to the surfaces in contact. A piece of similar paper wrapped round the ferrite rods beforehand

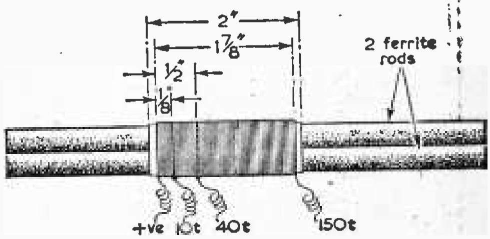

Fig. 2.—The winding details of the dual-wave coil.

will ensure a little clearance, so that the finished former is free to slide on the ferrite rod when the under piece is removed.

The gauge of wire is not critical, and it is not important that double silk covered wire is used—enamelled covered wire would function electrically. However, the best conditions prevail if the given specifications are adhered to—and the guide to the physical measurements, in Fig. 2, may then be followed.

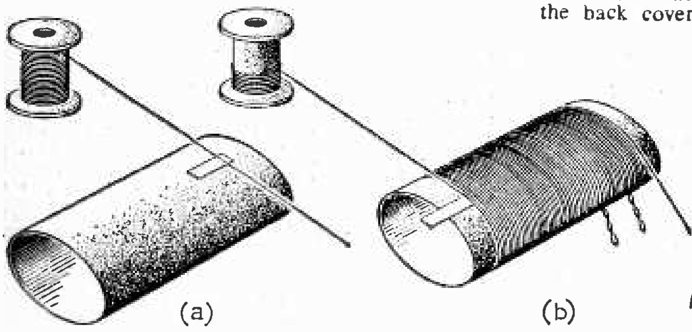

Fig. 3. (left)—The method of winding the coil on its former.

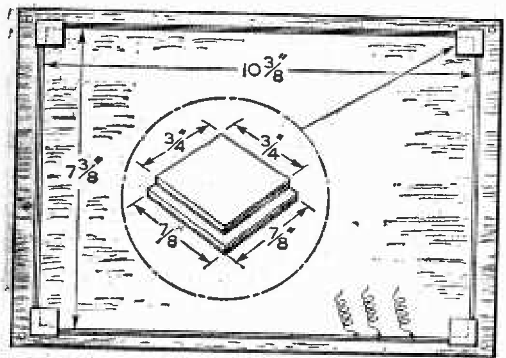

Fig. 4.—This shows the way in which the frame aerial is wound on to the inside of the back of the receiver.

The taps on the coil are formed by making a loop in the wire and twisting together the pair thus formed: then carry on winding.

A convenient method to wind the coil is to cut a narrow piece of Sellotape to a size about ¼in. x ½in. to form an anchoring tab. Then wrap the extreme end of the tape round the wire and attach the wire to the former (Fig. 3a) by means of the remaining length of adhesive tape. Successive turns of the winding will hold the tape firmly in position. Likewise, slip a piece of tape, the same size as before, underneath the wire (adhesive side uppermost) about 15 turns from the completion of the winding (Fig. 3b). When the final turn has been wound on, pull the extruding length of tape upwards and back over the top of the winding. A coating of varnish over the entire winding will hold it secure, but first remove the former from the ferrite rods, otherwise it may stick to the rods. The ferrite rod aerial may then be connected, and the position of the coil on the rods adjusted to give the best results. This position will most likely be in the centre.

Winding the M.W. and L.W. Coils Separately—One on a Ferrite Rod—the Other as a Frame Aerial

If the L.W. coil is to be wound as a frame aerial, the existing M.W. winding on the ferrite rods need not be disturbed. If the L.W. coil is to be on the ferrite rod, then wind the coil as in the first method, omitting the 10-turn tap.

The frame aerial may be wound on the inside of the back cover of the receiver cabinet; the size should be about 7⅜in. x 10⅜in. The coil is wound round four blocks, ¾in. square, cut from hardboard and cemented to the inside of the back cover of the receiver; four larger blocks, ⅞in square, also cut from hardboard, are cemented on top of the former blocks, to prevent the wire from sliding off (Fig. 4).

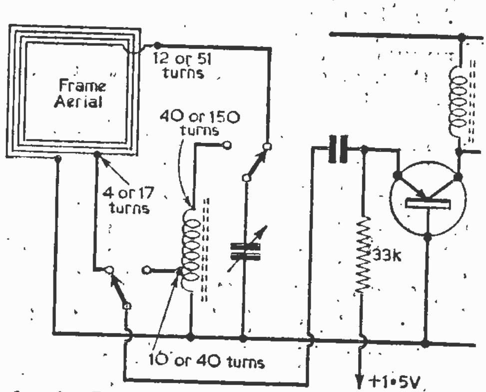

Fig. 5.—This shows the method of connecting the frame aerial in circuit.

For medium-wave tuning, the frame aerial consists of 12 turns of 34s.w.g., d.s.c., wire tapped at 4 turns; for long-wave tuning, 51 turns of the same type wire is tapped at 17 turns, connected as in Fig. 5.

The Second Tuned Circuit

The arrangement of the second tuned circuit remains identical for the three methods; and is shown in Fig. 1.

The L.W. coil used is a Teletron HLX.

Ascertain that connecting wires in the first and second tuned circuits of the receiver are not in close proximity, which would result in instability.

The method of aligning the receiver is the same as that described in the June 1960 issue, but in the first instance make sure that the 40pF reaction capacitor is fully out and then slowly turn in to increase the positive feed-back until the best results are obtained once the required signal is heard.

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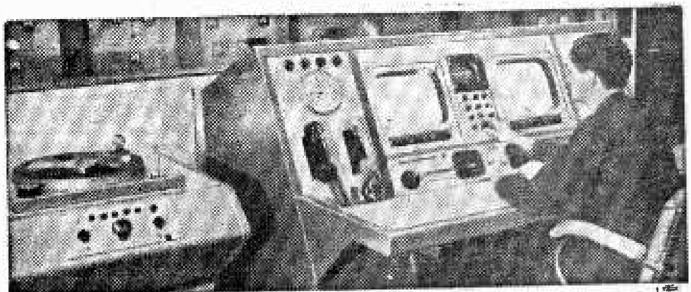

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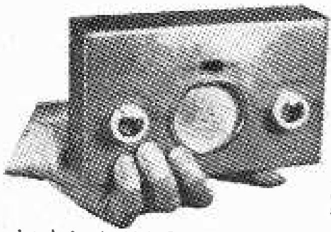

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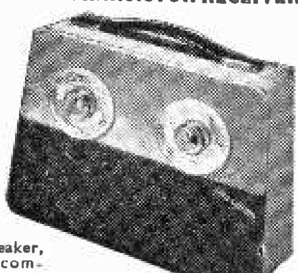

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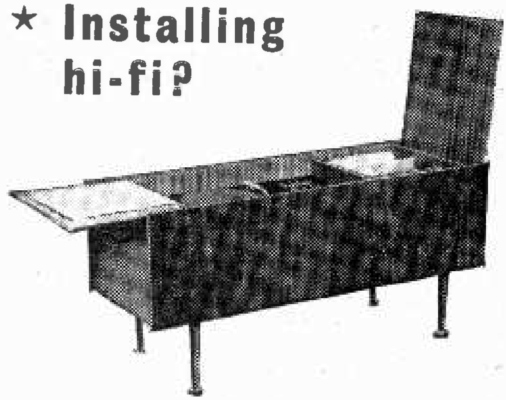

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Letters to the Editor

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.

TRANSMITTER LICENCES

SIR,—Surely we have not started that stupid business about low-power transmitter licences again? Mr. Dick's letter in the July issue seems to point to this. To own a "ham" transmitter licence is a privilege, not a right, and it seems only fair that one should earn this privilege by taking the G.P.O. examination. As for saying that only a simple test, if any, would be required, is ridiculous; the present test does not seem all that difficult.

Regarding his wish to abolish the morse test for inputs of under one watt, I should have thought that morse was the only way to achieve a reasonable range with this type of equipment. Moreover, if this test were abolished, there would be dozens of irresponsible people using ex-government transceivers, which, among other things, are by no means TVI-proof.—M. J. REDMAN (Brighton).

SIR,—I have read with interest the great deal of correspondence which you have published recently on the subject of novice licences.

It has been my ambition for the last three years to obtain an amateur transmitting licence, and at last I have taken the Radio Amateurs Examination, and am now striving to attain the morse sending speed necessary for the G.P.O. test. If, and when, I finally obtain my licence, I shall feel justified in using the frequency bands allocated to amateurs. I have been asked by many people studying science subjects what justification amateurs have in using parts of the precious frequency spectrum for their own pleasure. I then proceed to tell them that at least the amateur has a knowledge of morse, which might be valuable in an emergency.

If novice licences or special concessions to "phone-only" operators were permitted in this country, the people who have to defend the amateur's cause would have no argument for the continued existence of amateur bands.

It takes three years as an SWL to become really familiar with amateur procedure, and anyone who cannot accumulate enough knowledge in that time to pass the RAE cannot be really interested in amateur radio.—D. A. PARK (Bagshot).

ITV SOUND

SIR,—The reception of TV sound on a radio receiver, as described by B. Quest (July issue) can sometimes be caused by the sound channel of a local TV station interacting with part of the lower vision side-band to form an intermediate frequency; similar to the I.F. generated in a frequency changer.

Reception of such a signal can only be on a sensitive TRF receiver; not with a superhet. This effect disappears below 1Mc/s—750kc/s, this being the separation between the furthest sound and vision signals, and it should disappear altogether when the vision carrier is not modulated. — C. BARNES (Cheshire).

VINTAGE MODELS

SIR,—I was not surprised to read in the July issue of P.W. a letter from Mr. A. V. Newman expressing his pleasure on hearing a friend's 1934 radio.

The pleasant tone of these vintage sets is a phenomenon not met in these days of "high fidelity".

I would not care to open any discussion on the merits or demerits of high fidelity in these columns—it would rage on indefinitely—but the pleasure derived from listening to music on the old faithfuls is almost entirely due to the absence of the more irritating top frequencies and the presence of a measure of "woofiness" from the larger cabinets with their uncontrolled resonances. —W. J. HUNTINGFORD (Guildford).

CORRESPONDENTS WANTED

SIR,—I am 15 years old and I am very interested in radio and TV construction and theory. I would therefore like to correspond with any other readers of the same age.—H. JOHNSTONE (2 Fox Hill, Distington, Cumberland).

DISHEARTENED SWL

SIR,—Being one of the "younger SWL's set", and after reading in several books that local hams are always ready to help SWLs, I decided to visit a nearby operator.

The books could not have been more wrong! He considered that SWLs were maniacs, forgetting that he was once one himself.

I can only hope that not all amateur radio enthusiasts hold similar opinions.—E. L. W. (Cheshire).

THREE FREE BLUEPRINTS

WITH the October, November and December issues we are presenting free blueprints intended to teach the beginner the fundamentals of practical radio construction and also to enable him to build useful receivers for his own use. The final design will be a transistorised superhet tuner unit with an amplifier which may also be used with a battery-operated record player.

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A Wobbulator for F.M. I.F. Alignment

(Continued from page 410)

The circuit of the instrument is shown in Fig. 1. A signal derived from the X-detecting plates of the oscilloscope is fed to V1A which is arranged in a cathode-follower circuit. The silicon-junction diode is connected from the cathode load of this valve to the tuned circuit of the oscillator, which is set to give a centre (unmodulated) frequency of 10·7Mc/s. The voltage across the cathode resistor (R4) also provides the reverse bias necessary for the diode. The decoupling condensers C2 and C3 are given large values to ensure that the timebase waveform suffers negligible distortion in passing through V1A.

Although the second half of V1 is not used in the circuit, it is given a feed from the H.T. so that a current passes through it all the time that the unit is switched on; this avoids "cathode poisoning" or loss of emission in V1B.

The 10·7Mc/s oscillator is provided by V2A and the circuit values are so arranged that the frequency of operation is 10·7Mc/s when there is no input to V1A. This centre frequency is set by altering the setting of a dust core in the former of coil L1.

(To be continued)

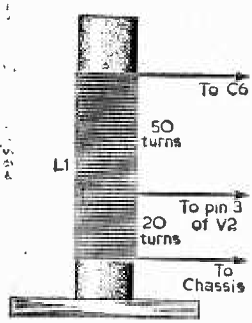

Fig. 4.—Details of the coil windings (on ¼in. former with dust core).

COMPONENTS LIST

Resistors:

R1 10M	R4 6·8k	R7 22k	R10 220Ω	R13 10M
R2 1M	R5 100k	R8 4·7k	R11 470Ω	VR1 2M
R3 220Ω	R6 100k	R9 1M	R12 1k	VR2 10k or 25k

Capacitors:

C1 0·25µF 350VW Paper	C7 50pF Ceramic
C2 32µF 350VW—Daly W3 13-10	C8 1000pF Ceramic
C3 32µF 350VW—Daly W3 13-10	C9 1000pF Ceramic
C4 1000pF Ceramic	C10 0·01µF Paper 250VW
C5 1000pF Ceramic	C11, C12 16, 16µF 350VW—Daly W2/39/10
C6 20pF Ceramic	

Valves: V1A and V1B ECC81 V2A and V2B ECC81

Diode: D1 SVC1 GEC Semiconductor Division, School Street, Hazel Grove, Stockport, Cheshire

Chassis: 6in × 4in. × 2½in., approximately

Coil: This is wound on a ¼in. internally threaded coil former and details are given in Fig. 4. A dust core is required.

Sundries: Two B9A valveholders, tag strips, mains switch, wire, etc.

Transformer: Mains primary, 180V to 250V H.T. secondary, 6·3V 1A winding for heaters. (A "converter" transformer is very suitable.)

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Note that the value of R12 may require to be altered to ensure that the H.T. line voltage does not exceed 190.

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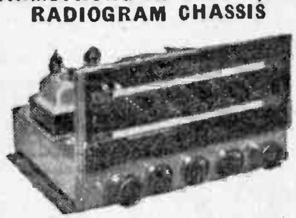

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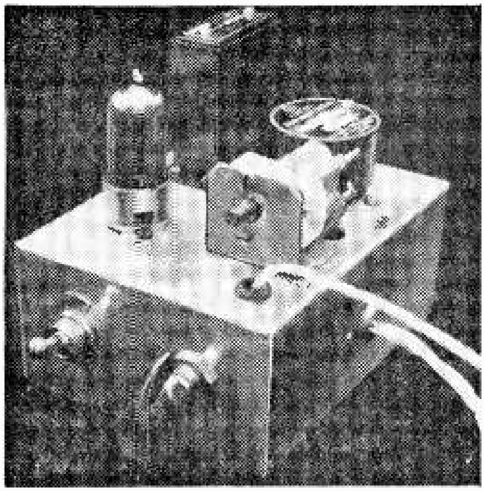


A crystal frequency marker

By J. Longwood

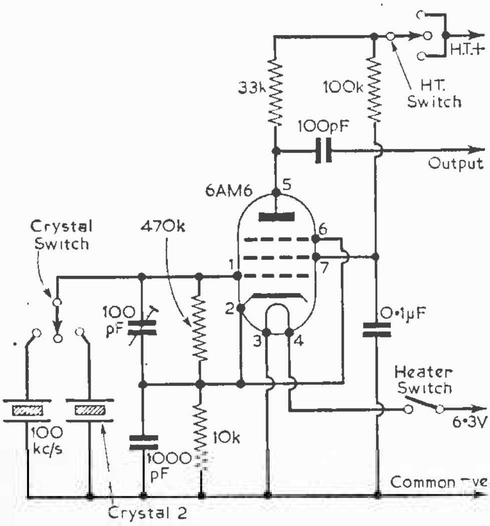


Fig. 1.—The circuit of the unit.

CRYSTAL frequency markers are intended to give frequency check points over a wide range, so that receivers or signal generators may be accurately calibrated. The marker described here has a useful coverage of 100kc/s (3,000m) up to about 15Mc/s (20m) or more, the maximum frequency depending on the sensitivity of the receiver.

The Circuit

The circuit is shown in Fig. 1, and any high slope, R.F. type pentode may be used instead of the 6AM6. With some valves pin connections will of course be different, while octal valves will require an octal holder instead of the miniature holder. Two crystals are provided for, but it is perfectly in order to use a single crystal only, as will be explained. The current required by the valve may usually be drawn from the receiver. The marker may be permanently connected—the heater switch being opened when it is not required. In addition to the heater switch, the 3-way rotary switch, which allows either crystal to be selected, has a central "off" position which interrupts the H.T. circuit. This allows the marker to be turned off and on again without waiting for the heater to reach working temperature. It also allows the marker signal to be interrupted at any time, so that it can be easily distinguished from other carriers which may be heard on crowded S.W. bands.

Operating Details

Constructors who have not used a crystal marker will probably find details of the method of operation useful. When the 100kc/s crystal is in circuit, the output from the marker is at 100kc/s and multiples of 100kc/s. As example, its signal will be heard at 200kc/s (1500m), 300kc/s (1000m) and so on. In terms of wavelength, the marker signals are widely spaced on long waves, but much closer together on medium waves, and closer still on short waves. As 100kc/s is the same as 0·1Mc/s, the signal will be heard at 0·1Mc/s intervals troughout M.W. and S.W. bands. For example, on the M.W. band of about 600kc/s to 1500kc/s, the marker signal will be present at 600, 700, 800, 900 and 1000kc/s, and 1·1Mc/s (1,100kc/s), etc., up to 1·5Mc/s (1,500kc/s). The same result is obtained on S.W. bands. Harmonics become weaker, and this sets the upper limit at which the marker signal can be heard. With a highly sensitive receiver, harmonics may be heard up to 30Mc/s (10m).

Receiver Calibration

For receiver calibration, the appropriate marker harmonics are tuned in, and the receiver scale is drawn up to agree, or the dial readings are noted down. For example, marker signals at 3·5, 3·6, 3·7 and 3·8Mc/s will accurately set the limits of the "80m" amateur band. Medium wave tuning scales, or commercial S.W. bands, can be calibrated in the same way.

In the unit shown, crystal 2 was a 1750kc/s crystal. When in circuit, this gives marker signals at 3·5Mc/s, 7Mc/s, etc., in addition to the fundamental (1750kc/s), for easy identification of amateur bands, with any receiver. Almost any crystal which may be to hand can be used for a somewhat similar purpose. It is also quite usual to have a 1Mc/s crystal, to give tuning points at 1Mc/s intervals, the 100kc/s crystal then being used to fill in the 0·1Mc/s tuning points between those obtained with the 1Mc/s crystal.

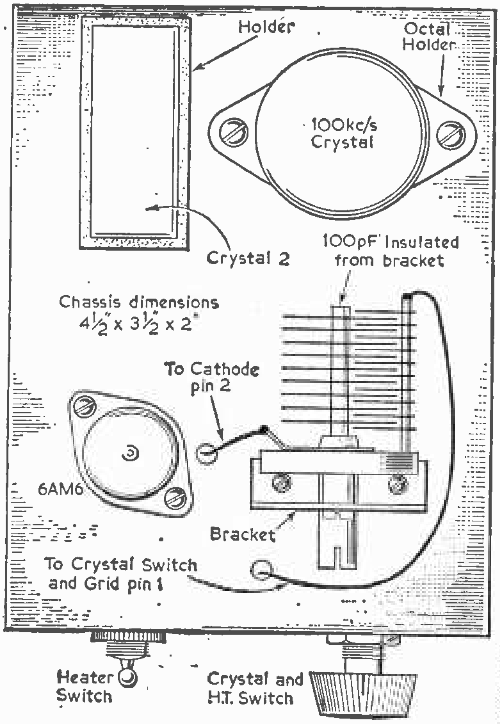


Fig. 2 (above).—Above chassis view of the marker.

It is perfectly in order to omit the second crystal and change-over switch. This will not in any way influence the accuracy of calibration at 100kc/s intervals, but will mean that the 100kc/s marker signals will have to be counted off fairly carefully; or known stations or bands will have to be tuned in, to identify the particular harmonic.

Unit Construction

Dimensions and layout are of little importance, but a small chassis about 3½in. x 4½in. x 2in. deep will be convenient. Fig. 2 shows a suitable layout. The 100pF variable condenser, which is used for exact frequency setting of the 100kc/s crystal, must be insulated from the chassis. This can be done by having a clearance hole in the bracket, and using insulating washers. Some surplus condensers have mounting bushes isolated from the moving plates—if this is the case, insulating washers are unnecessary. The spindle is slotted to receive a screwdriver blade.

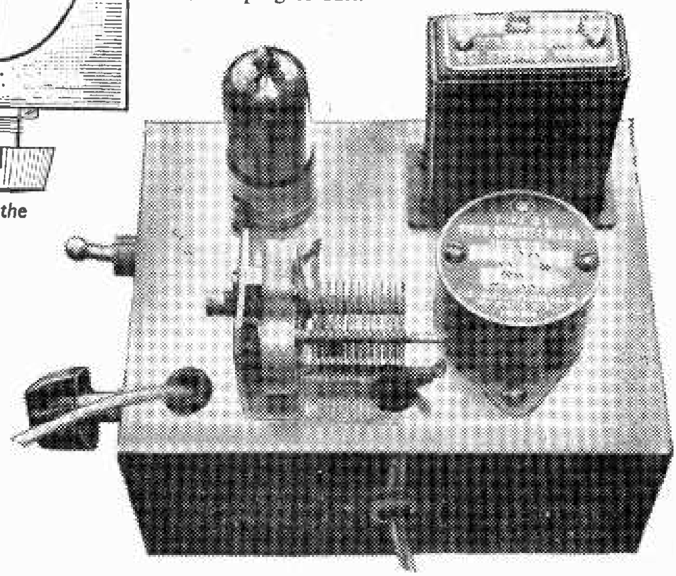
Fig. 3 shows underchassis wiring, the 3-way switch actually being mounted on the chassis runner. An octal holder is shown, for an octal based 100kc/s crystal, but the holder should of course suit the crystal to be used. The second holder was for surplus ¾in. spacing crystals.

A small tagboard provides anchorage for power supply leads, and some of the components. Power requirements are 6·3V, 0·3A for heater, and approximately 5mA at 200V to 300V for H.T. Wiring should be reasonably short and direct, and well insulated.

If the second crystal is not to be used, wire the 100kc/s crystal holder directly to the 100pF condenser fixed plates, and tag 1 of the B7G valveholder. A second toggle switch in the H.T. circuit will then allow the marker to be switched off, with heater running.

If a separate power pack is required, this can use a small converter or eliminator transformer, and metal rectifier. Two 8μF or similar smoothing condensers will be adequate, and the usual smoothing choke may be omitted, a 2k resistor being employed instead. In addition to about 250V for H.T., the transformer must have a 6·3V heater secondary.

When drawing power from the receiver, any convenient means of connecting the leads may be employed. It may be feasible to mount a socket on the receiver chassis, and to fit the marker leads with a plug to suit.



The Prototype Marker Unit

Frequency Adjustment

Crystal No. 2 is used for quick location of bands, with an entirely uncalibrated receiver, as described, and no attempt is made to adjust its frequency, as the 100kc/s crystal is used for actual, exact calibration. With the 100kc/s crystal, the 100pF pre-set condenser permits a very small shift in

(Continued on page 437)

(Continued from page 434)

frequency. The exact setting of this condenser can be found by beating the marker against the BBC 200kc/s (1500m) Light Programme, or against the National Physical Laboratory signal radiated on 2·5Mc/s. By this means, an extremely high degree of accuracy indeed can be reached.

If a new 100kc/s crystal is purchased and used with the parallel capacity setting specified by the maker, the standard of accuracy will be high enough for all practical purposes. But it is quite easy to check against one of the standards mentioned, so this is in any case worth while.

To set the 100kc/s crystal against the BBC 200kc/s transmitter (the frequency of which is maintained to high standards) it is necessary to arrange that the Light Programme signal and marker signal are of roughly the same strength. This can be done by removing the receiver aerial, or using a short piece of wire for aerial, and also by modifying the coupling between marker output lead and receiver aerial lead. An exact balance between signal strengths is in no way necessary, but adjustment will be difficult if one signal almost completely swamps the other.

With the receiver tuned to the Light Programme, and the marker working, a very low-pitched audio tone, or flutter, may be heard. This is the difference between crystal harmonic and BBC frequencies, and the 100pF trimmer is adjusted with an insulated blade so that the tone or flutter falls in frequency, and ceases.

If the receiver has a tuning eye or tuning meter, this will show fluctuations in signal strength when the marker tuning is almost exactly correct (say within 1c/s). If there is no eye or meter, a rise or fall in background noise or volume will be apparent. A higher standard of accuracy would be quite pointless for all normal purposes.

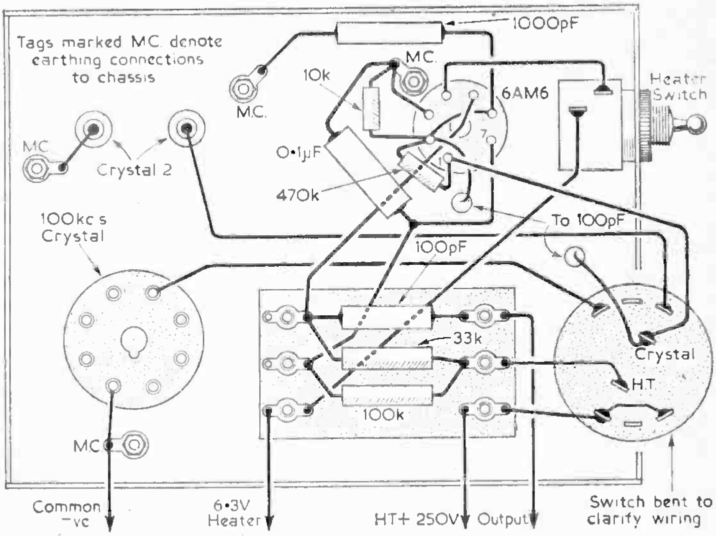


Fig. 3.—The wiring diagram of the crystal marker.

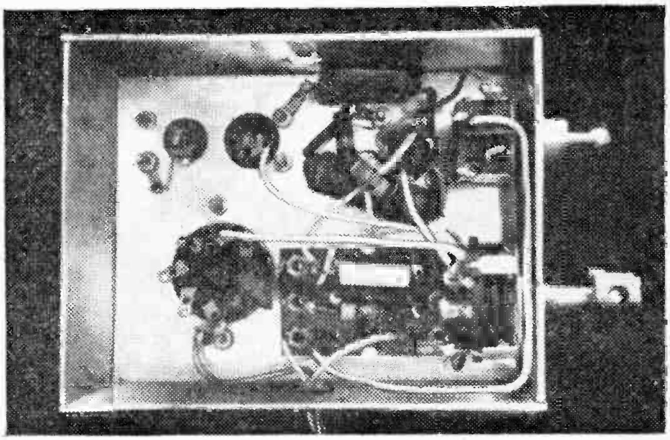
Receiver Calibration

The method of using harmonics has been described. Through the L.W. and M.W. bands, the marker signals will be very strong, and only loose coupling between marker output lead and receiver aerial input will be necessary.

For higher frequencies, the marker signal will be weaker, and tighter coupling will be required. It will be necessary to bring the marker output lead near the receiver aerial lead, or to twist it round a short insulated wire inserted in the receiver aerial socket. The receiver aerial may then be temporarily detached.

Tuning Indication

If the receiver has a tuning eye or meter, this will show fluctuations when the marker signal is tuned in. The marker signal is unmodulated. That is, it consists of a radio frequency carrier only, with no audible tone. With TRF receivers, the signals can be located by advancing reaction until the detector is just oscillating. The marker harmonics can then be tuned in at 100kc/s intervals, in the same way as broadcasting stations. A receiver with BFO (beat frequency oscillator) will make the harmonics audible in a similar manner.



An under-chassis view of the unit.

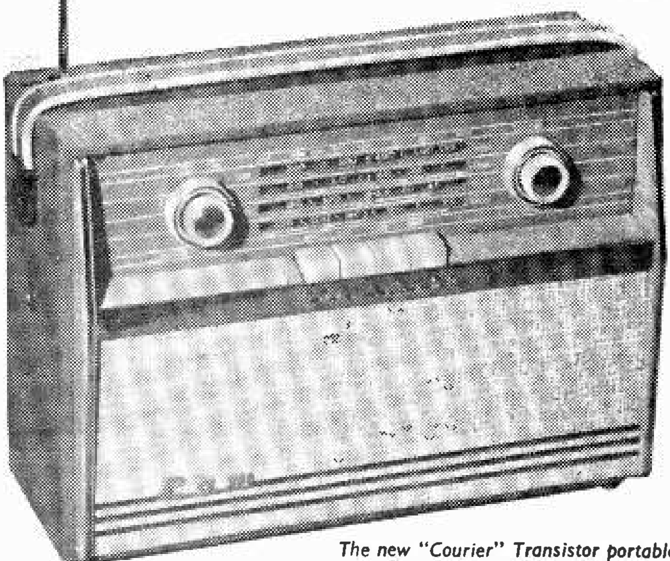
Trade News

NEW PORTABLE RECEIVER

FOUR wavebands are covered by the "Courier" receiver, which is made by Pam Radio and Television Ltd. It employs eight transistors and printed circuit chassis. Apart from the internal ferrite aerial for long and medium wavebands, a telescopic rod aerial is included.

Provision is made for connecting this set to a car aerial for use in a car.

700mW output is achieved from this receiver which weighs only 6lb 13oz. The price of the "Courier" is 25 guineas and it is made by *Pam Radio and Television Ltd., 295 Regent Street, London, W.1.*



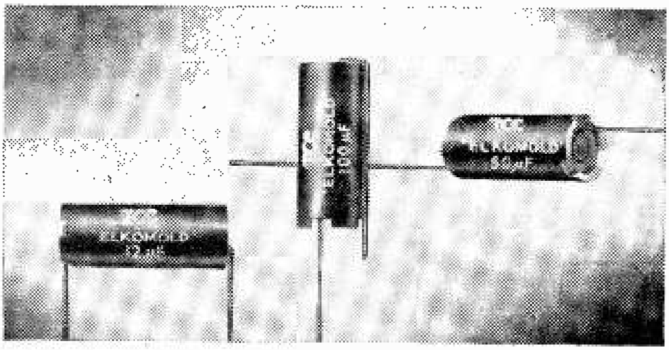
The new "Courier" Transistor portable by Pam Radio and Television Ltd.

TRANSISTOR RADIO FOR STANDBY NAVIGATION

A PORTABLE transistor receiver, called the "Navigator" is now being marketed in this country by the Zenith Radio Corporation. This set, as well as receiving normal broadcasting stations, is suitable for standby navigation purposes by private pilots and yachtsmen, as it covers weather stations and L.F. directional beacons.

The "Navigator", which covers the 550-1600kc/s and 150-400kc/s bands, is an 8 transistor set with 500mW output. It weighs only 5lb.

The "Navigator" is fitted with an accurate and easily read azimuth scale for taking cross-bearings and has precision vernier tuning on the main control. The price of this receiver in this country is £69 6s. 11d. The agents for the Zenith Radio Corporation in this country are *United Mercantile Company Ltd., Sovereign House, Queen Street, Mayfair, London, W.1.*



These TCC "Elkomold" electrolytic capacitors will be on show at the Radio Show.

CAPACITORS AT THE RADIO SHOW

AT this year's National Radio Show TCC will be exhibiting many ranges of capacitors.

Sub-miniature electrolytics for potted assemblies and transistor circuitry will be on show along with Tantalum electrolytics—entirely new ranges of wet and dry solid sintered capacitors for wide ranges of temperature.

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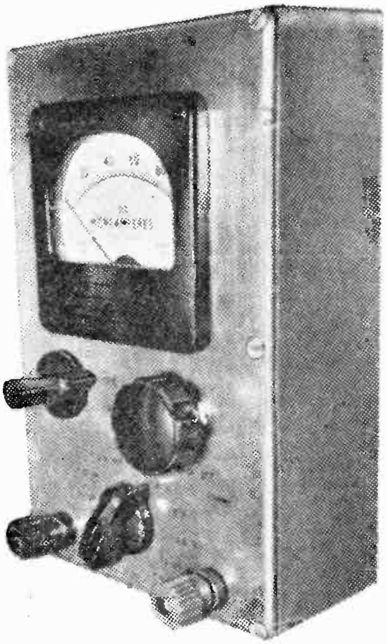
Printed circuits will also be featured on the TCC stand as will "Flexistrip", a new cable having hair-thin copper tape conductors embedded in transparent polyester. *The Telegraph Condenser Co. Ltd., North Acton, London, W.3.*



A Sensitive Multimeter

A 10,000Ω/V INSTRUMENT

(Continued from page 296 of the August issue)

By R. Murray-Shelley

THE figures, given in Table 1 (page 296 of the August issue) should only be used as a guide, the exact lengths being found by a process of trial and error, using another meter of known accuracy in the circuits of Fig. 2. The additional components required for the construction of the shunts are, a 3V dry battery, a 1k potentiometer (pre-set, linear), a 2·2k resistor and a 50Ω resistor. The principle of this method of construction is to vary the length of wire in the shunt until the readings of the two meters are the same for a given current (e.g. for the 10mA range, the multimeter reads full scale when the check meter reads 10mA).

Somewhat lower accuracy can be tolerated for the 1A range, and thus the shunt should be adjusted so that while the check meter reads 100mA, the reading of the multimeter is 10, assuming that the meter is calibrated from 0 to 100, i.e. 0·1 of the full scale deflection. The reason for this is that a normal dry cell battery cannot supply 1A for even a short period and thus calibration must be achieved using a lower current.

When the correct lengths of wire have been obtained, they should be wound either on a small choke former or a 2 or 3W resistor of at least 5,000Ω resistance. The purpose of this is merely to act as a carrier for the wire. Resistance wire is occasionally difficult to obtain, and in the prototype, wire removed from a 50Ω 5W resistor was used very satisfactorily. Insulated copper wire (40s.w.g.) was used for the 100mA shunt, and 28s.w.g. for the 1A shunt. The formula for calculating shunt values is:

$$R = \frac{Im \times Rm}{I - Im}$$

where I is the maximum current which the meter is to measure in amps, and Im and Rm are as in the August issue.

The shunt for the 1mA range has a value of over 100Ω. This is most easily made by using a 100Ω close tolerance high-stabilty resistor in series with a wire-wound resistor made as described above.

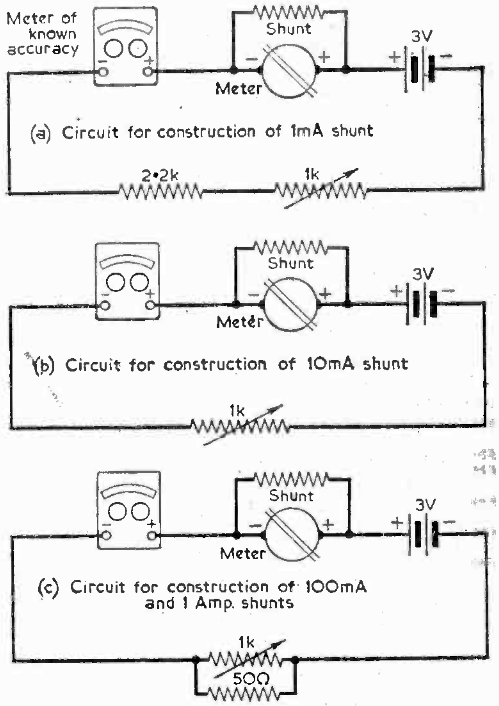


Fig. 2.—These circuits illustrate the use of a meter of known accuracy to calibrate the multimeter under construction.

Tolerance

The resistors used for the multipliers should be high-stability components of 1per cent or 2per cent tolerance. The exact calculated values are not always obtainable, since only preferred values are usually stocked. In the component list, therefore, when a resistor is not a preferred value, a pair of preferred resistances has been suggested, which when connected in series or parallel, depending on the resistance in question, will give the required value of the multiplier.

Resistance

This instrument has provision for measuring resistances to 1M in two ranges. The circuit used is quite conventional, and although it is by no means the most accurate method which may be employed, nevertheless, it is adequate for general purposes.

The principle of this method depends on measuring the current flowing in a circuit, the potential across which is known, and thus obtaining the resistance of the circuit from Ohm's Law. If the unknown resistance is a part of that circuit, then, assuming the resistance of the rest of the circuit is known, the unknown resistance may be found by subtraction. The basic circuit measuring to 1M is shown in Fig. 3.

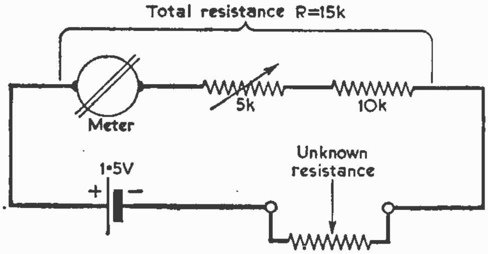


Fig. 3.—The basic ohms circuit, measuring up to 1M.

Calibration

In use the meter terminals are first shorted together, and the variable resistor is adjusted until the meter reads full scale. The unknown resistance is then connected across the meter terminals, when the reading of the meter will drop. The new reading is noted and the resistance is calculated using formula:

$$Rx = \frac{R(1 - D)}{D}$$

where D is the fraction of the full scale current, and R is the resistance of the rest of the circuit (in this case 15k). This method of calculating the resistance can be rather tedious, and the most accurate alternative method is to draw a graph between resistance and meter readings for various resistances. (Two graphs will be required, one for each range.) Another method of achieving the same result is to add a resistance scale to the meter itself, though this is not so accurate, since the current does not vary directly as the unknown resistance.

It is a good idea to wire the resistance ranges before wiring the voltage ranges, since, then, the precision resistors which are to be used for the multipliers can be used to calibrate these ranges.

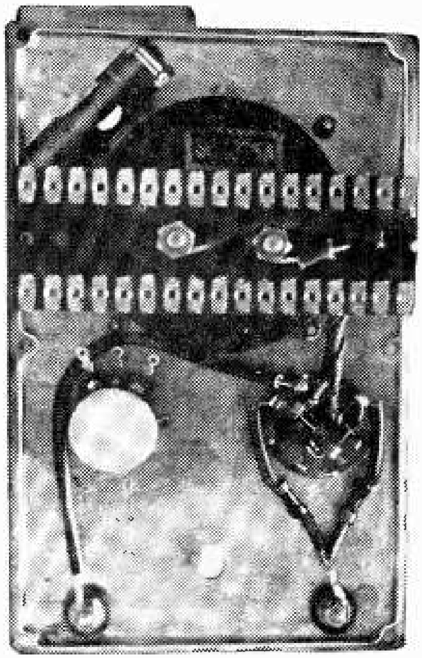
The resistance R14 is used as a range multiplier to achieve a resistance range of up to 10k. The value of this resistance is given by the formula:

$$R14 = \frac{R}{(N - 1)}$$

where R, as before, is the resistance of the meter circuit, and N is the ratio of the resistance ranges. In this case:

$$N = \frac{1M}{10k} = 100.$$

For meters not having the specified characteristics, the value of R is given by (battery E.M.F. ÷ Im) where the battery E.M.F. is the voltage of the cell used—in this case a 1·5V penlight cell, or a larger U10 cell is recommended. Im is the meter full-scale deflection as before (in amps).



A view of the meter components, before the wiring is completed.

The resistance ranges are also useful for testing continuity, at the same time giving some idea of the resistance of the circuit under test.

Construction

The prototype instrument was housed in a metal box, size 7½in. x 4½in. x 2in. deep. This box was of very stout construction, being diecast, and made of zinc alloy. Ranges of meter boxes are available, and the exact size used will depend entirely upon the size of the basic meter movement. There is no real objection to the use of a steel box since the meter used is of the moving coil type, and is not easily affected by external magnetic fields as a moving iron meter might be.

The layout is in no way critical. In the original instrument the multipliers and shunts were carried on a group board attached to the rear of the meter movement.

Connection should be made with stout (16 to 20s.w.g.) tinned copper wire, insulated where necessary with insulating sleeving. The rectifier elements can be wired directly to the range switch and to the A.C./D.C. switch. The range switch has three wafers, each being 1-pole, 12-way, giving a composite 3-pole, 12-way switch. If this is difficult to obtain, a 3-pole, 11-way switch could be used

(Continued on page 445)

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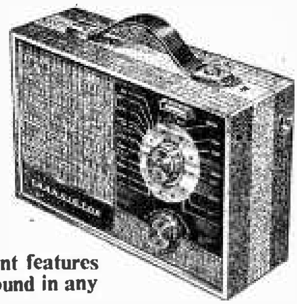

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(Continued from page 442)

in its place, though one, or possibly two ranges would now have to be omitted (e.g. 1,000 volts A.C. and D.C., or the 1A range of the 10k range). The purpose of the third wafer of the range switch, S2c, is to avoid any possibility of damaging the meter movement on the higher current ranges. This might well happen if the positive terminal of the instrument were to be connected directly to the pole of the wafer, S2b, and a faulty contact were to develop on S2b. The result would then be that the shunt would be removed from the circuit, and the full current in the circuit under test would be applied to the meter movement, in most cases causing it to burn out.

It is important when wiring the range switch to note carefully which position of the switch corresponds to which range.

All connections to the multimeter are made using only two terminals, and these terminals should be of the type which are totally insulated from the panel. The cell is conveniently held with a Terry clip. Connections to the cell may be soldered, since its life is many months.

Resistor Ratings

The resistors used for the multipliers need only be of ½W rating, since they will only be called upon to carry a very small current. In the case of an instrument using a 1mA meter, however, the resistors should be rated at 1W, at least for the 300V and 1,000V ranges.

The power dissipated by a resistor is given by the formula: Power (watts)$=(Ir)^2 \times R$,

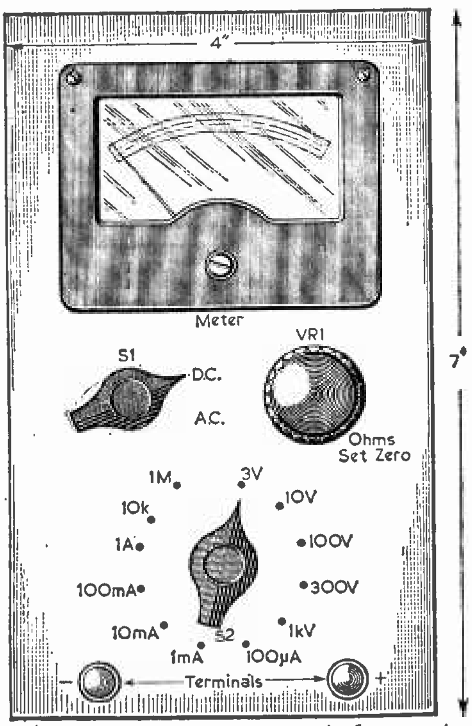
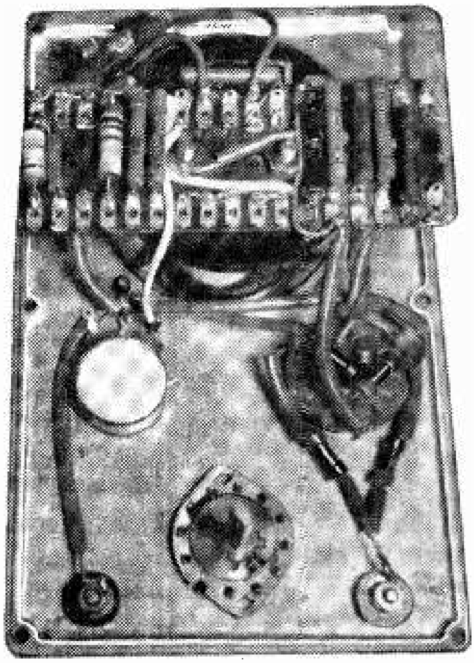


Fig. 4.—The layout of controls on the front panel.



The underchassis view with the wiring complete.

where Ir is the current in the resistor in amps, and R is its resistance.

The current in the resistor will be the same as that in the meter, and thus the maximum current which a multiplier will be called upon to carry is equal to the full scale deflection of the meter. Using this relationship the ratings of the resistors required for any meter movement can be calculated.

Soldering

It is particularly important when constructing equipment of this kind that all soldered joints should be of low resistance, and not of the "dry" type. Cored solder should always be used, and the iron should be clean, and sufficiently hot that the solder flows easily. The components to be soldered should be cleaned carefully, particularly the switches, if these are of the "surplus" type. In this case, the switch contacts themselves should be cleaned, first by scraping them, and then by using a proprietary switch cleaner, preferably one which contains switch lubricant.

Taking Readings

When using the completed instrument, always start with a high range, working down to the lower current and voltage ranges. This avoids any possibility of damaging the meter movement. The instrument should be disconnected from the apparatus when changing ranges. The test leads can be about 3ft long, and they should terminate in a pair of test prods, if possible of the retractable type.

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Postage and packing 1/-

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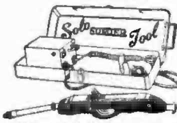

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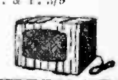

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The index letters which precede the Blueprint Number indicate the periodical in which the description appeared. Thus PW refers to PRACTICAL WIRELESS; AW to *Amateur Wireless* and WM to *Wireless Magazine*.

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

SPECIAL NOTE

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. *The majority of the components for these receivers are no longer stocked by retailers.*

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The PW Monophonic Electronic Organ	—	8/-
(No constructional details are available with this blueprint)		
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(No constructional details are available with this blueprint)		
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The PT band III converter ..	—	1/6

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PRACTICAL WIRELESS, SEPTEMBER, 1961

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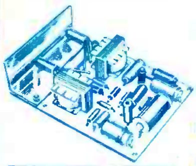

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- Output to 3 ohm speaker.
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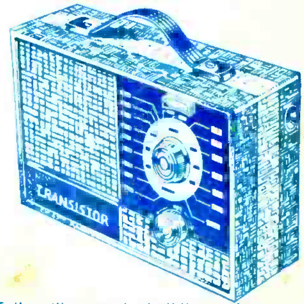

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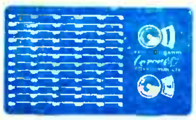

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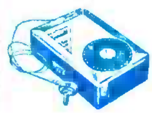

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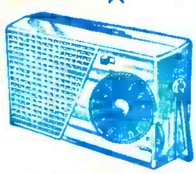

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